Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

Type of the Paper (Article, Review, Communication, etc.)

Analysing discussions around Rural Health on Twitter during the COVID-19 pandemic

Wasim Ahmed [1], Josep Vidal-Alaball [2,3,4] and Josep Maria Vilaseca [4,5]

[1] Stirling University Business School, University of Stirling, Stirling, FK9 4LA, Scotland, UK; wa10@stir.ac.uk
[2] Unitat de Suport a la Recerca de la Catalunya Central, Fundació Institut Universitari per a la Recerca a l'Atenció Primària de Salut Jordi Gol i Gurina, 08272 Sant Fruitós de Bages, Spain; jvidal.cc.ics@gencat.cat
[3] Health Promotion in Rural Areas Research Group, Gerència Territorial de la Catalunya Central, Institut Català de la Salut, 08272 Sant Fruitós de Bages, Spain
[4] Faculty of Medicine, University of Vic – Central University of Catalonia, Vic, ES. josepmaria.vilaseca@umedicina.cat
[5] Consorci d'Atenció Primària Barcelona Esquerra. Barcelona. ES
[6] Correspondence: jvidal.cc.ics@gencat.cat ; Tel.: 93 693 0040, 08272 Sant Fruitós de Bages

Abstract: Individuals from rural areas are increasingly using social media as a means of communication, receiving information, or actively complaining of inequalities and injustices. This study captured 57 days' worth of Twitter data from June to August 2021 related to rural health. The study utilised social network analysis and natural language processing to analyse the data. It was found that Twitter served as a fruitful platform to raise awareness of problems faced by those living in rural areas. Overall, Twitter was utilised in rural areas to express complaints, to debate, and share information. Twitter could be leveraged as a powerful social listening tool for individuals and organisations who want to gain insight into public views around rural health.

Keywords: Rural Health; Twitter Messaging; Social Media; Covid-19, SARS-CoV-2; coronavirus; social network analysis

1. Introduction

Globalisation and the proliferation of the World Wide Web and social media has led to an increase in the amount of information available at any time and all over the world. One of the places where getting access to information is crucial is in rural areas. This is because it can help to break traditional isolation to which those living in rural areas may be subjected. In the past, it was believed that rural communities were isolated, with poor access to online information and excluded from social media. This is partially true [1], however in recent times, in both developed and developing countries, a significant number of individuals from rural areas are using social media as a means of communication, receiving updated information, or actively complaining of inequalities and injustices [2].

The use of Twitter as a popular form of social media used for healthcare communication has been studied for several years [3]. Twitter has been used as a means of health promo-

© 2021 by the author(s). Distributed under a Creative Commons CC BY license.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

tion by large urban hospitals and clinics in the United States of America [4]. Twitter has also been used as a new source of data to study depression and its wider determinants in the slum populations in India and Brazil and for predictive analytics and sentiment analysis [5].

A recent study of scientific literature analysing the implications of Twitter in health-related research identified a high diversity of themes ranging from professional education in healthcare, to big data, social marketing and substance use, physical and emotional well-being of young adults, and public health and health communication [6]. The analysis of social media provides a useful tool for public health specialists and government decision makers to gain insight into population reactions and feelings [7], especially in times of uncertainty like the one we are facing with the present pandemic [8].

A study by Cuomo *et al.* analysed the geospatial distribution of Tweets related to COVID-19 to try to illustrate the full scope of the pandemic. The authors found that rural areas in the United States of America engaged in COVID-19 social media conversations at later stages compared with urban areas [9].

The place of birth has been regarded as an important determinant of health [10]. The availability of resources in rural areas differs from urban areas and this has an impact on population health [11,12]. Another problem of rural areas is the shortage of health professionals willing to work in these areas [13]. Some initiatives are being developed to promote interest in rural health in this context. One of such initiatives uses social media for this objective. This is the case of the Rural Family Medicine Cafés, which since 2015 has been organising regular meetings using social networks to put in contact health professionals who work or have an interest in rural health [14,15].

There are few studies investigating the use of Twitter in relation to rural health issues and trying to analyse the more common topics covered in these areas. This is particularly interesting at the time of the COVID-19 pandemic. The main overall research aim of our study is to analyse the conversations about rural health taking place on Twitter during the COVID-19 pandemic to better understand the use of this social media tool in rural settings. More specifically, the objectives of this study are to:

- Develop an understanding of the content and debates being shared on Twitter.
- To identity influential users around rural health on Twitter.
- To uncover the key hashtags and websites being shared.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

2. Materials and Methods

2.1 Sampling Tweets and Ethical Approval

This study made use of the Twitter Archiving Google Sheets (TAGS) tool to retrieve 15,586 tweets matching the "rural health" keyword. Tweets were retrieved from 10/06/2021 to 06/08/2021 covering 57 days. TAGS draws upon the Twitter Search Application Programming Interface (API) to retrieve tweets. The project received ethical approval from Newcastle University (Approval number: 2036/2020). Although it can be argued that tweets are in the public domain, the project was careful not to draw attention to individual users acting in a personal capacity. However, the users and key tweets reproduced in this study derive either from accounts and users in the public domain, social media influencers, health organisations, politicians, and academic journals.

2.2 Data Analysis

The software NodeXL (Social Media Research Foundation, California, CA, USA) was used to conduct a social network analysis of the data [16]. The network graph was laid out using the Harel–Koren Fast Multiscale layout algorithm that is integrated into NodeXL. Natural language processing was applied to the tweets in order to identify word-pair correlations on the clusters identified from the social network analysis. In order to identify influential users the metric of betweenness centrality was applied which is derived from network theory and is used in this paper as a way of finding Twitter users that have influence in our dataset. This methodology has been used by the authors in previous research [17-19].

Patient consent was waived because our study involved the analysis of publically available Twitter data and our study only highlighted influential users that are in the public domain, and no patients were included in the study. No private and/or personal non-public information was utilised. Ethical approval was gained from Newcastle University (reference 2036/2020).

3. Results

3.1. Results of Social Network Analysis

Figure 1 provides a visual representation of the Twitter activity based on the data that was captured. Circles represent individual Twitter users and the lines between them represent connections such as mentions and replies. The figure highlights how there were a number of different groups of users that were conversing about different topics related to rural health. The largest group in the network (group 1) is that of a broadcast network where a small number of users are retweeted with high frequency.

There are also a number of other smaller groups and broadcast networks giving the overall network a community shape. Appendix 1 contains a full list of keywords associ-

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

ated with each of the clusters, which provide insight into the types of topics that were being discussed.

Aside from 'rural, health' itself, the most popular co-word combination in group 1 was that of 'fighting, covid' (n=873). Other interesting keywords identified within this group included, 'busting, myths' (n=873) indicating the combatting of misinformation. The tweet ranked number 3 in regard to attracting the most retweets (in Table 4) may account for some of these keywords. In group 2, interesting word-combinations included 'health, systems' (n=373), 'expanding, medicaid' (n=256), 'taxpayers, money' (n=254), and 'affordable, health' (n=212).

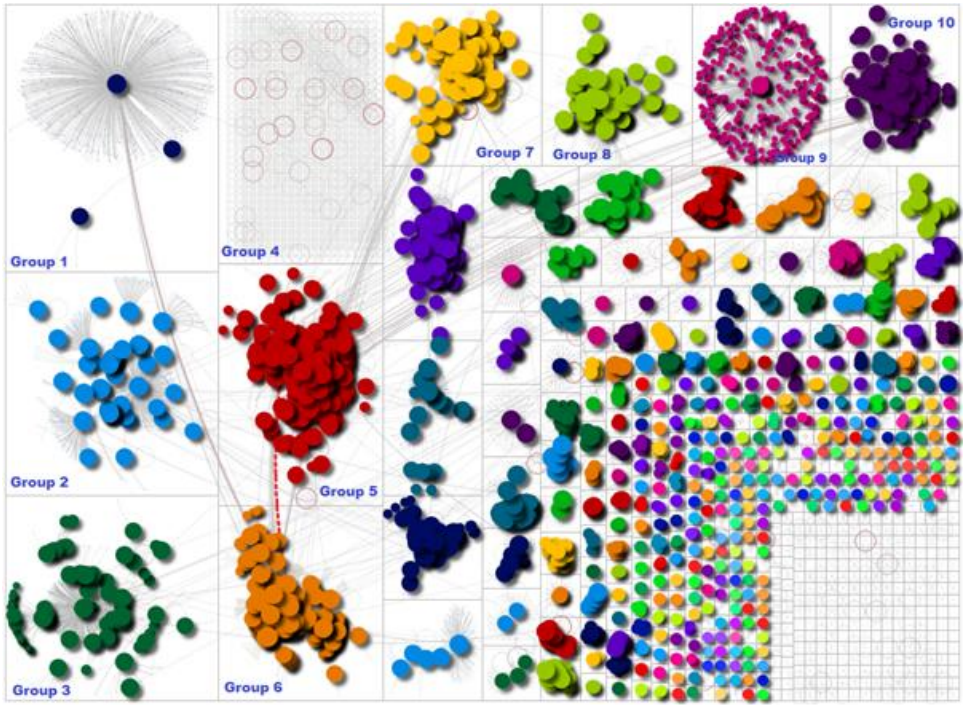

Figure 1. Social network visualization and discussions across groups

3.2 Results of Time Series Analysis

Figure 2 provides an overview of the unique edges (i.e., tweets, retweets, mentions etc.) within the dataset. There appears to be a constant stream of Twitter activity with two large peaks taking place on the 18th of June and the 16 of July, respectively. Overall, there appears to be much more activity taking place during June 2021. These peaks relate to spikes in retweets due to the tweets contained in Table 4.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

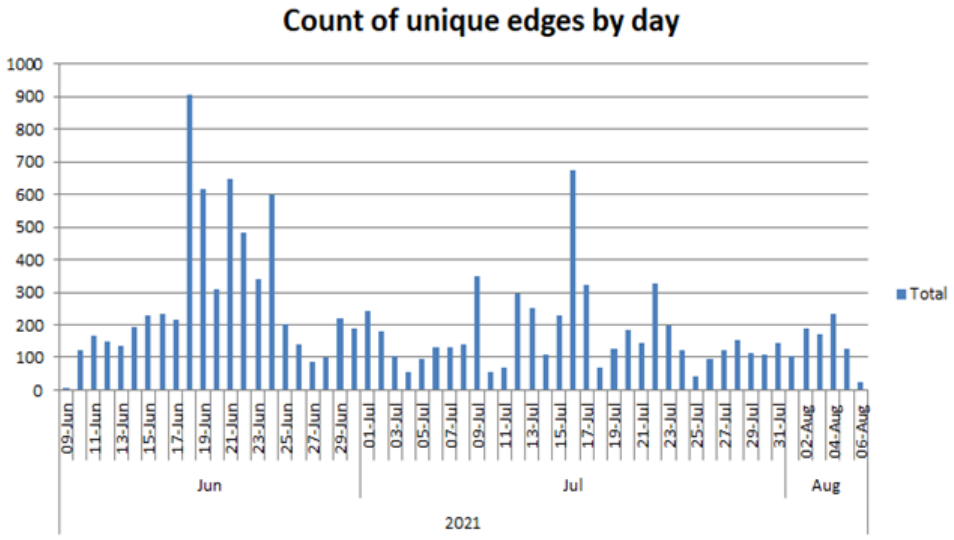

Figure 2. Time series chart of Twitter activity

3.3 Results Related to key users, websites, hashtags, and retweets

Table 1 provides insight into the key users. The first key user is the account of Akhilesh Yadav, Socialist Leader of India. This is followed by the Twitter account of the World Health Organization (WHO) and the Rural and Remote Health Journal Twitter, an open-access academic international journal. In fourth place we found the account of Senator Reverend Raphael Warnock, United States Senator from Georgia and in fifth the account of the National Rural Health Association, a US non-profit organization with the mission to provide leadership on rural health issues through advocacy, communications, education, and research.

Table 1. Key Users by Betweenness Centrality

User handle	Bio	Betweenness Centrality
yadavakhilesh	Socialist Leader of India. Chief Minister of UP (2012 - 2017)	5185471
who	We are the #UnitedNations' health agency - #HealthForAll. Always check our latest tweets on #COVID19 for updated advice/information.	5150502
rrh_journal	Open-access, peer-reviewed journal providing an international evidence base	4270264

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

	to inform improvement in rural and remote health (free-to-read, no page charges)	
senatorwarnock	United States Senator from Georgia. Pastor of Ebenezer Baptist Church.	3855435
ruralhealth	National Rural Health Association, 21k+ members nationwide, providing leadership and support at NRHA.	3000683
bprophetable	Only way to get good politicians is get rid of bad ones. I try to retweet facts and everyone's opinions including those I disagree with #FactsMatter	2476886
dainikbhaskar	India's Biggest Hindi Newspaper & News App. For Realtime News Updates, Local News for 2000 cities, Short Video News, Download our App: http://dainik-b.in/riOAhsOKg6	2403907
nytopinion	We amplify voices on the issues that matter to you. | Tell us what you think: letters@nytimes.com	2372269
timryan	Proud dad and husband, Ohio native, die-hard Browns fan. Running for U.S. Senate to fight like hell to cut workers in on the deal.	2349314
ruraldoctorsaus	Rural Doctors Association of Australia - promoting excellent medical care for rural and remote Australians.	2209906

Table 2 provides information about the top websites used in tweets. The top website used in tweets and by far (877 occurrence) is one from The Verge, an American technology news website. It features an article on how health care workers are

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

fighting misinformation about COVID-19 in rural India. The second most used website in tweets, but with significantly less graph count is one related to India as well. It is an article from The New York Times talking about how the bodies floating at the river Ganges and buried at their shores showed that the authorities were not telling the truth about the full extent of the death toll caused by COVID-19. The third most used website was from a suspended account. Finally, the fourth most used website was from Gary Votour, running for Governor of South Carolina (US) and the fifth was an article from IndiaSpend, an Indian on-line journal, talking about how Indian rural health centres were struggling with staff shortages, especially pharmacists and doctors.

Table 2. Top websites used in tweets

Rank	Title	Count
1	India's Healthcare Workers Are Busting Misinformation On WhatsApp	877
2	The Ganges Is Returning the Dead. It Does Not Lie.	164
3	This tweet is from a suspended account	115
4	Official campaign website for Gary Votour for Governor of South Carolina	89
5	As Third Wave Looms, Rural Health Centres Struggle With Expired Drugs, Missing Doctors	69
6	Myth Vs Facts Government of India has been working towards effective COVID-19 management in rural India by sustained strengthening of the Rural health Infrastructure, and through focussed Public Health Measures in active collaboration with the States	61
7	Gary Votour for South Carolina Governor campaign	60
8	Chhattisgarh to privatise rural health infra; public health experts and activists demand roll back	55
9	Official Account Of Chhattisgarh Pradesh Congress	47

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

	Committee.	
10	Barak Obama's twitter account, it reads: Today, the Supreme Court upheld the Affordable Care Act. Again. This ruling reaffirms what we have long known to be true: the Affordable Care Act is here to stay.	47

Table 3 provides insight into the top hashtags used in tweets. The most used hashtag is #appoint_pharmacist_for_rural_health a hashtag used in a campaign to advocate for the appointment of pharmacists in rural India. The second most used hashtag was #33yearsofpmk a hashtag commemorating 33 years of the Paattali Makkal Katchi (Working people's party) abbreviated as PMK, a political party in Tamil Nadu, India. The third hashtag is directly related to rural health: #ruralhealth and the fourth and fifth are to hashtags, one in English and the other in Korean to celebrate the birthday of Sunoo (Birth Name: Kim Sun-oo), member of the Korean band ENHYPEN. The hashtags related to COVID-19 come in 6th and 10th position.

Table 3. Top hashtags used in tweets

Top Hashtags	**Occurrence**
appoint_pharmacist_for_rural_health	1498
33yearsofpmk	573
ruralhealth	353
sunooourmiracleofjune	341
눈부신_선우의_열아홉번째_생일	339
covid19	302
pharmacistfederation	287
rural	198
medicaidsaveslivesact	157

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

Table 4 provides information about the top ten retweets identified in the dataset. The first, second and fourth retweets are addressed to specific individuals. The first one is an appeal to the Prime Minister of India to appoint more rural doctors and the second and fourth ones are in relation to a campaign to uncover water corruption in rural areas. The third is a recognition of rural health activists and they work fighting misinformation about COVID-19 in rural India. The others have several purposes related to rural and public health: to report corruption related to rural health problems and the deplorable conditions of rural health care facilities, to congratulate a doctor by giving some key indicators of a Rural Health program milestone, to announce the building of healthcare facilities and to report the shortage of health workforce and encourage professionals to work in rural areas.

Table 4. Top Ten Retweets

Rank	Tweet Content	Occurrence
1	🙏🙏 Respected PM @narendramodi and #maankibaat🚨 On this pathetic conditions of our Rural health ,🆘50K FMG doctors are ready to Serve Nation,. We request @PMOIndia to immediately appoint them as front line warrior, as Nation need them at this Moment. #PMModi50000FMGdoctors	1079
2	I've been criticised for talking to "crude comedian" @friendlyjordies But in my 18mths as Member for Murray, not one Sydney journo has come here. FJ spent two days here uncovering water corruption & rural health crisis, do I ignore him b/c he uses cuss words? #nswpol #auspol	1025
3	Fighting Covid isn't just a question about health, it's also about busting myths in our social media world. I want to thank all our front line rural health activists who are combatting COVID with facts and science!	899

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

https://t.co/s7rlY2FNal

4	Both @friendlyjordies and Alan Jones have interviewed me several times: on water corruption and the rural health crisis. I'm constantly asked to justify/defend unrelated things FJ have said/done in the past. But I never get the same questions about Alan Jones. Why is that?	558
5	Rural health care facilities in shambles in #UttarPradesh! Here's a detailed report. #ITVideo #CoronavirusCrisis https://t.co/RZRvoPjaeT	414
6	"What's your degree? "Public Health" "Ay ang sad, you work in communities? Mas maganda sa hospital" SO WHAT'S WRONG WITH WORKING IN COMMUNITIES? IN RURAL HEALTH UNITS? IN GIDA? WE NEED MORE HEALTH WORKERS THAT WILL SERVE IN RURAL AREAS https://t.co/wtzbjbIJap	407
7	In celebration of Sunoo's birthday, we gave packed lunchboxes to the frontliners of Los Banos, Laguna Rural Health Unit 💙. Happy birthday Sunoo and thank you to our frontliners! 💙 #SunooOurMiracleOfJune #눈부신_선우의_열아홉번째_생일 @ENHYPEN_members 💙 @cessism @PeytedDi https://t.co/vgN5Fw9XpX	390
8	15/25 Construction of 14 bed RHCs(rural health centres) in Swabi, Shangla, Nowshera, Mardan. (Pic for Shewa Swabi) https://t.co/pABGiYqBNv	349

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

9	राज्य के 1000 से अधिक स्वास्थ्य केंद्र बंद पड़े है। इनके भवन निर्माण खर्च व उक्त केंद्रों में तैनात कर्मियों को दिया जाने वाला हज़ारों करोड़ कहां जा रहा है? नीतीश सरकार इन जर्जर केंद्रों को कागजी तौर पर चलाकर सुनियोजित तरीके से संगठित भ्रष्टाचार कर रही है https://t.co/d0tEdiUEp4 **Google translate:** More than 1000 health centers in the state are closed. Where are the thousands of crores given to their building construction expenses and the personnel posted in the said centers going? Nitish government is doing organized corruption in a systematic manner by running these dilapidated centers on paper.	311
10	Dr. Anbumani has established the National Rural Health Mission (NRHM) in 2005, 10 years post implementation of the NRHM India's MMR today 166/1L deliveries IMR is reduced to 41/1K live births. An evergreen milestone of Indian health ministry #PMKinIndianGovernance	229

If we consider the retweet count shown in table 4, it is clear the most widely used language is English, either in non-English native speaking areas or in countries where other local languages are spoken. In total, 4,553 retweets (80%) are written only in English. If we include tweets that are mixing English and other languages, it accounts for 94.5 % (5,350 retweets). It seems that English is used as a lingua franca to reach a wider audience on Twitter. The second most used language is Tagalog, mixed with English in the main body of the Tweet (407 retweets, 7 %). The third most used language is Korean, but in this case used only as a hashtag, being the main text of the tweet in English (390 retweets, 6.9%). The fourth one is Hindi, being only used in one out of the top ten retweets in our dataset (311 retweets, 5.5%).

3.4 Results Related to Geographical Locations

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

The geographical location of the debates is mainly in India, Pakistan, Australia, Philippines, and the United States of America. The most widely used language is English. Other languages used are Hindi, Korean and Tagalog.

4. Discussion

Regarding language, our study identified that the Latin alphabet was the most widely used. The study also found that Devanagari was also used for the text body of the tweet, and the Korean alphabet is was used on occasion only for the hashtag part oof tweets (the main body of the tweet is written in English). The Tagalog language was written in the Latin alphabet. Although Chinese is one of the largest populations in the world our study didn't observe use of the Chinese language on this topic. This can be explained by the restrictions placed on accessing Twitter in China. Although a longer follow-up may change the distribution of most widely used languages and alphabets, it seems that the English and Latin alphabets are overwhelmingly used on Twitter related to this topic.

Our study found that the key users related to this topic are not only individuals (mainly politicians), but also organisations dealing with aspects related to rural health. The top websites used in the tweets are neither specialised in healthcare nor in public health. The tweets sometimes use wide audience sources, like international newspapers (The New York Times) or local press.

It was found that some of the top hashtags were not strictly related to rural health. They included a celebration of the anniversary of a member of a top Korean boy band and the anniversary of the foundation of an Indian political party, although this political party has strong relations with rural areas. The most used hashtag relates to a campaign claiming for the appointment of a pharmacist in rural areas, indicating the shortage of pharmacists in these settings. The COVID-19 hashtag is also popular, being used in two different forms (covid19 and covid). However, during the time-period examined, this is not the top hashtag, probably due to a shift to other health concerns and the decrease in the number of cases worldwide during the period monitored.

The top ten retweets explicitly mention rural health, healthcare, or public health problems. The topics are in general of local interest, pointing at very

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

specific issues. Even when rural health is part of a politician campaign or a politician's comment, its interest is local or national. The main uses of Twitter identified in our study are complaints, debates, information sharing, acknowledgements, advertisements, and politician's campaigns.

Regarding the geographical location of the top tweets, the location with the most influential tweets derived from India. This is not surprising given the size of India and the number of rural areas. The United States, the Philippines, and South Korea are also amongst the most frequent locations where influential tweets were being sent from.

The study has several limitations. A circumscribed 57-day time period was examined which may have excluded certain tweets falling outside this period. Another limitation is that the Search API used can only retrieve data from public facing Twitter accounts and not from private accounts, however, the majority of accounts are set as public. Another limitation is that as our studied retrieved data using a very specific keyword (rural health), our data may have excluded tweets from users who tweeted without using our target keyword.

Assessing needs for those living in rural communities has traditionally been challenging. Several circumstances have been a constraint: language as a barrier, isolation, lack of registries, difficulties to carry out interviews, location of the households, and expenditure to perform studies. Twitter could prove to be a solution for these problems and could be used as a social listening tool to identify the concerns and needs of rural communities. Our study shows that Twitter can be effectively used at least in a couple of ways: as a means of communication in rural areas and as a source of information on rural health. Moreover, the information existing on Twitter, when filtered by geographical locations, may be of interest for stakeholders, healthcare workers, politicians, patients, and communities in general.

Twitter could also be used strategically for those living in rural areas to communicate with one-another, for sharing local updates and warning of disasters such as areas to avoid. It could also be used as a way of connecting for sharing resources and supplies. This could be facilitated through the use of domain-specific hashtags related to each area and widely advertised and popularized locally.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

5. Conclusions

Twitter has been shown to be a powerful means of communication which is used in rural areas. Twitter is a capable tool to raise awareness of the problems existing in rural health. India is the country with the most Twitter related conversations on rural health. Twitter is used in rural areas to express complaints, to debate, to share information, to acknowledge somebody or something, and to create advertisements or politician's campaigns. Twitter could be leveraged as a powerful source of information for individuals and organisations working on rural health.

Appendix A-

Table 5. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G1	G1 Count
rural,health	874
fighting,covid	873
covid,question	873
question,health	873
health,busting	873
busting,myths	873
myths,social	873
social,media	873
media,world	873
world,line	873

Table 6. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G2	G2 Count
rural,health	834
health,care	732
health,systems	373

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

expanding,medicaid	256
taxpayers,money	254
care,georgia	216
improve,health	216
health,outcomes	216
access,affordable	212
affordable,health	212

Table 7. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G3	**G3 Count**
alan,jones	1058
rural,health	684
health,crisis	618
water,corruption	560
corruption,rural	560
friendlyjordies,alan	529
jones,interviewed	529
interviewed,times	529
times,water	529
crisis,constantly	529

Table 8. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G4	**G4 Count**
rural,health	748
health,care	131
health,clinics	89
covid,19	80

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

health,unit	67
health,clinic	29
role,rural	27
increasing,advanced	25
advanced,practice	25
practice,providers	25

Table 9. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G5	**G5 Count**
rural,health	871
health,care	117
sam,rural	101
health,advocate	100
health,clinics	97
health,conference	72
rural,communities	53
national,rural	52
rural,america	51
covid,19	46

Table 10. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G6	**G6 Count**
य,क	4176
र,म	3793
क,न	2784
न,य	2784

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

क,त	2784
फ,र	2401
म,स	2401
स,स	2401
स,ट	2401
ट,क	2401

Table 11. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G7	G7 Count
rural,health	226
health,centres	110
primary,health	69
health,infrastructure	68
healthcare,system	58
private,hospitals	52
state,level	52
level,organisations	52
organisations,protest	52
infrastructure,rural	52

Table 12. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G8	G8 Count
rural,health	431
health,care	425
destroying,rural	243
attacking,family	214
family,physicians	214
physicians,destroying	214

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

health,networks	214
networks,alienating	214
alienating,nurses	214
nurses,dismantling	214

Table 13. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G9	**G9 Count**
rural,health	341
happy,birthday	341
birthday,sunoo	341
celebration,sunoo's	339
sunoo's,birthday	339
birthday,packed	339
packed,lunchboxes	339
lunchboxes,frontliners	339
frontliners,los	339
los,banos	339

Table 14. Word-Pairs Associated with Groups

Top Word Pairs in Tweet in G10	**G10 Count**
rural,health	413
health,care	65
health,commissioner	61
health,workforce	32
national,rural	32
ruth,stewart	30
rural,remote	29

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

health,brink	26
brink,workforce	26
workforce,cliff	26

References

1. Greenberg AJ, Haney D, Blake KD, Moser RP, Hesse BW. Differences in Access to and Use of Electronic Personal Health Information Between Rural and Urban Residents in the United States. J Rural Heal. 2018;34:s30–8.

2. Mehmet M, Roberts R, Nayeem T. Using digital and social media for health promotion: A social marketing approach for addressing co-morbid physical and mental health. Aust J Rural Health. 2020;28(2):149–58.

3. Pershad Y, Hangge PT, Albadawi H, Oklu R. Social Medicine: Twitter in Healthcare. J Clin Med. 2018 May 28;7(6):121. doi: 10.3390/jcm7060121. PMID: 29843360; PMCID: PMC6025547.

4. Kordzadeh N. Health promotion via Twitter: a case study of three medical centers in the USA. Health Promot Int. 2021 Aug 11:daab126. doi: 10.1093/heapro/daab126. Epub ahead of print. PMID: 34379755.

5. Thapa B, Torres I, Koya SF, Robbins G, Abdalla SM, Arah OA, Weeks WB, Zhang L, Asma S, Morales JV, Galea S, Rhee K, Larson HJ. Use of Data to Understand the Social Determinants of Depression in Two Middle-Income Countries: the 3-D Commission. J Urban Health. 2021 Aug 18:1–10. doi: 10.1007/s11524-021-00559-6. Epub ahead of print. PMID: 34409557; PMCID: PMC8373292.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

6. Yeung AWK, Kletecka-Pulker M, Eibensteiner F, Plunger P, Völkl-Kernstock S, Willschke H, Atanasov AG. Implications of Twitter in Health-Related Research: A Landscape Analysis of the Scientific Literature. Front Public Health. 2021 Jul 9;9:654481. doi: 10.3389/fpubh.2021.654481. PMID: 34307273; PMCID: PMC8299201.

7. Vidal-Alaball J, Fernandez-Luque L, Marin-Gomez F, Ahmed W. A New Tool for Public Health Opinion to Give Insight Into Telemedicine: Twitter Poll Analysis. JMIR Form Res 2019;3(2):e13870. URL: https://formative.jmir.org/2019/2/e13870 DOI: 10.2196/13870

8. De Rosis S, Lopreite M, Puliga M, Vainieri M. The early weeks of the Italian Covid-19 outbreak: sentiment insights from a Twitter analysis. Health Policy. 2021 Aug;125(8):987-994. doi: 10.1016/j.healthpol.2021.06.006. Epub 2021 Jun 18. PMID: 34176671; PMCID: PMC8226063.

9. Cuomo RE, Purushothaman V, Li J, Cai M, Mackey TK. Sub-national longitudinal and geospatial analysis of COVID-19 tweets. PLoS One. 2020;15(10 October):1-11. doi:10.1371/journal.pone.0241330

10. Cofiño Fernández R. Tú código postal es más importante para tu salud que tu código genético (1) [Your post code is more important for your health than your genetic code (1)]. Aten Primaria. 2013 Mar;45(3):127-8. Spanish. doi: 10.1016/j.aprim.2013.02.001. PMID: 23499154; PMCID: PMC6985478.

11. Lee H, Lin CC, Snyder JE. Rural-Urban Differences in Health Care Access Among Women of Reproductive Age: A 10-Year Pooled Analysis. Ann Intern Med. 2020 Dec 1;173(11 Suppl):S55-S58. doi: 10.7326/M19-3250. PMID: 33253026.

12. Rahman M, White EM, Thomas KS, Jutkowitz E. Assessment of Rural-Urban Differences in Health Care Use and Survival Among Medicare Beneficiaries With Alzheimer Disease and Related Dementia. JAMA Netw Open.2020;3(10):e2022111. doi:10.1001/jamanetworkopen.2020.22111

13. Lehmann, U., Dieleman, M. & Martineau, T. Staffing remote rural areas in middle- and low-income countries: A literature review of attraction and retention. BMC Health Serv Res 8, 19 (2008). https://doi.org/10.1186/1472-6963-8-19

14. Floss M. How to Do a Rural Cafe: A Short Manual. 1st ed. (2018). [E-book]. Available online at: https://wonca.net/site/DefaultSite/filesystem/documents/Groups/Rural%20Practice/Manual%20Rural%20Cafe.pdf (accessed August 14, 2021).

15. Wheatley A, Floss M, Bakola M, Kampouraki M, Silveira B, Scott-Jones J. The Rural Family Medicine Café Project: A Social Media Strategy to Reduce Occupational Isolation and Improve Support for Rural Healthcare Professionals. Front Public Health. 2020 Nov 19;8:595255. doi: 10.3389/fpubh.2020.595255. PMID: 33330339; PMCID: PMC7710660.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 13 September 2021 doi:10.20944/preprints202109.0216.v1

16. Ahmed, W.; Lugovic, S. Social media analytics: Analysis and visualisation of news diffusion using NodeXL. Online Inf. Rev. 2019, 43, 149–160.

17. Ahmed, W.; Marin-Gomez, X.; Vidal-Alaball, J. Contextualising the 2019 E-Cigarette Health Scare: Insights from Twitter. Int. J. Environ. Res. Public Health 2020, 17, 2236.

18. Ahmed, W.; Vidal-Alaball, J.; Downing, J.; Seguí, F.L. COVID-19 and the 5G Conspiracy Theory: Social Network Analysis of Twitter Data. J. Med. Internet Res. 2020, 22, e19458.

19. Ahmed, W.; Vidal-Alaball, J.; Lopez Segui, F.; Moreno-Sánchez, P.A. A Social Network Analysis of Tweets Related to Masks during the COVID-19 Pandemic. Int. J. Environ. Res. Public Health 2020, 17, 8235. https://doi.org/10.3390/ijerph17218235