Research Article

Profile of Popular Tweets During the 2019 Philippine Poliomyelitis Outbreak
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ABSTRACT

Background: Exploring the characteristics of the most popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 can guide health professionals in the competent use of social media for health education.

Objective: To determine the characteristics of popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 according to source, content type, tone, sentiment, and topic.

Study Design: Cross-sectional.

Study Setting: Twitter.

Methods: To recover the tweets with keywords of the outbreak of poliomyelitis in the Philippines in 2019 from publicly available content, Tweet Binder was used to stream for tweets in English between September 14, 2019, to March 14, 2020. These were checked for redundancy and relevance. The tweets were classified according to source, content type, tone, sentiment, and topic. Descriptive statistics was used to analyze the data. The data was presented in tables and graphs.

Results: The top five most popular tweets during the outbreak were from news outlets and personal accounts. These were mostly news articles and blog posts. The popular tweets of the outbreak were from personal accounts followed by news outlets. A few health professionals were active on Twitter. News articles were the most commonly shared type of content. Most of the tweets had an unclear or neutral stand on vaccination. A few opinions against vaccination were noted. Majority of the tweets contained information rather than sentiments. The resurgence of poliomyelitis in the Philippines was the most discussed topic.

Conclusion: Popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 had the following characteristics: (1) source–personal accounts, (2) content type–news articles, (3) tone–neutral or unclear towards vaccination, (4) sentiment–information, (5) topic–resurgence of poliomyelitis in the Philippines.

Keywords: Poliomyelitis, Outbreak, Vaccine, Social Media, Twitter

INTRODUCTION

The reluctance or refusal to vaccinate has been threatening to undo the advancement made in the battle against vaccine-preventable diseases.[1-3] In 2019, the World Health Organization listed vaccine hesitancy as the number seven threat to global health.[4] In the Philippines, this threat was made evident when the Department of Health declared last September 19, 2019 an outbreak of poliomyelitis–a debilitating and crippling viral illness which has long been controlled in the country by vaccination since 2000–putting numerous children at risk of lifelong paralysis. This declaration was triggered by a confirmed case of polio in a three-year-old girl from Mindanao last September 14, 2019.[5-7] News of this outbreak resulted to an explosion of online content in social media platforms such as Twitter.

The impact of social media on vaccination should not be underestimated. *Digital 2019* reported that 45% of the global population were active social media users.[8] Young adults aged between 25 to 34 years were the most populous among active social media users. Among adolescents aged 13 to 17 years, 3% of males and 4% of females were frequent users. The same report said that 76 million Filipinos aged at least 13 years old were in social media. This comprised 71% of the national population. Filipinos engaging in social media grew by 13%

between 2018 to 2019. *Twitter,* the fifth most active social media platform in the country after Facebook, YouTube, Facebook Messenger, and Instagram, was reported to have 5.08 million monthly active users. It has been a popular online social networking service for collaborative journalism through the broadcast of *tweets*.[9, 10] Twitter users were more likely to follow breaking news and viewed a greater mix of news topics than Facebook users.[11] It has been shown to quickly disseminate news through the population, provide timely information to witnesses and casualties of disasters, and aid the development of consensus among its users.[12, 13] Its concise lay-out has greatly simplified the recovery of data for research: *hashtag*s to index content*, likes* to express agreement, and *retweets* to share content.[14-17]

While health care providers remain an important source of accurate information, ostensible consensus in social media affects the decision-making, the perception of harm, and the risk-management behaviors of its users.[18,19] The sharing of potentially harmful information in social media continues to threaten the success of national vaccination programs. This leaves children at even greater risk of developing vaccine-preventable diseases. Exploring the characteristics of popular online content on vaccination in social media is one approach in the study of public opinion on immunization.[20-22] An effective communication program that champions for vaccination also requires the creation of educational materials that take into account the communication patterns of users of social media.[23, 24] Health educators are more likely to enjoy the patronage of a community when they utilize sources of information that cater to their preferred sentiment and tone of speech. Eventually, with their acceptance comes a higher degree of compliance.[25]

It is anticipated that this study will help transform social media from a predominantly amateur forum of discussion to an effective conduit for health education.[26] When health care providers partake in discussions on social media, their input accretes with the opinion of laypeople towards a consensus, and their specialized contribution can mitigate the effects of misleading information.[19]

Research Objectives

General Objectives
To determine the characteristics of popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 according to source, content type, tone, sentiment and topic.

Specific Objectives
1. To determine the top five most popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 according to the number of likes and retweets.
2. To determine the frequency of the following attributes of popular tweets during the outbreak of poliomyelitis in the Philippines in 2019:
    A. Source
        A.1. Government agency
        A.2. Health professional
        A.3. International organization
        A.4. Journalist
        A.5. News outlet
        A.6. Non-governmental organization
        A.7. Personal account
    B. Content type
        B.1. News article
        B.2. Blog post
        B.3. Image
        B.4. Other
        B.5. No attached link
        B.6. No access to attached link
    C. Tone
        C.1. Pro-vaccination

C.2. Anti-vaccination

C.3. Neutral/unclear

D. Sentiment

D.1. Information

D.2. Frustration

D.3. Humor/sarcasm

D.4. Concern

D.5. Others

E. Topic

Definition of Terms

1. **Attributes**–referred to the different characteristics of tweets (e.g., *content type*, *number of retweets*, *number of likes*, *relevanc*e, *sentiment*, *source*, *tone*, and *topic*).[27]

2. **Content type**–referred to media used to convey information, such as: *blog posts*–items of content written in an informal manner on a regularly updated web or social media page run by any individual or group, *images*–items that predominantly convey information through the sense of sight such as drawings, photographs and videos, *news*–formal written works of recent information by a journalist or news outlet intended for immediate and mass consumption, *no attached link*–items that do not connect to an external source of content, *no access to attached links*–items that connect to an external source of content but were inaccessible, and *others*–any item that did not belong to the previously mentioned content types such as headline banners and sound clips.

3. **Popular tweet**–any tweet with a *native retweet* of at least 10 times.

4. **Relevance**–a traceable and logical connection to the outbreak of poliomyelitis in the Philippines last 2019 established by providing an answer to any of these interrogative words: *who*, *what*, *when*, *where*, *how*, and *why*.

5. **Retweet**–referred to the use of the *native retweet* service to share content on Twitter.[18]

6. **Sentiment**–referred to emotions contained within a tweet such as: *concern*–feeling of worry on something considered important, *frustration*–emotion that arises from the perceived resistance or inability to fulfill a goal, *humor/sarcasm*–use of irony or hilarity in conveying ideas, *information*–the objective provision of facts, and *others*–any item that does not belong to the previously mentioned types.

7. **Source**–referred to the authorship of online content: *government agency*–any instrumentality of the government of the Republic of the Philippines, *health professional*–an individual in the practice of a profession involved in the maintenance of human health, *international organization*–an organization established within international law possessing its own international legal personality, *journalist*–a person engaged in the occupation of collecting and disseminating news through print, radio, television and the internet, *news outlet*–a corporate entity engaged in the collection and dissemination of current information to the public, *non-governmental organization*–an organization independent of government having a particular purpose, and *personal account*–any other individual given personalized access on Twitter for private use.

8. **Tone**–referred to the following attitudes towards to poliomyelitis vaccination: *pro-vaccination*–refers to the expressed attitude towards vaccination, *anti-vaccination*–refers to the expressed attitude against vaccination, and *neutral/unclear*–any item that does not belong to the previously mentioned types.

9. **Topic**–referred to the themes defined by thematic analysis according to the procedure outlined by Braun and Clark.[29]

Ethical Considerations

The study commenced when the approval from the Cebu Institute of Medicine–Cebu Velez General Hospital Institutional Review Board was obtained (Appendix 1). Strict confidentiality was observed during the entire course of the research. The author had no conflict of interest while conducting this research.

RESEARCH METHODOLOGY

Study Design

The study utilized a cross-sectional design.

Study Setting

The study was done over Twitter – a social media networking service which allows registered users to engage with one another by the broadcast of tweets.

Study Population

Inclusion Criteria: Tweets with the following attributes:
1. Scope–Tweets on the 2019 Philippine poliomyelitis outbreak (posted from September 14, 2019, to March 14, 2020, containing the keyword *Philippines* with any of these keywords: *poliomyelitis*, *polio*, *vaccine*, or *immunization*)
2. Language–English language
3. Popularity–native retweet count of 10
4. Publication–publicly available for recovery through Twitter's Application Programming Interface (API) by *Tweet Binder*
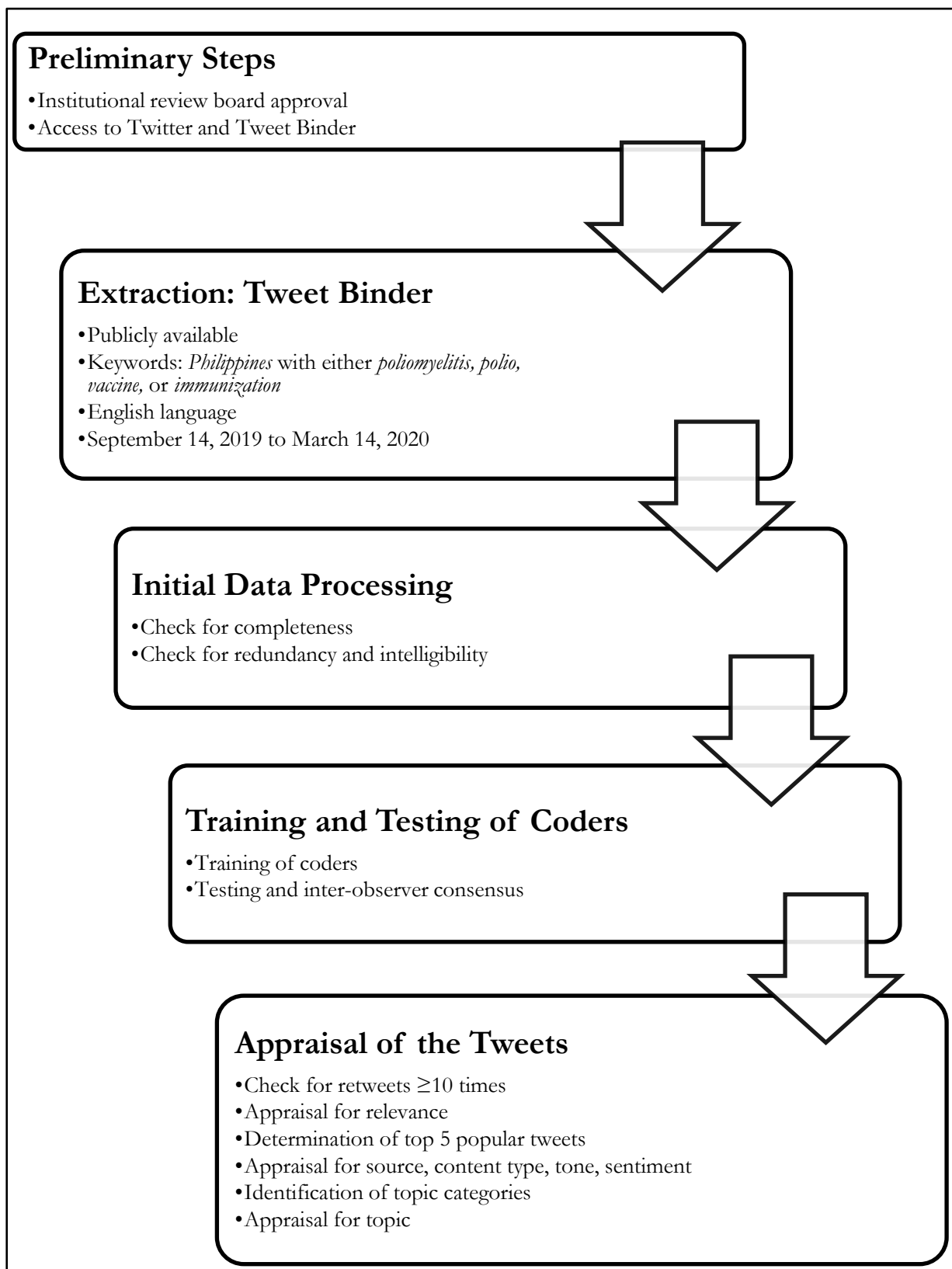
Exclusion Criteria:
1. Duplicates and unintelligible content
2. Unrelated content

Data Collection

The research received the approval of the Cebu Institute of Medicine–Cebu Velez General Hospital Institutional Review Board. *Tweet Binder*, a third-party application service, was used to the recover the desired tweets from publicly available content.[30-32] It streamed for alphanumeric tweets in English posted between September 14, 2019, to March 14, 2020. The tweets may have any of these keywords: *poliomyelitis*, *polio*, *vaccine*, *immunization* but must always have the keyword *Philippines*. The keywords were typed into the search query box while the dates and the language were selected in drop-down lists in the online interface. This yielded a list of all the tweets of interest with their usernames, account names, uniform resource locators (URL) and the number of likes and retweets. This report was downloaded as a Microsoft Excel Workbook. The report was manually examined for completeness, clarity, and redundancy. Extra information in tweets, such as links to web pages, were opened for content. Hashtags were retained with the "#" symbol removed.

Three coders were trained for content analysis. Each coder received a coding sheet containing 30 randomly selected tweets. Each coding sheet had a unique ordinal position for the same tweet. The assignment of the tweets in the coding sheets was exclusively known to the author. Each coder appraised the tweets in the coding sheet by assigning a number that corresponds to a specific choice for a certain attribute. Each coder evaluated the tweets for these key attributes. The coders were not allowed to discuss with each other.

Preliminary Steps

- Institutional review board approval
- Access to Twitter and Tweet Binder

Extraction: Tweet Binder

- Publicly available
- Keywords: *Philippines* with either *poliomyelitis, polio, vaccine,* or *immunization*
- English language
- September 14, 2019 to March 14, 2020

Initial Data Processing

- Check for completeness
- Check for redundancy and intelligibility

Training and Testing of Coders

- Training of coders
- Testing and inter-observer consensus

Appraisal of the Tweets

- Check for retweets ≥10 times
- Appraisal for relevance
- Determination of top 5 popular tweets
- Appraisal for source, content type, tone, sentiment
- Identification of topic categories
- Appraisal for topic

Figure 1. Flowchart for Data Collection.

The coders were, thereafter, taught to identify and code for topic. *Topic* referred to the themes defined by thematic analysis according to the procedure outlined by Braun and Clark.[29] While discussions involving the author and the coders to develop the topics were allowed, each coder returned to independently appraise the tweets for topics. Interrater reliability was measured by Fleiss' kappa (*k*). The study ensued once the coders attained an acceptable level of consensus (*k* ≥ 0.8) in all the key attributes.

During the pretest, the coders had a Fleiss' kappa of 0.49 for relevance, 0.77 for source, 0.31 for content type, 0.34 for tone, 0.35 for sentiment and 0.63 for topic. Since the agreement between coders was poor ($k < 0.8$), feedback was collected and issues in coding were clarified. With these changes, the coders were retested for consensus with the following results: Fleiss' kappa of 1.00 for relevance, 1.00 for source, 0.92 for content type, 0.95 for tone, 0.95 sentiment and 1.00 for topic.

All tweets that had a retweet count of at least 10 times were identified from the report. The coders used the same procedure for content and thematic analysis as learned from their training. The tweets were appraised for relevance (Appendix 2). Tweets which were not relevant were removed from the dataset. A copy of the remaining tweets was sorted according to the number of likes and retweets. The remaining tweets were then evaluated according to source, content type, tone, and sentiment (Appendix 3). The **source** of the tweet was classified as follows: *news outlet, journalist, health professional, government agency, international organization, non-governmental organization,* and *personal account.* The **content type** of the tweet was categorized as *news article, blog post, image, other, no attached link,* and *no access to attached link.* The **tone** of the tweet was classified into *pro-vaccination, anti-vaccination* and *neutral/unclear.* The **sentiment** of the tweet was recorded as *information, frustration, humor/sarcasm, concern,* and *others.* The tweets were only considered for **topic** once all other attributes have been coded. The coders returned the completed coding sheets with schemata on how the tweets were evaluated (Appendix 4). The agreement of at least two of three coders classified a tweet into categories within attributes. When all coders do not agree, the tweet was removed. The resulting codebook included the following variables: username, uniform resource locator (URL), tweet, number of likes, number of retweets, source, content type, tone, sentiment, and topic (Appendix 5). This was in the format of a Microsoft Excel Workbook. This was stored in a password-protected storage service and would be disposed after two years.

Descriptive statistics was used to determine the frequency categories within each of the attributes. Proportions were used for categorical variables. Inter-rater consensus was expressed in Fleiss' kappa at 5% level of significance. Minitab version 19.0 for Mac Mojave OS was used in the analysis of data and statistical computations.

RESULTS

There were 13,944 publicly available tweets containing keywords of the polio outbreak made between September 14, 2019, to March 14, 2020. Almost all of these tweets were in English. Original content comprised 30.99% of the tweets while 69.01% were retweets. The tweets were from 10,116 users each contributing an average of 1.38 tweets. Almost a quarter (23.12%) of these contributors each had 1,000 to 5,000 followers. The tweets were projected to reach 332,869,693 user accounts and had the potential to be seen 724,653,931 times over Twitter. There were no redundancies and unintelligible content in the report (Appendix 6).

A total of 259 tweets with the keywords of the outbreak were retweeted at least ten times. These were evaluated for relevance. The coders had good consensus on relevance ($k=0.99; p<0.00005$). Forty-five (17.37%) of the tweets were removed for not being relevant. The remaining 214 tweets (82.63%) were suitable for analysis (Figure 2).

Four tweets remained in the top five most popular tweets of the outbreak be it according to likes or retweets. These were news articles and blog posts from news outlets and personal accounts. They either informed the public of the outbreak or expressed frustration over the resurgence of polio cases. These tweets have an unclear or neutral stand on vaccination. Two tweets were not present in both lists. Unlike the other four tweets, both were in favor of vaccination (Table 1-A and 1-B).
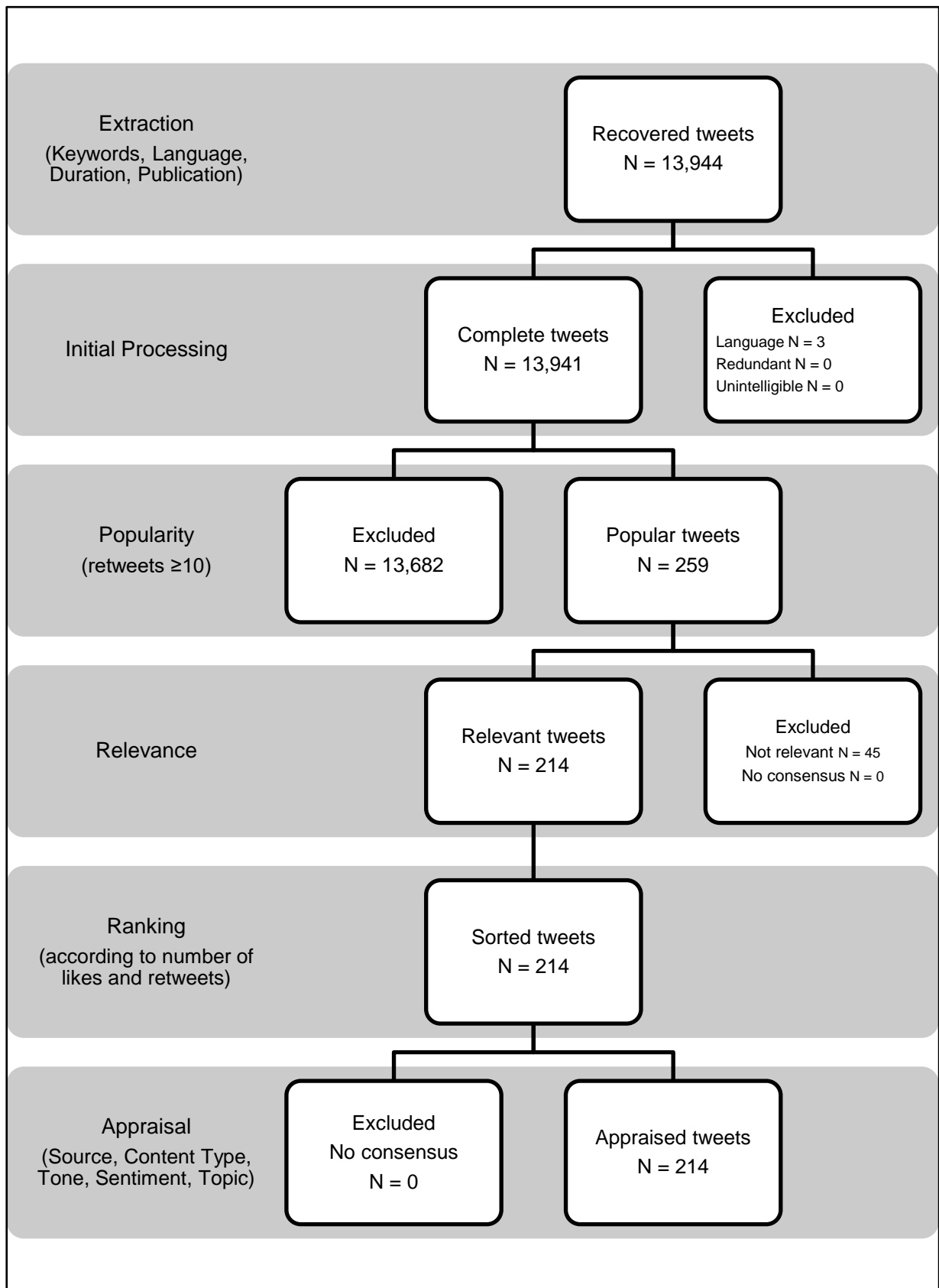
Figure 2. Flowchart on the Selection of the Study Population.

Table 1-A. Top Five Most Popular Tweets During the 2019 Philippine Poliomyelitis Outbreak Based on Likes.

Rank	Account Name and Tweet	Likes
1	Thérèse "Polio remains in only 3 countries: Pakistan, Afghanistan and Nigeria. There is a fourth now: Philippines. Polio is so contagious that as long as a single child is infected with poliovirus, children in all countries are at risk. Fuck you very much, Persida Acosta. THIS IS ON YOU. https://t.co/3VmPziiDRp"	12,555
2	#DefendPressFreedom #JunkTerrorBillNOW "We're in deep shit: Dengue, African Swine Flu, now Polio. While the rest of the world moves forward medically, the Philippines is slowly being sucked into a modern-day Dark Ages of sorts. And the president? Still rambling endlessly and senselessly about his ambush fetish. 🙅‍♀️🙅‍♂️ https://t.co/cgEX8HnHNP"	12,098
3	CNN Philippines "BREAKING: DOH confirms reemergence of polio in the Philippines,19 years after the World Health Organization declared the country free of the disease https://t.co/sDo55hwVGt https://t.co/HZcMwtTU7G"	5,185
4	ABS-CBN News "JUST IN: Department of Health confirms re-emergence of polio in the Philippines, 19 years after declaring the country as polio free.	via @raphbosano https://t.co/kYPuqDMHjY"	3,038
5	TwoCityTrails "Singapore's SEA Games-bound team to get polio vaccinations after 'increased' incidents of disease in the Philippines. □□ #SEAGames2019 https://t.co/5dTZ5Dyabw"	2, 639

Table 1-B. Top Five Most Popular Tweets During the 2019 Philippine Poliomyelitis Outbreak Based on Retweets.

| Rank	Account Name and Tweet	Retweets
1	Thérèse "Polio remains in only 3 countries: Pakistan, Afghanistan and Nigeria. There is a fourth now: Philippines. Polio is so contagious that as long as a single child is infected with poliovirus, children in all countries are at risk. Fuck you very much, Persida Acosta. THIS IS ON YOU. https://t.co/3VmPziiDRp"	6,478
2	CNN Philippines "BREAKING: DOH confirms reemergence of polio in the Philippines,19 years after the World Health Organization declared the country free of the disease https://t.co/sDo55hwVGt https://t.co/HZcMwtTU7G"	5,093
3	#DefendPressFreedom #JunkTerrorBillNOW "We're in deep shit: Dengue, African Swine Flu, now Polio. While the rest of the world moves forward medically, the Philippines is slowly being sucked into a modern-day Dark Ages of sorts. And the president? Still rambling endlessly and senselessly about his ambush fetish. □ ♀□□ ♂□ https://t.co/cgEX8HnHNP"	5,055
4	World Health Organization Philippines "There is an outbreak of #polio in the Philippines. Learn more about what this means and how you can protect your family: https://t.co/ViNxImSDO0 #EndPolio https://t.co/JpzUrS7yTu"	2,618
5	ABS-CBN News JUST IN: Department of Health confirms re-emergence of polio in the Philippines, 19 years after declaring the country as polio free.	via @raphbosano https://t.co/kYPuqDMHjY	2,137

Personal accounts of individual users posted 78 popular tweets (36.45%) during the outbreak. This was closely followed by news outlets which contributed 73 tweets (34.11%). The involvement of other sources of tweets were as follows: international organizations with 19 tweets (8.88%), non-governmental organizations with 17 tweets (7.94%), health professionals with 16 tweets (7.48%), journalists with 10 tweets (4.67%) and government with one tweet (0.47%) (Figure 3).

N = 214
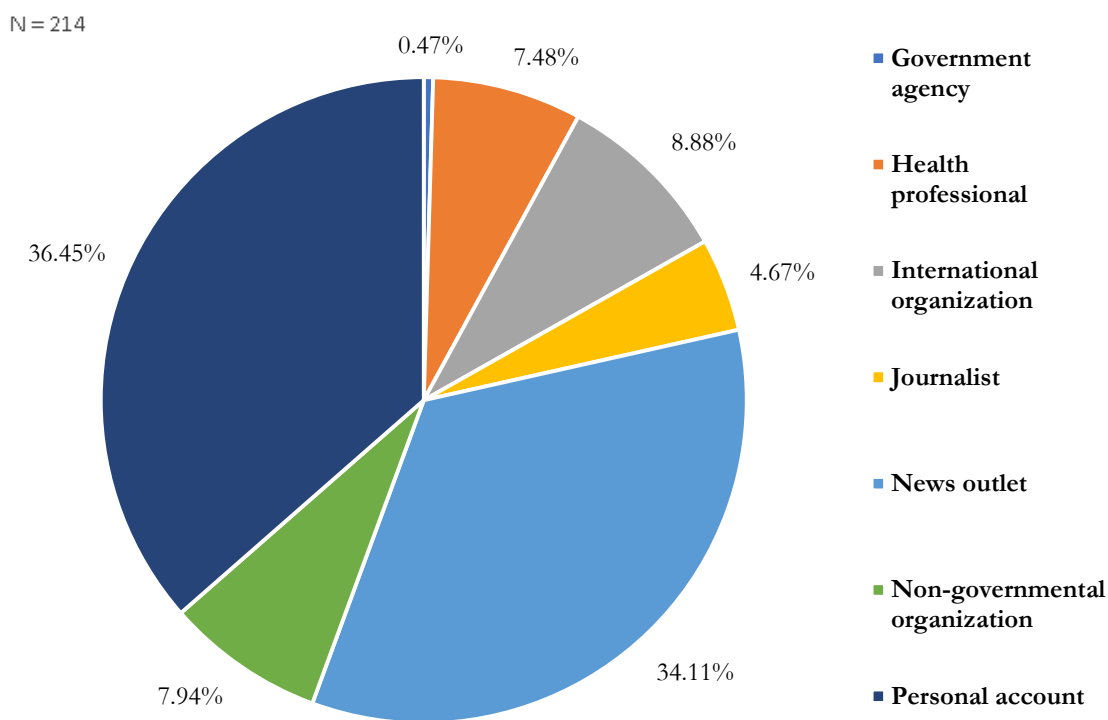
Figure 3. Sources of Popular Tweets of the 2019 Philippine Poliomyelitis Outbreak.

The most common type of content shared during the outbreak were news articles in 111 tweets comprising 51.87%. Other types of content on Twitter during the outbreak included 63 blog posts (29.44%), 34 images (15.89%) and two others (0.93%)–a headline banner and an audio clip. Four tweets (1.87%) had broken links to online content outside of Twitter (Figure 4).
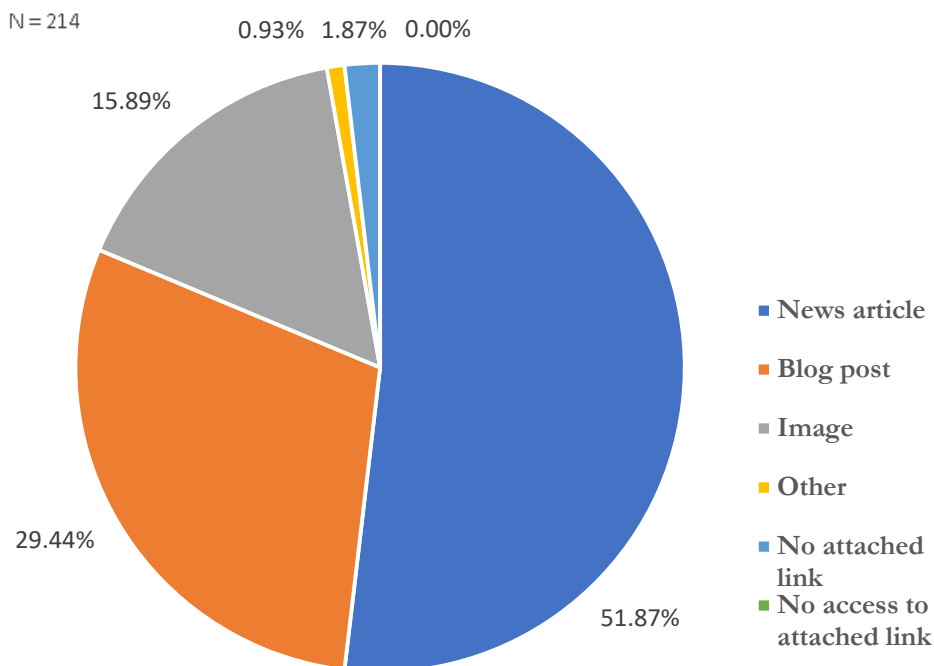
Figure 4. Content Types of Popular Tweets of the 2019 Philippine Poliomyelitis Outbreak.

Most of the tweets during the outbreak did not express a stand on vaccination or were neutral to this preventive measure. This included 155 tweets (72.43%) with a neutral or an unclear tone. There were 55 tweets

(25.70%) which expressed favorable opinions towards vaccination while four tweets (1.87%) had views against vaccination due to the documentation of vaccine-derived polioviruses in affected children (Figure 5).
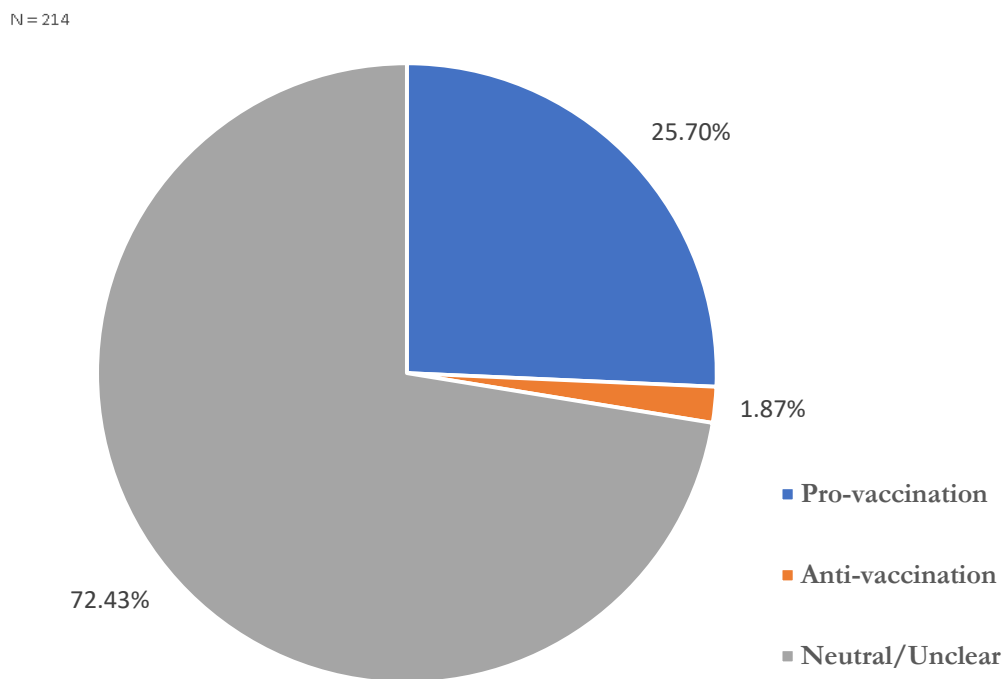
N = 214

Figure 5. Tones of Popular Tweets of the 2019 Philippine Poliomyelitis Outbreak.

With regards to the sentiments of the tweets, 176 tweets (82.24%) conveyed information. Fifteen tweets (7.01%) expressed concern towards anticipated needs and problems while 11 tweets (5.14%) contained frustrations and expressed perceived resistance in the prevention, control, and mitigation of the outbreak. Tweets which heavily relied on context for proper interpretation included 12 humorous and sarcastic tweets (5.61%) (Figure 6).
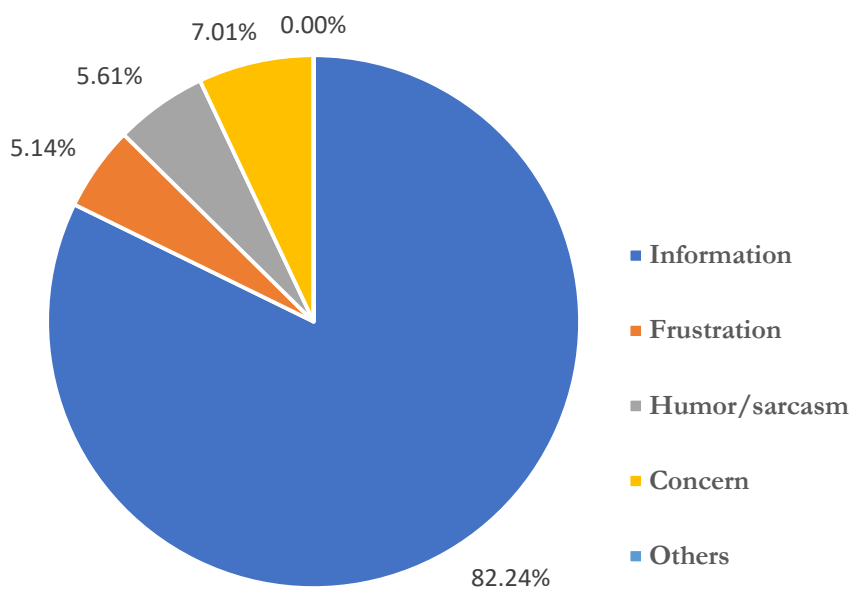

Figure 6. Sentiment of Popular Tweets of the 2019 Philippine Poliomyelitis Outbreak.

Thematic analysis of the tweets resulted in five topics. *Resurgence of poliomyelitis in the Philippines* included 131 tweets (61.21%) on the existence of an outbreak. *Disease susceptibility and severity* comprised seven tweets (3.27%) on the pathogenic nature, presentation, diagnosis, and management of poliomyelitis. *Regulation and policy issues* referred to the 23 tweets (10.75%) on how the Philippine government responded. *Non-government initiatives* consisted of 21 tweets (9.81%) on how individuals and organizations responded. *Vaccine efficacy* had 32 tweets (14.95%) on how immunization can control the outbreak (Figure 7).
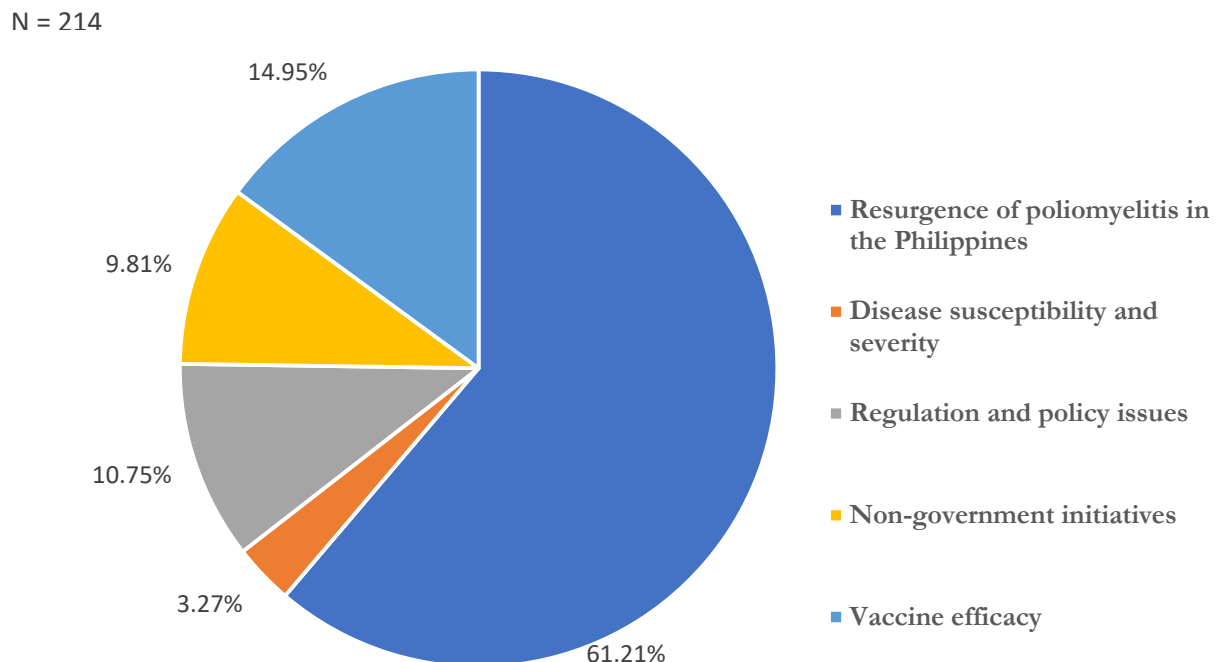

Figure 7. Topics of Popular Tweets of the 2019 Philippine Poliomyelitis Outbreak.

The coders made consistent assessments in all five key attributes ($k>0.8$, $p< 0.0005$). The agreement in the nominal assessments of the three coders was acceptable (Table 2).

Table 2. Validity of the Attributes of Relevant Popular Tweets.

Attribute	Tweets Inspected	Matched Responses	% Agreement	k	p-value
Relevance	259	258	99.61	0.99	< 0.00005
Source	214	209	97.66	0.98	< 0.00005
Content	214	205	95.79	0.95	< 0.00005
Tone	214	204	95.33	0.92	< 0.00005
Sentiment	214	208	97.20	0.94	< 0.00005
Topic	214	206	96.26	0.96	< 0.00005
Over-all	1329	1290	97.07	0.97	< 0.00005

DISCUSSION

Users of social media exchange information through the active publication of material (i.e., posting) or through the passive consumption of content (i.e., browsing).[34, 35] During emergency events and other non-routine situations, Twitter functions as a broadcasting medium. This skews social media activity to favor a small number of highly active contributors that tend to disseminate information towards a far larger aggregate of bystander receivers.[11-13] The results of this study show that the number and content of tweets on the polio outbreak was consistent with other studies which described Twitter as a broadcasting medium.[36-41]

The heuristic processing of information can explain the recovery of about 14,000 tweets with keywords of the outbreak from nearly 10,000 users. Most of these tweets were retweets.[42-44] The methods of this study rely on the

fact that the repeated use of certain concepts related to an outbreak lead to the frequent presence of the keywords on Twitter.[45-49] Using these keywords, users can search for similar tweets. The immediate appraisal and almost instantaneous sharing of content through retweets were the result of personal decisions. In choosing what to share during the polio outbreak, users usually selected tweets with the keywords.[18, 19] The frequent use of these keywords explains why most of the tweets recovered in the report were retweets and why retweets remain the preferred measure on how popular a particular content is on Twitter.[50-55] With every retweet, the original tweet is perceived by other users as particularly important. This translates to its *virality*–the creation of huge volumes of retweets quickly.

In a study based on mathematical models, once a tweet is retweeted, it gets retweeted again almost instantly on the second to the fourth hop away from the source.[9] It should then come as no surprise that the tweets which contain the keywords of the polio outbreak were projected to have been sent out to at least 300 million users (also known as *reach*) and had the potential to be seen at least 700 million times (also known as *impact*) over Twitter.[10] A few studies showed that any tweet shared as retweets reaches an average of 1,000 users irrespective of how many followers the original author has. This suggests that the retweet of a single tweet from users with at least 1,000 followers – which constitute almost a quarter of the sources of the tweets in the report – can be very persuasive.[50-55]

Most of the top five popular tweets on the outbreak of poliomyelitis in the Philippines in 2019 were news articles and blog posts from news outlets and expressions of frustration on the resurgence of cases from personal accounts of laypeople. The numerous likes and retweets which frequently appear in the ongoing stream of posts are heuristic cues for consensus.[56,57] Since it can imply approval, retweeting suggests to other users that the information contained within a tweet is worthy of mass broadcast. Liking, in contrast, provides a more personal and meaningful form of approval that is less public. Hence, when users opt to retweet, their choice to disseminate information is in a more conspicuous manner. As a nonverbal form of interpersonal communication, retweeting and liking reflects the immense value users attach to the most popular tweets.[12] Also, these leading tweets illustrate on how individual decisions in social media can align towards a goal.[40, 41] It is this choice to share a post with others that makes social media a viable avenue for health education.[58-60]

In this research, personal accounts posted most (36.45%) of the popular tweets on the outbreak of polio in the Philippines in 2019. This was followed by news outlets (34.11%), international organizations (8.88%), non-governmental organizations (7.94%), health professionals (7.48%), journalists (4.67%) and government agencies (0.47%). A study in Spain which did a content and source analysis of popular tweets on diphtheria showed that news outlets constituted 15% of the sources. Other sources were authors (10.8%) and journalists (2.6%). There was no mention on how many of the tweets were from personal accounts. None of the tweets came from healthcare professionals or organizations.[25] The popularity enjoyed by news outlets in both of these outbreaks results from the active role they take in exceptional situations.[34, 35] For example, a typical broadcast of an outbreak begins with the dissemination of its existence from news outlets in the form of news articles based on government issuances.[11-13, 35-41, 61] Since these announcements are perceived to come from reliable sources, users of social media use their personal accounts to validate and express their views.[62] During outbreaks, some individuals and groups rise to the occasion as experts in their field.[12, 26] In this study it was observed that some popular tweets came from these expert health professionals. It is worth mentioning that they have created substantial impact because they were among the top sources of popular tweets. However, a similar study on the measles outbreak in the United States in 2015 concluded otherwise. They reported that news organizations have a higher impact than articles from health professionals and organizations in dispersing health-related material in social media.[63] During the polio outbreak, the activity of a small but influential cohort of health experts on Twitter help counter misinformation by producing highly engaging content and by competitively excluding potentially harmful content from public consumption.[26, 34-35]

This study found that the most common type of content shared during the polio outbreak were news articles followed by blog posts, images, headline banners and audio clips in decreasing order of frequency. Regardless of the type of content, breaking news on disasters and tragedies get shared a lot on Twitter.[64] In both the diphtheria and poliomyelitis outbreaks, news articles were the most popular type of content.[25] These news articles highlight

pressing health issues in social media. Likewise, they create substantial impressions that can initiate and sustain public discussion in social media.[65]

The tone of the popular tweets during the polio outbreak was also analyzed. This study noted that a substantial proportion of the tweets were neutral or unclear towards vaccination (72.43%) and some of the tweets were in support of immunization (25.70%). However, during the diphtheria outbreak in Spain, most of the tweets were in support of immunization (58%) and some of the tweets were neutral or unclear towards vaccination (42%).[25] Since the most common type of content shared during the outbreak were news articles, it is expected that the tone of the statements was neutral or objective rather than opinionated.[11] The tweets against vaccination for polio were from accounts of individuals suspicious of the efficacy of the vaccines. This suspicion came about because of the report that the polio virus recovered from the affected children were vaccine derived.[5-7] Tweets from anti-vaccination groups were not noted among the popular tweets of the polio outbreak. During the diphtheria outbreak in Spain, however, anti-vaccination tweets were not reported. The marginal prominence of anti-vaccination tweets during the polio outbreak, could also be the result of competition from tweets that reassure and empower the public.[25]

Another key attribute analyzed in this study was the sentiment of the tweets. Majority of the tweets of the polio outbreak were factual (82.24%). Tweets with sentiments of concern (7.01%), humor/sarcasm (5.61%) and frustration (5.14%) followed in decreasing order of frequency. In contrast, tweets on a diphtheria outbreak in Spain were slightly led by the emotions of frustration, humor/sarcasm, and concern (53%). This was then closely followed by informative tweets (47%).[25] Since most of the popular tweets during the polio outbreak were news articles from news outlets, emotional tweets from personal accounts did not gain as much attention. While it is known that messages with negative emotions get more retweets on Twitter, the need for information during outbreaks explain this level of publication and consumption.[12, 66] This was also brought about by the peculiarities of social interaction among Filipinos that has now extended to social media.[5-8] The social norms and cultural practices of a group plays a substantial role in dictating the social media activity of its members.[20-25] For example, in cultures that tolerate the expression of emotion in public, some users resort to social media to air out their frustration.[45] One study in Netherlands showed that the reason why social media users expressed frustration during an outbreak was because of the knowledge that the disease is preventable.[67] Furthermore, in a study in 2013 on the role of emotional response on the virality of social media content also found out that the use of humor and sarcasm garnered more attention, increased revenue or eased the sharing of divisive views during discussions.[68-70]

The last key attribute was on the topic of popular tweets. The *resurgence of poliomyelitis in the Philippines* was the most discussed topic (61.21%) followed by *vaccine efficacy* (14.95%). The rest of the tweets were on the topics *regulation and policy issues* (10.75%), *non-government initiatives* (9.81%) and *disease susceptibility and severity* (3.27%). The popularity of this topic stems from the fact that cases of poliomyelitis have resurfaced after having been controlled in the Philippines since the year 2000. This incongruity has brought to the attention of the public the issue of poor vaccine coverage despite the existence of a national vaccination program.[5-7] During the diphtheria outbreak, the most popular topic was on criticisms towards anti-vaccination groups (35%). The groups do not believe in the effectiveness of immunization.[25]

This study cannot determine as to which kinds of tweets would be more effective in changing one's attitude and behavior towards vaccination. One study in 2015 on the effect of scientific consensus on public support for vaccination showed that statements of consensus on the safety and efficacy of vaccines improved the parents' perceptions on vaccine safety.[19] Another study in 2013 on the how parents decide on the vaccination of their children showed that discouraging vaccination may be perceived as irresponsible and bad parenting.[71] However, these studies were not designed to observe for changes in individual or public opinion over long periods of time. The long-term effect of discussing vaccination on Twitter in the context of current social norms remains to be seen.[72]

CONCLUSION

The top five most popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 were news articles and blog posts from news outlets and personal accounts that expressed frustration on the resurgence of

cases. Popular tweets during the outbreak of poliomyelitis in the Philippines in 2019 had the following characteristics: (1) source–personal accounts, (2) content type–news articles, (3) tone–neutral or unclear towards vaccination, (4) sentiment–information, (5) topic–resurgence of poliomyelitis in the Philippines.

The dissemination of information during this outbreak relied on the heuristic appraisal of messages in tweets and the rapid creation of numerous retweets. The outbreak has solicited ideas of individual and community response. It has prompted the expression of various sentiments and elicited the activity of a few who are against vaccination. A few health professionals were able to post highly engaging online content that was shared with many people in a brief time. This worked to keep potentially harmful messages from gaining the attention of passive users of Twitter.

RECOMMENDATIONS

The extensive reach and immense impact of messages broadcasted in social media should not be disregarded. While health professionals continue to provide facts and advice related to health, social media has transformed the choices and actions of its users. The pragmatic use of social media can help address the threat of vaccine hesitancy in the country. Public health programs can utilize social media, such as Twitter, to address misinformation in vaccination.

The use of social media has resulted to a community of users who share, obtain, and utilize information gathered online. In response to this momentous change in human interaction, the competent use of social media should now be in the skill set of contemporary health professionals. They should not shy away from Twitter simply because of unfamiliarity but should make the most out of this platform. Simply put, humans just found another way to talk about their health.

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