Title:
Geospatial Distribution of Local Health Department Tweets and Online Searches about Ebola During the 2014 Ebola Outbreak

Running Title:
Tweets and Online Searches about Ebola

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This version is the Accepted Version of an article published in *Disaster Medicine and Public Health Preparedness* after peer review. Accepted for publication. The final authenticated version is available online at:
https://doi.org/10.1017/dmp.2017.69

Abstract

Objective

This study compared the geospatial distribution of Ebola tweets from local health departments (LHDs) to online searches about Ebola across the United States during the 2014 Ebola outbreak.

Methods

Between September and November 2014, we collected all tweets sent by 287 LHDs known to be using Twitter. Coordinates for each Ebola tweet were imported into ArcGIS 10.2.2 to display the distribution of tweets. Online searches with the search term "Ebola" were obtained from Google Trends. A Pearson correlation was conducted to access the relationship between online search activity and per capita number of LHD Ebola tweets by state.

Results

Ebola tweets from LHDs were concentrated in cities across the northeast states, including Philadelphia and New York City. In contrast, states with the highest online search queries for Ebola were primarily in the south, particularly Oklahoma and Texas. A weak, negative, non-significant correlation (r=-.03, p=.83, 95% CI -.30-.25) was observed between online search activity and per capita number of LHD Ebola tweets by state.

Conclusions

We recommend LHDs consider using social media to communicate possible disease outbreaks in a timely manner, and consider using online search data to tailor their messages to align with the public health interests of their constituents.

Keywords: Ebola; emergency preparedness; local health department; social media; Twitter

Introduction

The 2014 Ebola Outbreak was first recognized during March 2014 within West Africa, which has become the largest Ebola outbreak since the virus was discovered. Shortly afterwards, the U.S. Centers for Disease Control and Prevention (CDC) confirmed three cases of Ebola in Dallas, TX and one case in New York, NY.[1] During the outbreak, there was a surge in interest about Ebola online. Ebola was the third most searched term in the U.S. on Google in 2014.[2] Similarly, tweets mentioning Ebola peaked multiple times in the U.S. throughout the outbreak on Twitter.[3] Despite high levels of online conversation about Ebola, numerous studies have indicated that the discussion of Ebola on news media and social media may have prompted fears and misinformation among the public.[3]

Local health departments (LHDs) are typically considered the first line of defense in protecting the health of their communities by providing information about health issues, and preparing for and responding to public health emergencies.[4] One way LHDs communicate with their constituents is through social media, such as posting on Facebook or sending a tweet via Twitter to quickly disseminate information.[5] From our previous study,[6] about 77% of LHDs using Twitter had tweeted at least once about Ebola for a total of 1,648 Ebola-related tweets during the data collection period. Among the LHDs that tweeted about Ebola, there was an average of seven Ebola tweets per health department, with most tweets providing information about the virus or directing people to resources that would enable them to learn more about Ebola through a web site or an infographic.[6]

Our prior study indicated that geographic proximity to the nearest Ebola case (Texas or New York) was not significantly associated with LHDs tweeting about Ebola,[6] however, we did not examine how the geospatial distribution of LHD tweets aligned with LHD constituent interest in Ebola. This is an important topic for public health as LHDs may not be sending messages that align with their constituents' current public health concerns. This study aims to answer three primary research questions: (1) What was the geospatial distribution of LHDs tweeting about Ebola? (2) What was the geospatial distribution of online searches about Ebola in the U.S.? and (3) What is the association between the geospatial distribution of Ebola tweets from LHDs and online search activity about Ebola?

Methods

Between September 3 and November 2, 2014, we used the NCapture tool of NVivo 10 to collect all tweets sent by 287 LHDs known to be using Twitter (bit.ly/1FrqEZe). The tool retrieved information such as coordinates, dates, and Twitter profile descriptions for each tweet sent by LHDs. Ebola-related tweets were identified by searching for the term "Ebola" in the tweets collected. Online search activity about Ebola was retrieved from Google Trends (bit.ly/1IiN9Oa), restricted by the search term "Ebola," and limited to searches that took place in the U.S. between September 1, 2014 and October 31, 2014. Google Trends assigns each state a relative search volume (RSV) on a scale between 0 and 100, which enables a comparison of search popularity between states. The search data is adjusted by geographical location and time range, relative to the data point with the highest search queries. For example, the state with the highest frequency of Ebola searches would be assigned an RSV value of 100, while other states would be assigned RSV values relative to this state.

The geospatial distribution of LHD Ebola tweets was analyzed by importing coordinates from each tweet into ArcGIS 10.2.2. A portion of the tweets (n=166, 10.1%) was missing coordinates. Consequently, addresses for LHDs missing coordinates were obtained by matching LHD names identified from their Twitter profiles to their addresses listed in the 2013 National Association of County and City Health Officials (NACCHO) Profile study.[7] Missing coordinates were then obtained for these LHDs by inputting their respective addresses into Google Maps. Coordinates for one Ebola tweet, however, could not be assigned as the Twitter account was a collaboration of three LHDs in separate locations. A Pearson correlation was conducted in SPSS 23 to assess the relationship between Google RSV values and per capita number of LHD Ebola tweets by state. Per capita number of LHD Ebola tweets was computed by dividing the total number of Ebola tweets for each state by its respective total number of LHDs.

Results

Ebola tweets

Ebola tweets from LHDs were primarily concentrated in multiple cities across the northeast region of the U.S. (Figure 1). The five cities with the highest number of Ebola tweets were Philadelphia (n=127), New York City (n=103), Cincinnati (n=95), Buffalo (n=84), and Baltimore (n=53). A high concentration of Ebola tweets was observed in New York state, where the fourth Ebola case was confirmed in New York City. In contrast, few LHDs tweeted about Ebola in Texas, where the first three cases were confirmed in Dallas.

[Figure 1]

Online searches

From September to October 2014, Texas registered the highest number of Google searches about Ebola among all states, with an RSV value of 100. In addition, Dallas registered an RSV value of 98, the second highest number of searches about Ebola among all U.S. cities. Other states with high RSV values for Ebola searches included Oklahoma (99), District of Columbia (89), Louisiana (80), and New York (77). There was a weak, negative, non-significant correlation (r=-.03, p=.83, 95% CI -.30-.25) between Google RSV values and per capita number of LHD Ebola tweets by state, indicating no association between online searches for Ebola and LHDs tweeting about Ebola.

Discussion

This study examined the geospatial distribution of LHD tweets and online searches about Ebola. The findings were consistent with our previous study, in which there was no association between states with confirmed Ebola cases and LHDs tweeting about Ebola (Figure 1).[6] Many LHDs in cities within a 200-mile radius of New York City increased Ebola tweeting when Ebola cases were confirmed between September and October 2014 by the CDC. Few LHDs in Texas, particularly around Dallas, tweeted about Ebola although there were three confirmed cases.

The initial public health response to the 2014 Ebola Outbreak bears some resemblance to the events that took place during the emergence of the HIV/AIDS epidemic in 1981. A common adage describing the initial public health response to the HIV/AIDS epidemic was, “What do we think? What do we know? What can we prove?”.[8] Although there was substantial evidence indicating a possible HIV/AIDS epidemic, public health officials intentionally delayed releasing

official statements about the outbreak until they could prove that the nationwide deaths of drug addicts and homosexual men were caused by HIV/AIDS. Confirmation linking these deaths to HIV/AIDS, however, was deemed essential as it would avert unnecessary panic among the public. This public health approach of delaying communication until there is confirmed evidence continues to persist today for other emerging infectious diseases. We speculate this may also explain the low frequency of Ebola tweets in Texas during the outbreak. Although the U.S. anticipated a possible Ebola outbreak, LHDs in Texas likely delayed tweeting about Ebola until they could prove the initial Texas cases were indeed caused by the Ebola virus.

A previous study suggested there was a moderate, positive correlation between the number of new weekly global Ebola cases and weekly search activity about Ebola on Google.[2] A similar situation may have occurred in the U.S. For instance, three southern states (Texas, Oklahoma, and Louisiana) were among the top five states with the highest RSV values for online searches about Ebola, likely attributed to the multiple confirmed Ebola cases in Texas. Despite the high levels of search activity about Ebola, southern states were shown to have considerably lower levels of LHD Ebola tweeting (Figure 1). Similarly, our findings indicated a poor correlation between the number of Ebola tweets sent by LHDs and the RSV values for their respective states. As the frequency of disease outbreaks and the number of unique infectious diseases continue to rise globally,[9] it is crucial for LHDs and other health authorities to disseminate information about disease outbreaks in a timely manner. We recommend LHDs consider using online search data to tailor their messages on social media and other communications so that they align with health topics of interest among their constituents to increase their engagement,[10] and mitigate potential fears and confusion spread from misinformation.[3]

This study was limited by a sample that was restricted to only local health departments. Likewise, we did not investigate state health departments on Twitter that may have tweeted about Ebola. In addition, it is possible that we missed the Twitter pages for some LHDs when we first collected our sample through a Web search conducted in July 2012.[5] Finally, Google online search data was only available at the state level so we were not able to examine patterns at the local level. Given that LHDs vary widely within and across states, state-level analyses may have obscured local patterns that differ by the varying structure. Despite these limitations, these findings are important as this is the first study to explore the geospatial distribution of LHDs communicating about a disease during an outbreak, and whether the distribution of LHD tweets aligned with that of online search activity for the disease.

Conclusions

Events from recent disease outbreaks, including the 2009 H1N1 influenza pandemic, 2014 Ebola outbreak, and the current emergence of the Zika virus may suggest gaps in the capacity for the public health system to prepare for and respond to public health emergencies.[4] Although delayed communications from public health officials are warranted, they may unintentionally harm public health by enabling infectious diseases to spread among those uninformed or misled by inaccurate information posted online.[3] Therefore, it is critical that LHDs communicate possible disease outbreaks with their constituents in timely manner before a crisis occurs.[4,6] The results of this study also highlight the potential for LHDs to utilize online search data to assess health topics of interest among their constituents and to tailor their communications to effectively engage the community in implementing emergency response strategies.[2,10] This is especially beneficial considering that high online search activity for a particular disease may be indicative

of increased information needs of Internet users, who may be seeking relevant information based on the users' own or friends' symptoms.[2] Further research is needed to better understand how health authorities can use information from online search data for these purposes.

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