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Impact of Twitter intensity, time, and location on message lapse of bluebird's pursuit of fleas in Madagascar

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Abstract
Background: The recent outbreak of bubonic plague in Madagascar reminds us of the continuing public health challenges posed by such deadly diseases in various parts of the world years after their eradication. This study examines the role of Twitter in public health disease surveillance with special focus on how Twitter intensity, time, and location issues explain Twitter plague message delay.
Method: We retrospectively analyzed the Twitter feeds of the 2014 bubonic plague outbreak in Madagascar. The analyses are based on the plague-related data available in the public domain between November 19th and 27th 2014. The data were compiled in March 2015. We calculated the time differential between the tweets and retweets, and analyzed various characteristics of the Tweets including Twitter intensity of the users.
Results: A total of 6873 Twitter users were included in the study, of which 52% tweeted plague-related information during the morning hours (before mid-day), and 87% of the tweets came from the west of the epicenter of the plague. More importantly, while session of tweet lease and relative location had effect on message lapse, absolute location did not. Additionally, we found no evidence of differential effect of location on message lapse based on relative location i.e. tweets from west or east nor number of following. However, there is evidence that more intense

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Twitter use appears to have significant effect on message lapse such that as the number of tweets became more intense, time differential between the tweets and retweets increased while higher number of retweets diminished message lapse.
Conclusion: This study affirms that Twitter can play an important role in ongoing disease surveillance and the timely dissemination of information during public health emergencies independent of the time and space restrictions. Further ways should be explored to embed social media channels in routine public health practice.

Introduction

The history, origin, cause, transmission, and death rate of bubonic plague is well documented [1]. However, bubonic plague continues to recur around the world years after it was eradicated. The number of cases reported globally in recent times is between 1000 and 2000, with most cases emerging out of Africa [2]. The recurrence of plague is due to many factors including absence of effective antibiotics and resistance of plague causing fleas to the insecticides. A 2014 outbreak of plague in Madagascar started from a single case and rapidly spread to 16 districts in the country due to high population density. The disease was confirmed in 119 persons and proved fatal in 40 of them [3]. Hence, it is increasingly essential to monitor the transmission of diseases and restrict their spread in a timely manner to prevent public health catastrophes [4]. Many public health agencies across the globe are adopting innovative ways to improve the detection of disease outbreaks. The electronic monitoring systems, such as EpiSPIDER, HealthMap, BioCaster, and the Global Public Health Intelligence Network mine the websites, like Twitter, for any reports on flagged diseases and provide a real-time tracking of disease progression [5–7].

Twitter is a publicly accessible social media platform where the users express a diverse range of views (tweets) within the allowable 140 characters. Most of the tweets are accessible via the Twitter Application Programming Interface (API), and have been used by the public health researchers in disease surveillance [7]. Studies have shown a strong similarity between the information extracted from the formal disease surveillance systems and that from the tweet mining [7]. For example, the information on cholera incidents in Haiti gathered from the HealthMap and the tweets collected via surveillance systems operated by the Haitian Ministry of Public Health indicated significant positive correlation [8]. Unlike traditional means of disease surveillance, which may take up to a week to confirm existence of an outbreak after its inception, social media can alert the public health agencies of an outbreak situation almost instantaneously [9,10]. In spite of this potential, it is not uncommon for the social media messages to face problems in their relay. The amount of time it takes for the first message about a disease outbreak hitting the public domain and its subsequent dissemination via social media is crucial to contain the spread of an outbreak. To best of our knowledge, the dependence of Twitter message relay on time and place issues and Twitter intensity has not been extensively explored in the context of disease outbreak situations. We have, therefore, examined the role of Twitter in the recent bubonic plague outbreak in Madagascar in this study with special focus on whether time of the day, the place of the message origin, and Twitter intensity can affect the relay of messages in emergency situations.

Methods

Fig. 1 presents a schematic framework that we have used as a basis for analysis and interpretation of the study findings.

Data source and timeframe

We retrospectively analyzed a cross-section of Twitter feeds during the 2014 bubonic plague outbreak in Madagascar. The analyses are based on the plague-related data available in the public domain between 19th November and 27th November 2014. The data were compiled in March 2015.

Operational definitions

We analyzed various characteristics of the tweets and the Twitter users. For example, we divided the tweets into the *time of the day* (session) when the

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