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Contents lists available at ScienceDirect

## American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

State of the Science Review

## Social media and outbreaks of emerging infectious diseases: A systematic review of literature

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EID  
social media  
systematic review

**Background:** The public often turn to social media for information during emerging infectious diseases (EIDs) outbreaks. This study identified the major approaches and assessed the rigors in published research articles on EIDs and social media.

**Methods:** We searched 5 databases for published journal articles on EIDs and social media. We then evaluated these articles in terms of EIDs studied, social media examined, theoretical frameworks, methodologic approaches, and research findings.

**Results:** Thirty articles were included in the analysis (published between January 1, 2010, and March 1, 2016). EIDs that received most scholarly attention were H1N1 (or swine flu, n = 15), Ebola virus (n = 10), and H7N9 (or avian flu/bird flu, n = 2). Twitter was the most often studied social media (n = 17), followed by YouTube (n = 6), Facebook (n = 6), and blogs (n = 6). Three major approaches in this area of inquiry are identified: (1) assessment of the public's interest in and responses to EIDs, (2) examination of organizations' use of social media in communicating EIDs, and (3) evaluation of the accuracy of EID-related medical information on social media.

**Conclusions:** Although academic studies of EID communication on social media are on the rise, they still suffer from a lack of theorization and a need for more methodologic rigor.

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The term emerging infectious diseases (EIDs) was first coined by Lederberg et al<sup>1</sup> to refer to those new infectious diseases appearing in the last 20 years. Some EIDs are caused by newly identified species of pathogens (eg, severe acute respiratory syndrome [SARS]) or pathogens affecting a new population (eg, West Nile virus). Re-emerging infections (eg, measles, drug-resistant tuberculosis) also belong to EIDs.<sup>2</sup> The several global or regional outbreaks of EIDs in the last decade (eg, Ebola virus outbreak between 2013 and 2016, H1N1 outbreak in 2009) coincided with the rise of social media as a source of public health information.<sup>3</sup> Researchers from disciplines such as health communication, public relations, medical informatics, and public health have started to explore social media's role in EID communication. The goal of the current study is to identify the major approaches and assess rigors in published research articles on EIDs and social media. It examines the theoretical

frameworks, methodologic approaches, and research findings in published journal articles. It then provides an evaluation of the current status of research and directions for future research endeavors.

### LITERATURE REVIEW

As disease-causing microbes are always evolving, the appearance of new pathogens, the effects of existing pathogens on new populations, and the rise of drug-resistant bacteria (or superbugs) continue to pose a threat to global health in the form of EIDs.<sup>2</sup> In addition to microbial adaptation and change, several other factors also contribute to the rise of EIDs. According to Lederberg et al,<sup>1</sup> human demographics and behaviors, such as increased population density or individual behaviors (eg, sexual activities, substance abuse), can lead to the emergence of new infectious diseases. Modern medicine has benefited the human race at the price of millions acquiring nosocomial infections in hospitals. Food-borne illnesses, such as those associated with *Escherichia coli*, are caused by problems in food processing and handling. Economic development and land use can also lead to EIDs.<sup>1</sup> One example is Lyme disease, a bacterium

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Conflicts of interest: None to report.

(*Borrelia burgdorferi*) carried by deer whose population and contact with humans increased with reforestation. The breakdown of basic public health and sanitation can also cause deadly attacks of EIDs (eg, Ebola outbreak in West Africa, cholera outbreak in Haiti).<sup>1</sup> Finally, international travel and commerce spread local EIDs (eg, SARS) across national boundaries.<sup>1</sup>

The history of the 21st century is arguably a history of the rise of social media, computer technologies that allow the collaborative creation and sharing of information. Obar and Wildman<sup>4</sup> define social media as services that are based on Web 2.0 technologies and largely rely on user-generated content, by which individuals and organizations create profiles and develop social networks online. According to a recent report of Pew Research Center, the percentage of U.S. adults using social media increased from 7% to 65% between 2005 and 2015.<sup>5</sup> Globally, an estimated 2.34 billion people were social media users in 2016.<sup>6</sup> Health communication researchers and practitioners have recognized the potential of social media in health education and promotion. A systematic review of literature<sup>7</sup> shows that social media can be effectively used in health promotion in a number of ways, including providing information access, delivering health campaigns, and providing social support. Public health organizations such as the World Health Organization (WHO),<sup>8</sup> the Centers for Disease Control and Prevention (CDC), and local public health departments have started to adopt social media in communicating with the public.

Social media are a potentially useful tool for the effective communication of EID outbreak updates and essential medical information to the public. EIDs represent unfamiliar risks to the public, who often turn to both traditional media and social media for information.<sup>9</sup> How these EIDs are portrayed and communicated in media shapes people's perceptions of risks, which in turn have a significant impact on their decision-making process and risk management behaviors.<sup>10</sup> Social media have been instrumental in informing the public about recent EID outbreaks such as the Ebola outbreak in 2014 and the H1N1 outbreak in 2009.<sup>3</sup> Furthermore, social media users not only share EID-related information that they obtain from other sources (eg, traditional media), but also share their own personal experiences and understanding about EIDs. Because information about EIDs on social media are user-generated, such information is not always accurate or useful. It often contains rumors, misinformation, and conspiracy theories.<sup>11</sup> As a result, the WHO calls for social media to be used more proactively in disseminating health messages to journalists, physicians, and the general public, particularly to counter misinformation about EIDs.<sup>8</sup> To better understand the status of existing research on EID communication on social media, we posed the following research question: What is the current status of research on EID communication on social media?

## METHODS

### Eligibility criteria

This article followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline. Only original peer-reviewed journal articles reporting empirical studies about social media and EIDs were included. Conference papers, book reviews, book chapters, letters to editors and replies, corrections and withdrawals, newspaper and newsletter articles, opinions and comments, and theses or dissertations were excluded. The main inclusion criteria were (1) must be original; (2) must report empirical studies; (3) must be peer-reviewed and published in English-language journals between January 1, 2010 and March 1, 2016; (4) must involve explicit analysis of social media contents about  $\geq 1$  EIDs; and (5) must be focused on user-generated contents that were produced by Web users in natural settings rather than teaching or intervention settings.

### Data sources and search strategy

Five medical and health science, psychology, social sciences, and communication databases were searched: PubMed/MEDLINE, PsycINFO, CINAHL Plus, Sociological Abstracts (ProQuest), and Communication Source (EBSCOhost). Based on an exploratory literature search and World Health Organization's "Disease outbreaks by year,"<sup>12</sup> key words used in the search included terms for health crises ("epidemic" or "pandemic" or "influenza" or "virus" or "infectious disease" or "outbreak" or "Ebola" or "measles" or "Zika" or "Cholera" or "SARS" or "flu" or "H1N1" or "H5N1" or "H7N9" or "dengue" or "fever" or "plague" or "MERS" or "malaria" or "polio") and terms for social media ("social media" or "social networking sites" or "SNS" or "Facebook" or "Twitter" or "YouTube" or "blog" or "chat room"). The initial search yielded 569 items. First, the titles of these articles were checked for duplications by one of the authors (B.B.), and 124 duplicates were removed. Next, the abstracts of the remaining 445 articles were screened by an author (B.B.) according to the criteria previously listed. Articles meeting one of the following criteria were excluded: (1) they were not written in English, (2) they were conceptual without empirical research, (3) they did not focus on EIDs, (4) they were only concerned with the contents of nonsocial media Web sites (eg, news Web sites), or (5) the social networking platforms under study (ie, discussion forums and online groups) were established by the research team specifically for teaching or research purposes. Studies on outbreak surveillance were also excluded from the current review. After screening, 71 articles remained in the sample. These articles could not be categorized as eligible based on the information provided in the abstract. Hence, the full texts of these articles were downloaded and read multiple times to ascertain eligibility. Two of the authors (L.T. and B.B.) discussed these articles to decide whether they should be included in the systematic review. Among these, 26 articles met the inclusion criteria. Reference lists from these articles were also screened, and 4 more articles were identified. In the end, a total of 30 articles were included in this systematic review. The earliest article was published in 2010 and the latest in 2016. [Figure 1](#) shows the article inclusion flow diagram.

## RESULTS

The 30 research articles were categorized by EIDs addressed, social media studied, and research approaches taken. In terms of the EIDs studied, H1N1 (or swine flu,  $n = 15$ ) received the most attention from researchers, followed by Ebola virus ( $n = 10$ ) and H7N9 (or avian flu/bird flu,  $n = 2$ ). A number of other EIDs, including West Nile virus, measles, Middle East respiratory syndrome coronavirus (MERS-CoV), and enterohemorrhagic *Escherichia coli*, only appeared in 1 article. (See [Table 1](#) for information about articles studying each EID.)

In terms of the types of social media studied, Twitter was undoubtedly the most scrutinized social media platform and was studied in 16 articles. YouTube, Facebook, and blogs were each studied in 6 articles. Discussion forums were studied in 3 articles, and Flickr appeared in 2 articles. Finally, Instagram, Web site comments, Weibo (a Chinese microblogging platform), and Delicious were each studied in 1 article. (See [Table 2](#) for information about articles studying each social media application.)

To provide a systematic overview of these studies, we evaluated them in terms of the topic studied, theory used, method used, and major findings. We found that these studies typically take one of the following 3 approaches: (1) assessment of the public's interest in and responses to EIDs, (2) organizations' use of social media in EID communication, and (3) assessment of the accuracy of medical information about EIDs on social media. Only 1 article fell into 2

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