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Abstract

Launched in 2002 in response to inadequate communications during the anthrax attacks and in preparations to the threats posed by H5N1, the Centers for Disease Control and Prevention (CDC)'s Crisis and Emergency Risk Communication (CERC) framework provides health professionals with trainings, tools, and resources to help them communicate effectively during emergencies and public health crises. Since that time, the framework has been used by the organization during outbreaks of infectious diseases. A core argument of CERC is that lack of certainty, efficacy, and trust serve as barriers to compliance with and support in CDC during an outbreak. According to CERC, providing the public with information about health and social risks, as well as information about ways individuals and organizations may ameliorate threats, could counter these perceptions, improve communications, and eventually save lives. However, the dissemination of the organization's crisis messages depends largely on the mass media coverage. Understanding the news media's agenda, priorities and role during outbreaks is essential for improving the cooperation between CDC and journalists. However, CERC provides little information about the actual behavior of journalists during crises, as reflected in news coverage of past outbreaks. This work aims to fill that gap in our understanding of the routinization of news during epidemics and its impact on audiences by systematically analyzing the coverage of epidemics in leading newspapers and using experiments to test its effects.

This study analyzed 5,006 articles from leading American newspapers covering three epidemics: H1N1, Ebola, and Zika. Using a mixed method of automated and manual content analysis, it identified three distinct themes used to cover the diseases; pandemic, scientific, and social. Next, manual content analysis was conducted to assess the prevalence of information components theorized by CERC to increase certainty, efficacy and trust- information about medical/health risks, social/economic disruptions, and potential individual and organizational responses to ameliorate risks and reduce harm. Analysis of the themes based on CERC principles demonstrated substantial discrepancies between what CDC aims to communicate during epidemics and what the media actually disseminated to the public. An experiment (n = 321) found that exposure to articles representing the themes affected perceptions of certainty, efficacy, and trust, that in turn were associated with intentions to comply with CDC. The experiment also demonstrated the ability of coverage that follows CERC principles more closely to reduce harmful perceptions that were associated with behavioral intentions in target audiences. Implications for public health organizations and communicators are discussed, including ways to improve cooperation with journalists and the use of alternative direct-channels for filling gaps in news media coverage.

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SPREADING NEWS:
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EFFECTS ON AUDIENCES - A CRISIS COMMUNICATION APPROACH

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Yotam Ophir

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ABSTRACT

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Yotam Ophir

Joseph N. Cappella

Launched in 2002 in response to inadequate communications during the anthrax attacks and in preparations to the threats posed by H5N1, the Centers for Disease Control and Prevention (CDC)'s Crisis and Emergency Risk Communication (CERC) framework provides health professionals with trainings, tools, and resources to help them communicate effectively during emergencies and public health crises. Since that time, the framework has been used by the organization during outbreaks of infectious diseases. A core argument of CERC is that lack of certainty, efficacy, and trust serve as barriers to compliance with and support in CDC during an outbreak. According to CERC, providing the public with information about health and social risks, as well as information about ways individuals and organizations may ameliorate threats, could counter these perceptions, improve communications, and eventually save lives. However, the dissemination of the organization's crisis messages depends largely on the mass media coverage. Understanding the news media's agenda, priorities and role during outbreaks is essential for improving the cooperation between CDC and journalists. However, CERC provides little information about the actual behavior of journalists during crises, as reflected in news coverage of past outbreaks. This work aims to fill that gap in our

understanding of the routinization of news during epidemics and its impact on audiences by systematically analyzing the coverage of epidemics in leading newspapers and using experiments to test its effects.

This study analyzed 5,006 articles from leading American newspapers covering three epidemics: H1N1, Ebola, and Zika. Using a mixed method of automated and manual content analysis, it identified three distinct themes used to cover the diseases; pandemic, scientific, and social. Next, manual content analysis was conducted to assess the prevalence of information components theorized by CERC to increase certainty, efficacy and trust- information about medical/health risks, social/economic disruptions, and potential individual and organizational responses to ameliorate risks and reduce harm. Analysis of the themes based on CERC principles demonstrated substantial discrepancies between what CDC aims to communicate during epidemics and what the media actually disseminated to the public. An experiment ($n = 321$) found that exposure to articles representing the themes affected perceptions of certainty, efficacy, and trust, that in turn were associated with intentions to comply with CDC. The experiment also demonstrated the ability of coverage that follows CERC principles more closely to reduce harmful perceptions that were associated with behavioral intentions in target audiences. Implications for public health organizations and communicators are discussed, including ways to improve cooperation with journalists and the use of alternative direct-channels for filling gaps in news media coverage.

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Chapter 1 – Communications during public health crises

In 1967, U.S. Surgeon General W. H. Stewart told Congress that it was time “to close the book on infectious diseases” (cited in Bloom & Murray, 1992, p.21). Unfortunately, that assertion quickly proved hubristic and wrong. The AIDS pandemic began in the mid-70s, followed by outbreaks of other diseases (Ungar, 1998), including the Zika Virus that began in Brazil in May 2015, with first cases in the United States being reported on January 2016. On the contrary, scholars have argued that “the world is becoming both increasingly complex and hazardous” (Seeger & Reynolds, 2008, p.4). Infectious diseases, especially those that involve unanticipated outbreaks, can cause severe physical, psychological, economic and social impact. As each outbreak is at least somewhat different than its predecessors (Coombs, 1999), new appearances of infectious diseases are characterized by uncertainty, both among scientists and the public. An essential part of crisis management is the communicating timely and accurate information that improves the understanding of risks and informs decision making (Coombs, 2009). Studying the ways information is disseminated during crises, with a focus on the mediated construction of health issues, is crucial for improving disease prevention, minimizing spread and impact and advancing treatment (Houston, Chao, & Ragan, 2008).

Organizations, practitioners, and researchers have tried to cope with the unexpected and threatening nature of crises by developing communication models and plans for emergency situations (Sellnow & Seeger, 2013). The framework used by the premier national public health organization that is in charge of most communications during a public health crisis in the United States, the Centers for Disease Control and Prevention (CDC), is the Crisis & Emergency Risk Communication framework, known

as CERC (Novak, Barret, & McAllister, 2008; Veil et al., 2008). According to CDC, CERC provides public health communicators with guidelines that are expected to reduce uncertainty, ameliorate risks, increase compliance with suggested behaviors, and induce support for the organization's coping efforts (Reynolds & Seeger, 2005). However, even if the CDC follows its own framework, and even if such guidelines are indeed effective as CERC developers have argued, the implementation of the framework depends to a large degree on the compliance of the mass media. In the words of communication scholar, Timothy W. Coombs, "organizational messages cannot help stakeholders if stakeholders do not encounter the message" (Coombs, 2017, p. 34). Despite the increase in alternative channels, such as social media (Vos & Buckner, 2016), mass communication remains a primary source of information for the public during epidemics (Reynolds & Seeger, 2014). However, despite acknowledging the importance of understanding the ways journalists operate during epidemics, CERC provides very little information regarding journalistic practices that can shed light on their needs and role during such public health crises. Just as CDC had developed CERC to routinize the unexpected, so do journalists use categorizations to process information about unexpected events (Tuchman, 1973). In order to identify the categories used to cover epidemics, this study systematically analyzes the coverage of three outbreaks in four leading media outlets. To limit the scope of this inquiry, I will focus on mass media, and on newspapers specifically. While not an exclusive channel for consuming information about epidemics, leading national newspapers were found to be similar to television news programs (Golan, 2006) and social media (Conway, Kenski, & Wang, 2015) in terms of

the topics being covered due to inter-media agenda setting (Harder, Sevenans, & Van Aelst, 2017).

The work reported here was carried out in four steps. First, a corpus of about 5,000 news articles was obtained, consisting of all¹ the news articles about epidemics that were published in four major American newspapers during three epidemics crises; the Swine flu outbreak of 2009, the Ebola outbreak of 2014, and the Zika outbreak of 2015. The thematic structure and composition of the corpus was analyzed using a structural topic model (Roberts et al., 2014), and a community detection technique for network analysis. This step revealed the existence of three separate themes in the news coverage. Second, manual content analysis was conducted examining the prevalence of information components recommended in CERC in articles that are prototypical of each theme. Third, the validity of the content analysis was established through a crowdsourcing mTurk survey that examined both how naïve audiences interpreted articles prototypical of each theme (representational validity) and whether exposure to articles with different themes yielded differences in related perceptions (construct validity). Fourth, an experiment was conducted to establish the causal consequences of exposure to articles representing the themes identified in content analysis, as well as articles consisting of all the information components recommended in CERC.

Using a mixed methodological approach allowed to examine the discrepancies between what was theorized and suggested in CERC (based on theories of crisis and risk communication) to be used by CDC throughout crises, and what was disseminated to the public through mass media channels during real outbreaks. By doing so, this work fills an

¹ That includes all the articles that are available through LexisNexis.

gap in CERC by adding an important layer to the model of communications during crises described in CERC, namely the use of journalistic routines during epidemic outbreaks and its potential effects on the public.

Epidemics as Public Health Crises

There is some dispute over the definitions of pandemics and epidemics (Youngerman, 2008). CDC defines epidemics as a sudden increase in the number of cases of a disease, above what is normally expected in a given population and an area.² According to CDC, pandemics are epidemics that spread over several countries or continents, usually affecting a large number of people. According to the WHO, a pandemic is “the worldwide spread of a new disease” (WHO, 2010)³. Doherty asserted that in practice the use of the term pandemic is often closer to the one suggested by the WHO, with a focus on spread, and not the number of infections and causalities (Doherty, 2012). WebMD describes the difference between epidemics and pandemics in terms of global reach and novelty, in the sense that pandemics are global outbreaks of diseases to which humans have little or no immunity.⁴ For example, although the associated risks such as microcephaly were newly identified, WHO avoided calling Zika a pandemic since the disease itself was not new. Nevertheless, many scientists and journalists did use the term pandemic to describe the Zika outbreak (Fauci & Morens, 2016). Since the focus of the current study is on outbreaks inside the U.S of three diseases that already occurred in the past, I will use the term epidemic to describe them from now on.

² <http://www.cdc.gov/ophss/csels/dsepd/ss1978/lesson1/section11.html>

³ http://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/en/

⁴ <http://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks#1>

Like other public health crises, epidemics are increasingly important forces that have the potential to do great physical, psychological and social harm, and result in complex, nonlinear and unanticipated interactions between systems (Seeger & Reynolds, 2008). Accurate, credible, timely, and reassuring communications by the medical and public health community have become an essential part of crisis management (Mackey, 2015).

Crisis communications include information about risks and ways to ameliorate them. Risk information may include warnings, risk assessments, notifications, and information about symptoms and medical treatments (Seeger & Reynolds, 2008). In addition to health-related information, risk information can include a discussion of social consequences of epidemics. For example, in addition to the assessment of susceptibility and health effects, risk information can include a discussion of the effects of an outbreak on the economy, politics, culture, and other forms of social disruption (Gubler, 2002). When communicating about ways to ameliorate these risks, crisis communication can focus on steps taken and resources allocated by officials and organizations (Coombs, 2009). However, crisis communication should also deliver practical information about what can be done by the public or by individuals to alleviate or avoid threats (Dahlstrom, Dudo, & Brossard, 2012; Sellnow & Seeger, 2013). Such information can increase self-efficacy (Bandura, 1990; Rosenstock, 1974), that in turn can influence behavioral intentions (Holden, 1992). To summarize, crisis communication during epidemics combines information about health and social risks, and ways organizations and the public can ameliorate them.

Communication in the rapidly changing information environments of epidemics is challenging (Coombs, 1999). Crisis communication needs to be fast, yet accurate and honest, and in many cases, the organization has to admit to the public that the risks are not completely known, and that no treatment for infected people is yet available (Hearit, 2008). For example, the CDC had to communicate about Zika at times in which a vaccine was still under development (Cohen, 2016) and required further tests before being distributed to the public (Dyer, 2016). As new viruses develop different and sometimes unique behavior patterns, crisis communicators often cannot provide practical advice based on complete and certain knowledge.

CDC's Crisis and Emergency Risk Communication Framework (CERC)

Public health organizations have developed strategies and frameworks that attempt to organize the otherwise chaotic nature of crises into relatively expected and manageable categories and timelines (Sellnow & Seeger, 2013). Following the 2001 Anthrax attacks, and the resulting scare among postal workers and the public at large (Quinn, Thomas, & McAllister, 2008), the CDC developed its own framework for crisis communication, the Crisis and Emergency Risk Communication (CERC) approach (Hewitt, Spencer, Ramloll, & Trotta, 2008; Reynolds & Seeger, 2005; Veil, Reynolds, Sellnow, & Seeger, 2008). Since its development in 2001, CERC has been used by CDC to guide communications during the Swine flu, Ebola, West-Nile, and Zika epidemics, among others (e.g., Reynolds & Seeger, 2005). CERC is an integrated model, consisting of elements from risk communication theories with their focus on persuading individuals to take action to limit risks, crisis communication theories about responding to an immediate and specific public need for information (Veil, Reynolds, Sellnow, & Seeger,

2008), and theories of health behavior, decision making, and health communication (Veil et al., 2008).

According to CERC, the goals of CDC's communications during crises are improving the public's understanding of risks and possibility of adverse events, reducing uncertainty, and inducing self-efficacy and reassurance and trust in the organization, in order to secure compliance and support from the public (Seeger et al., 2009). CERC asserts that these goals can be achieved by communicating information the public needs to make sense of the crisis (Weick, 1988). According to CERC, different phases in the development of a crisis require different types of information to be delivered to the public (Reynolds & Seeger, 2014). This study focuses on stages that take place during the epidemic's outbreak (initial and maintenance phases) and not on the pre-crisis, resolution, and evaluation stages that focus more on internal procedures and preparations for potential crises. It also focuses on information types and not on message characteristics (e.g., CERC recommends communicating with empathy, and establishing credibility, but these recommendations do not reflect information types to be delivered to the public, but rather a characterization of a message or a method of delivery, See Reynolds & Seeger, 2014, p. 50). According to the CERC lifecycle model, during an outbreak, CDC needs to provide the public with information about risks and responses. Risk information aims to establish understanding of the crisis circumstances, consequences, and anticipated outcomes (Reynolds & Seeger, 2014), and include health/medical risks (Reynolds, 2007), as well as social and economic disruptions (Reynolds & Seeger, 2014). Response information focuses on specific actions by health organizations and the public that can mitigate threats (Lundgren & McMakin, 2013). These include suggesting actions that can

be taken by individuals to reduce the likelihood of harm, as well as information about the activities taken by health organizations to ameliorate risks (Reynolds & Seeger, 2014). In sum, CERC suggests providing the public information about health and social risks, and about adequate individual and organizational responses (Lundgren & McMakin, 2013; Reynolds, 2016).

The main focus of CERC is the CDC's preparation to and communication during crises. However, its authors acknowledge that the success of CDC's communications during crises depends on its ability to reach its target audiences. Despite the agency's increasing use of direct communication channels, such as social media (Glowacki, Lazard, Wilcox, Mackert, & Bernhardt, 2016), pamphlets, and Public Service Announcements (Lundgren & McMakin, 2013), it still relies heavily on the mainstream mass media for disseminating its messages (Reynolds & Seeger, 2005). According to CERC, "the media are primary transmitters of risk information. They play a critical role in setting agendas and in determining outcomes" (Reynolds & Seeger, 2014, p. 36). However, our understanding of the news media's role and practices during epidemics is limited.

Mass Media in Crises

Modern life is increasingly mediated (Weimann, 1999). Citizens in large societies depend on the mass media (Zaller, 1992), especially when learning about topics such as science (Hmielowski, Feldman, Myers, Leiserowitz, & Maibach, 2014) and health (Southwell, 2013), that are "out of reach, out of sight, out of mind" (Lippmann, 1946. p.21). When trying to acquire information related to prevention of diseases, people often seek health information from non-medical sources, such as the mass media (N. Lewis et

al., 2012; Ramírez et al., 2013). In that sense, even if CDC communicators strictly follow the organization's crisis communication plan, the public may not be exposed to its message sufficiently for it to be effective (Hornik, 2002). Moreover, the information may reach audiences after being processed and changed by the media in the journey (Covello, 2003; Ulmer et al., 2008; Veil & Ojeda, 2010). For example, studies have shown that since information during crises is often scarce, the media may access a large number of sources, regardless of whether they were official spokespersons for public health organizations or not (Novak et al., 2008). Such tendencies and practices suggest that the actual coverage of epidemics in the media may not reflect the amount or types of communications recommended in CERC.

The prominence of coverage depends in large part on events' newsworthiness (Galtung & Ruge, 1965). Due to space (newspapers) and time (radio, digital media) limitations, the construction of news involves a process of selection, where some issues, events, and sources are likely to get more attention from the media than others, as they better fit journalists' needs (Althaus & Tewksbury, 2002; Gans, 1979). The current study examined leading newspapers as proxies for the information people consume. Despite the dramatic increase in sources, mainstream outlets remain the primary source of news information for most audiences (Mitchell, Gottfried, Barthel, & Shearer, 2016) and traditional news media still have a significant effect on the public's agenda (Djerf-Pierre & Shehata, 2017; Shehata & Strömbäck, 2013). Moreover, even in the age of multiple sources and selective exposure, inter-media agenda setting studies point to high similarity between what the leading printed newspapers report, and what is salient in other channels (Golan, 2006) and in user-generated outlets, such as Twitter (Conway et al., 2015). A

recent analysis supported this notion, finding agenda-setting function of newspapers on Twitter activity, as well as similarities in coverage between newspapers and digital media (Harder et al., 2017). Moreover, in the corpus used in this study, many of the articles that were published in the printed version of a newspaper (e.g., the New York Times) were later published in the newspaper's online version (i.e., www.nytimes.com), thus increasing the reach of the articles beyond readers of the printed version, a finding congruent with previous research (Hindman, 2008, p. 78).

Moeller argued that in order to become newsworthy, diseases need to pass the “Ebola standard” for sensationalism, prominence, novelty, controversy, emotional appeal, significance and proximity (Moeller, 1999). Epidemics tend to fit the newsworthiness criteria because they are mysterious, dramatic, spread rapidly, cause a high number of fatalities, and have the potential to create economic and political catastrophes (A. Y. L. Lee, 2008). Once they've become accepted as newsworthy, epidemics, like other disasters, are likely to be processed through journalistic routines (Scanlon & Alldred, 1982).

Although crisis (Ulmer et al., 2008) and risk (Calman, Bennett, & Corns, 1999; Greenberg, Sachsman, Sandman, & Salomone, 1989; Pidgeon & Henwood, 2010) communication scholars acknowledge the importance of meeting the needs of the media, their understanding of the needs and role of journalists during crises is limited. As a result, some of the most cited material in the field of crisis communication provides communicators with bland and vague advice such as “be accessible”, “tell the truth”, and “provide background information” (Covello, 2003). While these communication

guidelines and principles may be important for maintaining a healthy relationship between the crisis-managing organizations and the media (Veil & Ojeda, 2010), they are too broad and general, and do not systematically consider how the media works while covering a developing event, and especially during a crisis. Importantly, research in this area rarely tested for the effects of systematic news coverage patterns on the public. In part, this lack of systematic knowledge and theory in regard to crisis communication may result from crises' inherently chaotic and unexpected nature (Sellnow & Seeger, 2013). Nevertheless, even during a crisis, and despite its complexity and uncertainty, social actors, journalists included, "look for patterns that underlie appearances, actions, and events" (Hearit, 2008). In the words of CERC, organizations "rely on established routines for situations that are, by definition, not routine" (Reynolds & Seeger, 2014, p. 14).

Just like CDC is relying on routines aimed to organize the unexpected nature of disasters and crises, journalists too rely heavily on highly regulated routines (Golding & Elliott, 1979), that "guide people through procedures they need to carry out without forcing them to think too deeply about them" (Turow, 1992, p. 156). This phenomenon is even more profound during developing and inherently unexpected events (Tuchman, 1973). In her seminal work on the routinization of the unexpected, Tuchman asserted that although developing news is hard to predict, "there are, nonetheless, limitations on the facts it can possibly contain" (p.55). In order to limit the variability of journalistic material, they use categories that guide them to familiar practices of coverage. The use of categories and typifications allow journalists to work efficiently under time constraints and unexpected developments. Therefore, media coverage of epidemics is expected to be guided by coverage patterns. Due to the nature of their work, journalists, and especially

those working within the space constrains of print media, change the amount of coverage given to an event as it develops. For example, studies have shown that the media cover epidemics using issue-attention cycles (Downs, 1996; Oh et al., 2012). In the case of epidemics, the media tends to dedicate more time and space to new epidemics, and to gradually lose interest in them as the public loses interest (Coombs, 2008). Other studies have looked into the thematic patterns of epidemics coverage.

The media do more than to tell people that an epidemic is important enough to be on the agenda (McCombs & Shaw, 1972). In the words of Zaller (1992), “the information that reaches the public is never a full record of important events and developments in the world. It is, rather, a highly selective and stereotyped view of what has taken place. It could hardly be otherwise” (Zaller, 1992, p. 7). The emphasis on some aspects of an event at the expense of others is an “unavoidable reality of the public communication process” (Nisbet, 2010, p.44). By emphasizing different aspects and providing various perspectives regarding an outbreak, the media construct epidemics in various ways that may lead to different effects on public perceptions and behaviors (Fischer, 1998; Singer & Endreny, 1993). Studies of the media’s construction of infectious diseases include the American media’s portrayal of AIDS/HIV as a homosexual-only problem in the eighties (Clarke, 1992) and Hong Kong’s newspapers construction of SARS as a state secret of Chinese provincial officials (Powers & Gong, 2008). However, these studies tended to focus on idiosyncratic case studies, that while important, limit our systematic understanding of the common practices used to depict epidemics in the news (Baden & Lecheler, 2012; Heath, Li, Bowen, & Lee, 2008). These research efforts, as opposed to more generic approaches that categorize coverage across contexts (e.g., Iyengar, 1994)

fall short of providing a framework that would be applicable to different epidemics in different contexts. Like frames, social constructions are “of greatest interest to the extent they add up to something bigger than an individual story” (Reese, 2001, p. 13) (p. 13). Moreover, the lack of a systematic approach for the analysis of coverage may lead scholars to find the coverage they were consciously or unconsciously looking for (Tankard, 2001, p. 98). A systematic model for identifying thematic coverage across diseases will therefore contribute to our understanding of the media’s behavior during health crises, their reliance on routines, and its implications for crisis management efforts (Reese & Buckalew, 1995).

The Social Construction of Crises and Epidemics

The notion that social construction is important for the understanding of epidemics is well established (Powers & Xiao, 2008). The way people communicate about crises such as epidemics largely determines how they are likely to understand and behave toward them. As with other social phenomena, the reality of crises is constructed, through particular socially shared understanding, thinking and acting (P. L. Berger & Luckmann, 1966; Powers, 2008). A case on point is the social construction of HIV and AIDS, a topic ignored at first by the mass media and large portions of the public; in those early days, it was constructed as threat to marginal groups only and was not as a disease everyone can get (Ungar, 1998). This restricted framing (Herek, Capitano, & Widaman, 2003) resulted in a neglect of educational efforts about other transmission paths, for example by injection drugs (Sibthorpe, 1992). The construction of epidemics may differ from place to place. For example, SARS was constructed as a governmental failure in Hong Kong (Powers & Gong, 2008), but as a “killer” in Britain (Wallis & Nerlich, 2005).

While the Hong Kong construction puts the blame on human agents, the British one may portray the disease as a deadly and an uncontrollable natural force.

Due to their reliance on routines (Tuchman, 1973), journalists tend to use similar coverage patterns when covering new events and occurrences. As argued by Gamson and Modigliani, the formation of coverage patterns can be explained by journalistic norms and practices (Gamson & Modigliani, 1989). This allows scholars to identify recurring patterns in coverage while examining types of coverage that are more or less prevalent in coverage. Two main approaches were taken for analyzing media portrayals of crises and epidemics, the general approach and the specific approach. As mentioned before, general portrayals are those that are not unique to specific crises and diseases and have been applied in the past in other contexts. Noticeably, several studies have used the classic episodic and thematic frames (Iyengar, 1994) and applied them to infectious diseases (e.g., S. T. Lee, 2014). Similarly, An and Gower's (2009) analysis of crises adopted the typology of human interest, conflict, morality, economy, and responsibility (Semetko & Valkenburg, 2000). Scholars working with disease-specific frames, on the other hand, developed theoretically-driven categories to account for the unique characteristics of crises. For example, Shih and colleagues (2008) suggested the typology of consequence, uncertainty, action, reassurance, conflict, and new evidence (Shih, Wijaya, & Brossard, 2008). Their framework was used in several crisis studies (Birnbrauer, Frohlich, & Treise, 2015; Liu & Pennington-Gray, 2015). Other examples of crises-oriented typologies include the themes of scientific dishonesty, scientific explanation, criminal activity, and political advocacy (Bowe, Oshita, Terracina-Hartman, & Chao, 2014) and a suggestion to interpret the different stages of crises (pre-crisis, crisis, and post-crisis) as

frames (Harris, 2016). Some scholars were even more specific, looking into the unique coverage of specific diseases, without relying on more general categories, as is the case with the aforementioned construction of SARS as a state secret of Chinese provincial officials (Powers & Xiao, 2008) or the stigma-inducing construction of HIV as a problem limited to gays, lesbians, and drug users (Herek et al., 2003).

This chapter introduced the centrality and importance of media coverage during epidemic outbreaks. It discussed the social construction of epidemics in the media, and approaches taken by scholars to analyze coverage patterns. Subsequent chapters will examine the social construction of three epidemics in recent years. However, in order to better understand their context and characteristics, the next chapter will briefly introduce each of the diseases, with a focus on its symptoms, health consequences, possible treatments, and the timeline of each outbreak analyzed.

Chapter 2 - Case Studies

In order to provide background to the content analysis that follows, this chapter will briefly introduce the three epidemics used in this work as case studies. The use of three diseases rather than a single one broadens the scope of analysis beyond the specifics of a given case allowing the examination of patterns of coverage across instances. The three disease outbreaks examined in this study occurred between 2009 and 2017. The focus is on the coverage only within the United States. Every aspect of the diseases cannot be discussed. Rather, the aim is to provide readers with essential information that will allow them to understand and interpret the content of the news articles in the context of the specific diseases, including dates and events, key personnel and locations, essential jargon and terms, and basic biological information.

Case Study 1: Swine Flu (H1N1) Virus and the 2009-2010 outbreak

Swine influenza is a respiratory disease of pigs, caused by type A influenza viruses⁵ that normally do not infect humans. The variant that did infect people in 2009 was referred to as H1N1 (Vigsö, 2010), also responsible for the infamous Spanish flu of 1918 (Stephenson, 2009). The 2009 outbreak occurred at a time when CDC was preparing to fight a pandemic of H5N1, known as the avian flu⁶. It was first detected in the United States in April 2009 as a unique combination of influenza virus genes never encountered before in animals or people. The first case was detected in April 2009 in a 10 year old patient in California , who was tested as part of a clinical study. Two days later a second case was confirmed in California, with no known connection between the cases

⁵ <http://www.cdc.gov/flu/swineflu/influenza-in-swine.htm>

⁶ <http://www.cdc.gov/h1n1flu/cdcresponse.htm>

(CDC, 2009). Testing showed the virus was resistant to the two antiviral drugs Amantadine and Rimantadine, but susceptible to the antiviral drugs Oseltamivir and Zanamivir (Itoh et al., 2009).

In April 21st 2009, CDC had begun developing a H1N1 vaccine. CDC activated its Emergency Operations Center (EOC) on April 22nd 2009. Two days later, on April 23rd 2009, two additional cases of human infections were reported in Texas. Soon after, cases were reported in Mexico and Canada (Michaelis, Doerr, & Cinatl, 2009). On April 24th 2009 CDC uploaded complete gene sequences of the 2009 H1N1 virus to a publicly accessible international influenza database. On April 25th 2009, the Director-General of WHO declared the outbreak as a Public Health emergency of International Concern, PHEIC (R. Katz, 2009). At the same day, New York began investigating a cluster of cases in a school, and cases were reported in Ohio. Within days, WHO raised its pandemic alert level from phase 2 to phase 5, signaling an imminent pandemic that requires an immediate response.

As the outbreak spread, CDC began receiving reports of school closures and implementation of community-level social distancing measures, actions taken by public health officials to slow down the spread of highly contagious diseases (Coburn, Wagner, & Blower, 2009). On June 11th 2009, WHO raised the worldwide pandemic alert level to phase 6 (Seale et al., 2009). At the same time, CDC conducted a press conference with an audience of 2,355 participants⁷. The virus continued to spread and the number of affected countries almost doubled between June and July 2009. By June 19th 2009, all U.S states, the District of Columbia, Puerto Rico, and the U.S Virgin Islands had reported cases of

⁷ <http://www.cdc.gov/h1n1flu/press/>

2009 H1N1. The level of influenza activity remained above normal during the summer, and by the end of August 2009, H1N1 activity began to increase again in the U.S.⁸.

In an influenza preparedness summit on July 9th 2009, the Federal government announced the availability of \$350 million in supplemental funding for H1N1 response⁹. In October, the U.S Government responded to the epidemic with the launch of the national influenza 2009 H1N1 vaccination campaign. On July 22nd 2009, the National Institutes of Health (NIH) announced the start of a series of clinical trials for two potential vaccines (Girard, Tam, Assossou, & Kieny, 2010). Recommendations from the Advisory Committee for Immunization Practices (ACIP) included the definition of certain groups of people that needed to receive the initially limited supplies based on risk factors, including pregnant women, people who live with infants younger than six months of age, health care personnel and more (Jordan & Hayward, 2009). The vaccines were approved by the Food and Drug Administration (FDA) on September 15th 2009, and the vaccines' availability increased throughout November and December 2009. The epidemic was officially declared over by WHO's Director-General Margaret Chan on August 10th 2010¹⁰. CDC estimates that the epidemic resulted in approximately 60.8 million cases, 274,304 hospitalizations, and 12,469 deaths in the United States alone (Shrestha et al., 2011).

Case Study 2: Ebola Virus and the 2014-2015 outbreak

Ebola, named after a river in the Democratic Republic of Congo, is a filovirus, the prototype pathogen of viral hemorrhagic fever, a severe disease that is associated with

⁸ <http://www.cdc.gov/flu/swineflu/influenza-in-swine.htm>

⁹ <http://www2.ed.gov/news/pressreleases/2009/07/07092009b.html>

¹⁰ <http://www.medpagetoday.com/InfectiousDisease/SwineFlu/21603>

high case-fatality rate (Feldmann & Geisbert, 2011). The first recorded outbreak of Ebola was in 1976, but some of the virus's properties, as well as its hosting reservoir (its long term host) remain unknown today (Leroy et al., 2005). The disease remains largely a scientific mystery, partly because of its transitory nature. After the 1976 outbreak and two episodes in Zaire and Sudan in the late 1970s, it disappeared from Africa for about 15 years. Several individual infections have occurred in research labs during these years (Jahrling, Geisbert, Swearingen, Larsen, & Geisbert, 2007), raising worries around lab safety protocols. Several individual cases have also occurred, but no outbreak was reported. To this day, five recognized species of the disease have been identified (Quammen, 2014).

Ebola is usually transmitted to humans through a direct contact with infected people, animals, or cadavers. The virus seems to enter the host through mucosal surfaces, and breaks and abrasions in the skin (Feldmann & Geisbert, 2011). Therefore, healthcare providers caring for Ebola patients, as well as their families and friends are at the highest risk¹¹. In humans, it targets the lymphoid tissues, liver, and the adrenal gland, which may result in impaired blood pressure control. Despite the disease's name, not all patients show symptoms of bleeding (Quammen, 2014). The disease may lead to defects in blood coagulation, but the massive loss of blood, often associated with the disease and dramatized in popular fiction, most famously "The hot zone" (Preston, 1995), is infrequent (Feldmann & Geisbert, 2011). Infected people often show symptoms that include fever, headaches, muscle pain, weakness, diarrhea, vomiting, and abdominal pain¹².

¹¹ <https://www.cdc.gov/vhf/ebola/exposure/index.html>

¹² <https://www.cdc.gov/vhf/ebola/symptoms/index.html>

The outbreak of 2014 began on March 23rd, when the WHO was notified of an outbreak in Guinea (WHO Ebola response team, 2014). On August 8th 2014, the WHO declared the Ebola virus disease outbreak in West Africa a public health emergency of international concern. This outbreak was more severe than previous cases of Ebola virus (Baize et al., 2014; Quammen, 2014). Half a year after the initial reports, in September, more than 4,500 cases had been reported in five countries in West Africa, along with an estimation of about 2,300 deaths (WHO Ebola response team, 2014). Guinea was the first country to be affected, followed by Liberia and Sierra Leone, and then the virus made its way by airplane to Lagos, Nigeria. Liberia was especially hard hit. The disease led to political unrest in many West African countries. Sierra Leone used army soldiers to isolate treatment centers. In Guinea, riots broke out. On September 2nd, Dr. Thomas R. Frieden, director of the CDC told CNN that the outbreak was “spiraling out of control”. Soon afterwards, the United Nations secretary-General Ban Ki-moon called for a “massive surge in assistance” from the global community (Quammen, 2014). The final estimations made by CDC on April 2016 were that more than 28,000 people have been infected with Ebola in this outbreak, leading to more than 11,000 deaths¹³.

Only several cases of Ebola were reported in the United States. On September 30th 2014, CDC confirmed that a first case was diagnosed within the United States, in Thomas Eric Duncan, a man who had traveled to Dallas, Texas, from Liberia¹⁴. Duncan soon died, but two nurses who took care of him while in Texas, Nina Pham (diagnosed on October 10th 2014) and Amber Vinson (October 14th 2014), were diagnosed with infections (Drazen et al., 2014). The quarantine policies in regard to healthcare providers

¹³ <https://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html>

¹⁴ <http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/united-states-imported-case.html>

who treat Ebola patients led to criticism (Menzel, 2015), and Pham later sued the owners of the hospital in which she was treated, Texas Health Resources, arguing the staff was not well trained for treating Ebola patients, also arguing that private information about her condition was released to the public¹⁵. On October 23rd 2014, the New York City Department of Health and Mental Hygiene reported a case of Ebola in a medical aid worker, Craig Spencer, who served in the “Doctors Without Borders” organization in Guinea and returned to New York City. The case was confirmed by CDC on October 24th 2014. He was hospitalized in Bellevue Hospital Center, recovered, and finally discharged on November 11th 2014. At various points during the outbreak, American politicians suggested imposing a travel ban or a visa ban to prevent people from infected countries to enter the States, but the suggestion was criticized as ineffective, controversial, and even harmful and never saw the light of day (Bogoch et al., 2015).

Case Study 3: Zika Virus and the 2015-2016 outbreak

Zika virus is a Flavivirus, sharing the general shape and working methods of Yellow fever, West Nile, Japanese Encephalitis, and Dengue (McNeil, 2016; Tang et al., 2016). Although Zika had become familiar to the public during the Americas’ epidemic of 2015-2016, the virus was first discovered in 1947 in the forests of Uganda (Gatherer & Kohl, 2016), and was brought into the United States by scientists before the current crises began (Foy et al., 2011). Prior outbreaks of the virus (e.g., in Nigeria in 1952 or in Yap Island in Micronesia in 2007) and even the existence of cases in the United States did not attract much public nor scientific attention, as the symptoms seemed to be only mild (e.g., rash and fever) and temporary (Driggers et al., 2016; M. J. Hennessey et al., 2016).

¹⁵ <http://www.dallasnews.com/news/news/2016/10/17/ebola-nurse-nina-pham-lawsuit-texas-health-resources>

Moreover, Zika was often not diagnosed at all due to lack of apparent symptoms in many cases and resemblance to other diseases like Dengue (McNeil, 2016).

The recent outbreak was different. It included a threat that was not expected by scientists: the increase in Zika infections in Brazil was followed by a whopping increase in the number of newborns diagnosed with microcephaly (Rasmussen, Jamieson, Honein, & Petersen, 2016). Microcephaly is a rare neurological condition in which infants' brains are of abnormally small size, and in some cases even absent essential brain areas such as the cerebral gyri (Rubin, Greene, & Baden, 2016). At first, cases were diagnosed only in newborns to mothers who were infected with the virus at the first trimester of their pregnancies (Garcez et al., 2016), but later cases confirmed that the virus can damage fetuses at every point in time during the pregnancy (França et al., 2016). In addition to the threat to newborns, Zika can harm people of all ages, though rarely, through its correlation with the Guillain Barré syndrome, a post infectious immune disease that may lead to mortality in about 8% of cases and permanent disability in about 20% of cases (Winer, 2001). An association between the infection and the syndrome was first reported in French Polynesia in the Zika outbreak of 2013-2014 (Cao-Lormeau et al., 2016).

In December 2015, Brazil declared a state of emergency over the Zika outbreak, and the story was soon reported in the US media (McNeil, 2016). Soon after, in an exceptional decision, physicians began recommending that women delay or avoid pregnancies, and use contraceptive to avoid infections. These recommendations resulted in a controversy due to restrictive local laws in regard to abortions and negative attitudes toward contraception in many of the affected countries (Aiken et al., 2016). After several cases of American travelers who got infected abroad, a first case of locally-acquired

infection in Puerto Rico was reported by the CDC on December 31st 2015 (M. Hennessey, Fischer, & Staples, 2016). The WHO declared a public health emergency on February 1st 2016 (Cauchemez et al., 2016).

The main path of transmission for Zika is through vectors, insects who carry the disease. Specifically, Zika is carried by *Aedes aegypti*, known as the Yellow fever mosquito that exists in 30 U.S states. Scientists also suspect that ZIKV can be transmitted by *Aedes albopictus*, the Asian tiger mosquito that can be found in almost any U.S state (Broutet et al., 2016; McNeil, 2016). As the mobility of mosquitoes is relatively limited, initial assessments indicated that risk to North Americans would mostly be the result of travel to Zika-infected areas. Therefore, in January 2016 the CDC published an “interim travel guidelines” with a special focus on pregnant women or women planning a pregnancy . This recommendation was subsequently updated to include countries in South and Central America, Asia, the Caribbean, and the Pacific Islands (Petersen et al., 2016). Travel advisories received heightened media attention in the US media, in part because they affected preparations of both athletes and spectators who planned to attend the 2016 Summer Olympics in Rio and even led to some calling for their cancellation or delay (Massad, Coutinho, & Wilder-Smith, 2016).

In yet another turn of events, cases of non-vector-borne transmissions were found in the United States. The first case of transmission through sexual contact with a person who had acquired the infection while traveling abroad was reported in Texas in February 2016 (McCarthy, 2016). This surprising finding meant that people were now at risk, whether or not they physically visited an infected area, and thus prevention measurements needed to consider sexual transmission. As pregnant women were now

susceptible due to their sexual partners' travels to Zika-infected areas, more athletes and fans announced that they would not participate in the Olympic Games. Thus, at the very beginning of 2016, the Zika virus has already developed into a crisis with direct health and social effects on the United States and Americans.

This chapter introduced the three epidemic outbreaks analyzed in this work. It demonstrated some similarities and some differences between them in terms of the symptoms, health consequences, vulnerable populations, and possible treatments. The next chapter describes various approaches taken by researchers to analyze epidemics in the past, and explains the reasons behind the choice to analyze the coverage of the three diseases using an automated approach employed on a combined corpus of all diseases.

Chapter 3 – News Coverage of Epidemic Outbreaks: An Automated Content Analysis

Identifying and Measuring Thematic Content

The current study analyzes the content of news coverage on two levels, topics and clusters of topics that will be referred to as themes. A topic is a “subject matter” that occurs with some degree of frequency throughout and across a corpus (Jockers, 2013). Identifying topics across a large set of documents may be taxing and challenging. One common approach for categorizing complex and evolving linguistic data is the use of co-occurrence of words, i.e., identifying clusters of words that tend to occur together in the same documents, and those that tend not to be present in the same documents (David, Atun, Fille, & Monterola, 2011; Matthes & Kohring, 2008). The underlying assumption of this method is that words that tend to appear together in a document also share thematic substance (Sinclair & Sinclair, 2004). Manually identifying co-occurrences in complex and vast information environments can be a very demanding task, requiring very substantial resources, both in terms of time and money, and is virtually impossible in very large corpora (Jockers, 2014). Moreover, topics may only be apparent over time (S. C. Lewis, Zamith, & Hermida, 2013). Unfortunately, human coders, who are well suited for identifying textual features within a small body of texts, may not be able to discern linguistic patterns that manifest over time and across articles (Grimmer & Stewart, 2013). In recent years, attempts have been made to use computational approaches to content analysis in order to cope with the vast amount of data available today, including online archives of news materials (Miller & Riechert, 2001; Tankard, 2001). However, studies using automated tools for crisis communication analysis tend to focus on single case

studies, often while sampling only a few articles from a larger available corpus (Bantimaroudis & Ban, 2001; van der Meer, 2016).

The first goal of this study is to systematically ascertain the topics prominent in the American news coverage of the three prominent epidemics occurring at the outset of the 21st century discussed in the previous chapter. Using an automated tool (structural topic modeling) to uncover patterns of co-occurrence across the corpus, I first examined the existence and relative prevalence of topics. As I treated the three separate corpora (one for each disease) as a single corpus, some of the topics may represent co-occurrence patterns that are unique to a single disease. However, other topics may be common to several diseases:

RQ1. What topics were prominent in the American newspapers coverage of the epidemics?

As explained before, this study aims to understand the coverage of outbreaks beyond the scope and idiosyncrasies of single diseases. It is expected, for example, that the 2016 Olympic games in Rio will be a prominent topic in the coverage of Zika, as leading athletes withdrew from the tournaments due to fears of Zika, while some called for the cancellation of the whole event (Massad et al., 2016). However, the occurrence of the Olympic Games during the Zika outbreak was coincidental, and previous and future outbreaks of Zika or other diseases will most likely not occur during the Olympic Games. Nevertheless, the influence of the Zika outbreak in the Rio Olympics may be broadly

seen as an impact of a crisis on the well-being of societies through its effects on cultural events. As elaborated in the next section, this study goes one step forward and uses a clustering technique, community detection in network graphs (Meo, Ferrara, Fiumara, & Provetti, 2011), to identify broader themes of coverage:

RQ2a. What themes were prominent in the American newspapers coverage of the epidemics?

RQ2b. What were the similarities and differences in the use of themes between different epidemics?

RQ2c. How did the prominence of themes in American newspapers change throughout the timeline of each epidemic?

Method

Corpus and data gathering

A total of 5,006 news articles were collected using Lexis Nexis (the New York Times, the Washington Post, and U.S.A Today) and Factivia (Wall Street Journal). The journals were selected based on their centrality in the American news environment as leading prestige newspapers that can serve as a proxy for the general news environment (Jamieson & Campbell, 2000). First, three corpora were built, one per disease, with the search terms “swine flu” or “H1N1”, “Ebola”, and “Zika”. All articles that included these terms were added to the initial corpus, even if the disease was not the focal point of the

articles and was only mentioned in passing. Only news articles that appeared in the printed version of the newspaper were used, omitting blogs and online-only articles. Duplications were deleted. Finally, the researcher personally read all articles in the corpus and removed the few articles that in very rare occasions included the words but did not cover the diseases. That rare case happened only with Zika, as it sometimes was mentioned as a surname for a person discussed in an article. The H1N1 corpus consisted of 1798 articles, spanning between 01/09/09 and 09/08/10, a month after WHO declared the epidemic was over. The Ebola corpus consisted of 2113 articles between 03/20/14 and 07/16/15, a month after WHO declared Liberia to be Ebola free, following other West African countries. The Zika corpus consisted of 1095 articles, between 12/29/15 and 12/07/16, a month after the WHO declared that Zika is no longer a global threat, though the epidemic is not yet over by the time of writing. During major crises, most people are expected to get their news from the national media (Reynolds & Seeger, 2014). The outlets analyzed in this study were chosen to include top newspapers with high distribution and a relatively diverse political agenda between them. Three newspapers are elite newspapers (The New York Times, The Washington Post, and The Wall Street Journal), and one is a popular tabloid (USA Today). After preprocessing (removing punctuation, numbers, stop-words, replacing non-English characters with English ones (for example, replacing á with a)¹⁶, and using a sparsity level of 0.99 to remove uncommon words¹⁷), the final vocabulary consisted of 4,538 unique words (tokens).

¹⁶ For the full list of non-English characters replaced in this study, see: <http://reference.wolfram.com/language/tutorial/NonEnglishCharactersAndKeyboards.html>

¹⁷ Sparsity is used to reduce the number of words in the final vocabulary used for the model by removing words that appear unfrequently. Sparsity refers to the threshold of relative document frequency for a term,

Structural Topic Modeling

Structural Topic Modeling (STM) was used to estimate a model in the R language and environment in RStudio (Roberts et al., 2014)¹⁸. Topic modeling is a semi-automated, unsupervised method that can be applied to textual content (Blei, 2012). STM uses a Bayesian generative approach for text analysis, in which the model tries to “mimic” the writing process of a given corpus of documents (Blei, Ng, & Jordan, 2003). The algorithm attempts to extract a set of topics from which the given corpus could have been created. “Topics” are statistical entities, sets of frequency distributions of words, based on the linguistic assumption of co-occurrences, that is, that words that are more frequently being used in the same documents also associate thematically. In topic models, every word in the corpus (after pre-processing) has a probability of appearing in each of the topics, and every document is composed as a mixture of all topics (Grimmer & Stewart, 2013). Topic modeling is a “bag-of-words” approach, which means that narrative, location in the text, and syntax are not taken into consideration (Wallach, 2006). As opposed to other approaches to topic modeling (e.g., LDA, see Blei et al., 2003), structural topic modeling allows documents to vary in the distribution of words and topics, based on covariates (Roberts et al., 2014). Based on the research questions, the current study used the covariates of time (date of publication) and source (news outlet) when modeling the topics.

calculated as $N \times (1 - \text{Sparsity level})$, where N is the number of documents. Sparse = 0.99 will remove only terms that are sparser than 0.99. In the current study, all terms that appear in more than $5006 \times (1 - 0.99)$ documents will be retained. Others will be omitted. In the current case, words that appear in more than 50 documents will be retained in the corpus. Near the other extreme of sparsity=0.1, only terms that appear in nearly every document will be retained.

¹⁸ <https://www.r-project.org/about.html>

As in many clustering problems, a decision was made by the researcher regarding the number of topics to model. The choice of the number of topics was based on the STM package's searchk function (Roberts et al., 2014), providing indicators of coherency, exclusivity, residuals, and held-out likelihood for different sets of k (number of topics). The process was carried out in two stages. First, the function tested the range of 10-120 topics, in steps of 10 (see Figure 1). After identifying the best range to be between 30-40 topics, based on exclusivity, coherence, and held-out likelihood¹⁹, another function was ran with single topics intervals, testing all the options between these numbers. Finally, $k=35$ topics was selected, featuring a combination of these indices, that compromises between coherence and exclusivity, while providing a relatively strong held-out likelihood, before the curve's slope decreases, as can be seen in Figure 2. It should be noted that the currently available diagnostic tools do not provide a definitive answer to the question of how many topics a researcher should choose and the choice relies on researchers' judgment. There is no "right" answer for this question for a given corpus (Grimmer & Stewart, 2013)²⁰ The researcher also tested another model, that showed a potential based on its indices ($k=79$). The findings from this model were virtually the same, except some topics were broken into a higher-resolution ones that did not seem to substantially contribute to the understanding of the phenomenon. For example, when

¹⁹ The semantic coherence criterion was developed by Mimno and colleagues (Mimno, Wallach, Talley, Leenders, & McCallum, 2011), and is closely related to pointwise mutual information. It is maximized when the most probable words in a given topic frequently co-occur together. Exclusivity is measured through Roberts et al's (2014) FREX criterion, a weighted harmonic mean of the word's rank in terms of exclusivity and frequency. Exclusivity of a model will be higher when top frequent words are less shared between topics. There is a trade-off between coherence and exclusivity. Models with more topics tend to have higher exclusivity, but also lower semantic coherence. For more information on the held out likelihood criterion see Wallach, Murray, Salakhutdinov, & Mimno, (2009) and for residual analysis see Taddy (2011).

²⁰ See also: <https://cran.r-project.org/web/packages/stm/vignettes/stmVignette.pdf>

moving from 35 to 79 topics, a topic dedicated to athletes who withdraw from the Rio Olympics broke down into several topics, each dealing with a different competition (e.g., Gold players). The researcher has made a judgment call to use the k=35 model.

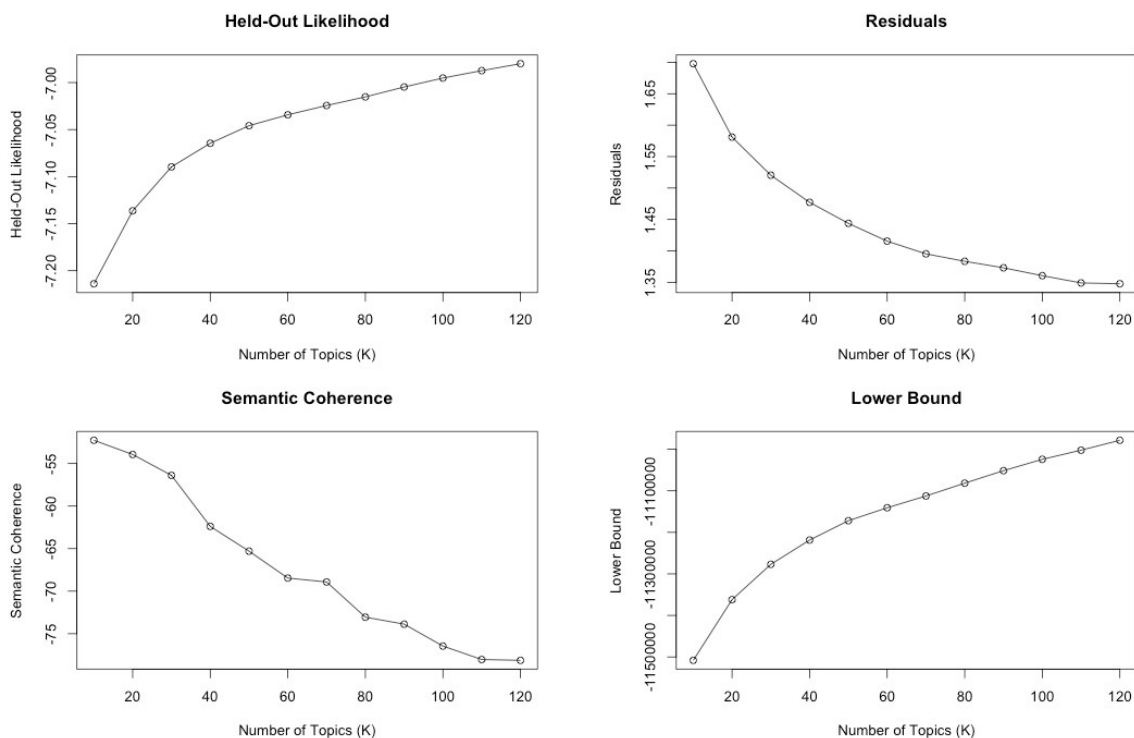


Figure 1. Diagnostic values by number of topics with intervals of 10 topics.

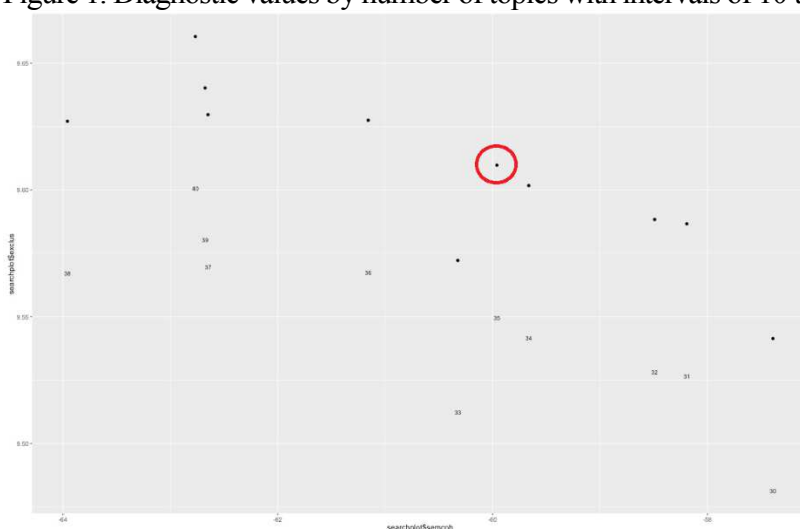


Figure 2. Diagnostic values by number of topics from 30-40. The y-axis presents the exclusivity score, the x-axis presents semantic coherence scores. K=35 is marked by a red circle, showing a compromise between semantic coherence and exclusivity.

The topics were then analyzed by the researcher using a hermeneutic qualitative procedure. In this procedure labeling of topics was made based on top-words in each topic (highest probability to be included in the topic), top FREX words (top exclusive words for each topic, see Roberts et al., 2014), and an examination of the top 30 articles that were dominated by each topic. (Topic modeling provides a statistical estimation of the relative prevalence of each topic in each document. These proportions are found in the N (number of documents) by K (number of topics) Theta matrix that is based on the posterior probability). Importantly, the labeling of topics was done as a preliminary step toward understanding the content in the corpus. A rigorous and systematic content analysis was conducted on the theme level (see chapter 4 for details about the content analysis process).

Network Analysis and Community Detection

Next, to identify themes, cluster analysis was conducted using R. In this analysis, topics served as network nodes, and have stronger edges between them if they share more frequent words. First, a matrix was created from the beta matrix, representing the probability distribution of each word conditional on the topic²¹. Next, a Pearson correlation matrix was calculated to evaluate the edge weight or “distance” between each pair of topics. One topic, topic-11 was omitted from analysis as it was irrelevant to epidemics, and consisted of linguistic artifacts that could not be interpreted as part of the epidemics phenomenon. A multi-dimensional scaling projection of the topics on two dimensions supported the omission, as topic-11 was isolated from the rest of the topics.

²¹ <https://cran.r-project.org/web/packages/stm/stm.pdf>

The researcher made a judgment call to omit the topic from further analyses. Next, a weighted (based on Pearson correlation), undirected (as it is a bag-of-word approach) network was built based on the correlation matrix. Since in topic modeling, each word appears in each topic, the resulting network was fully connected, as all topics shared the same vocabularies. To reduce the number of edges and retain only substantial connections, a filtering method was used, that offers “a practical procedure to extract the relevant connection backbone in complex multiscale networks, preserving the edges that represent statistically significant deviations with respect to a null model for the local assignment of weights to edges” (Serrano, Boguñá, & Vespignani, 2009). A systematic examination of different iterations with varied levels of filtering demonstrated that $\text{Alpha} = .15$ was the maximum point of reduction, after which complete topics were omitted from the model, as they had no edges to other topics. Edges below the threshold were omitted from the network. A sensitivity analysis was conducted using different community-detection techniques, comparing the methods of leading eigenvectors (Newman, 2006) and Louvain (Meo et al., 2011). Clusters were virtually the same and the final model used a Louvain approach with backbone Alpha of .15. An example for clustering with a different Alpha level can be seen in Appendix E. The results indicated that there were three communities in the network, with a modularity score of .56. The method automatically indicated which topics belonged to which communities, and cluster-variables were created from these topics for further analysis. These clusters represent the accumulative proportion of topics in each community that can be evaluated for each document, and for the corpus as a whole.

Content Analysis Results

The corpus consisted of 5,006 article. The amount of coverage by each outlet, per each disease can be seen in Table 1:

Table 1. The number of news articles per outlet, by disease

	Wall Street Journal	Washington Post	The New York times	USA Today	Total
H1N1	399	583	553	263	1,798
Ebola	482	574	810	247	2,113
Zika	159	340	456	140	1,095
Total	1,040	1,497	1,819	650	5,006

Topics

RQ1 examined the topics that were prominent in the American newspapers coverage of the epidemics. The structural Topic Model consisted of 35 topics. Table 2 presents the prevalence of each topic in the corpus, its label (assigned by the researcher), the top most common words in the topic, and the top FREX words (top exclusive words for each topic, see Roberts et al., 2014).

Table 2. Topics' prevalence and top words

#	%	Label	Top Words
1	2.4	Funding	congress, bill, house, funding, spending
2	2.7	Ebola Drugs	drug, said, vaccine, vaccines, drugs
3	2.0	Research	research, said, can, new, technology
4	2.6	H1N1	flu, virus, pandemic, swine, new
5	3.2	Florida	zika, said, virus, mosquito
6	2.6	Ebola Team	obama, president, white, house, said
7	2.5	Schools	school, schools, students, said, county
8	1.2	Rio Games	rio, brazil, games, said, will
9	3.3	Tourism	said, year, company, million, business
10	3.7	Microcephaly	zika, virus, said, woman, microcephaly
11	5.9	Irrelevant	like, people, can, one, just
12	1.6	Mosquitoes	mosquitoes, water, species, can, disease
13	1.2	Biosafety	says, usa, cdc, lab, safety
14	3.2	International Cooperation	said, united, states, military, world
15	4.1	H1N1 Vaccine	vaccine, flu, said, health, doses
16	5.7	Ebola Toll	ebola, said, outbreak, liberia, africa
17	2.0	Media	news, media, times, new, story
18	3.2	Thomas E. Duncan	ebola, said, hospital, health, dallas
19	1.9	Withdrawing Athletes	olympics, said, games, rio, olympic
20	1.4	Hygiene	hands, hand, masks, air, can
21	2.3	Sport Events	team, game, said, first, players
22	2.5	Screening Passengers	travel, will, said, travelers, ebola
23	1.7	Mexico	mexico, mexican, city, said, people
24	3.5	Flu Narratives	said, family, day, one, home
25	4.5	H1N1 Outbreak	said, flu, cases, health, swine
26	1.9	Blood Donation	blood, virus, test, tests, said
27	3.1	Midterm Elections	republican, democrats, republicans, senate, said
28	2.0	NY & NJ Quarantines	new, york, city, said, mayor
29	2.4	Liberians	said, ebola, people, one, died
30	4.1	Disaster Response	health, public, will, response, need
31	3.0	Dr. Kent Brantly	said, ebola, patients, hospital, medical
32	3.3	Medical Treatment	flu, people, children, disease, swine
33	2.7	Legal Issues	said, government, law, federal, court
34	3.3	Markets and Stocks	percent, economic, economy, market, year
35	1.7	Hospitals And Doctors	patients, doctors, medical, care, hospital

Themes

RQ2a examined what themes were prominent in the coverage. As explained before, themes were operationalized as clusters of topics, found through, a Louvain community-detection method. The three communities (themes) can be seen in Figure 3, using the labels given in Table 2 in the previous pages:

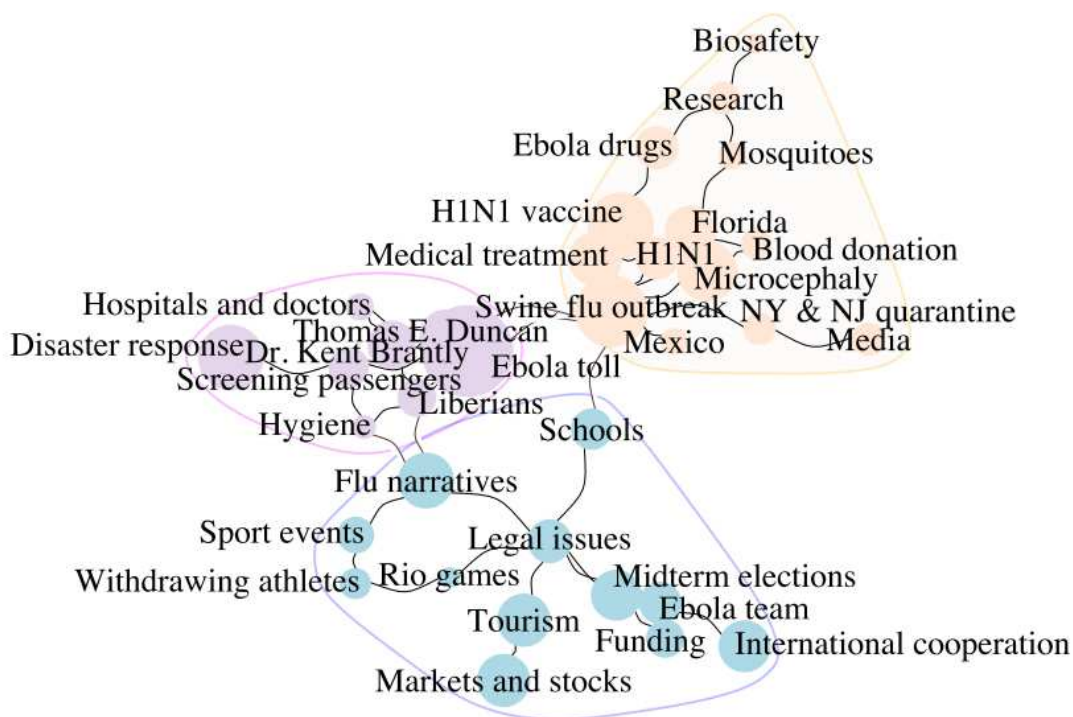


Figure 3. A topics network, with clustering based on the community- detection method of Louvain and backbone reduction with $\alpha = .15$. The size of the circle represents the relative size of the topic. The labels were applied by the researcher.

For convenience, each theme was assigned a letter, as detailed in Table 3:

Table 3. Topics in each theme.

Theme	Topics
A	Biosafety, Research, Ebola drugs, Mosquitoes, H1N1 vaccine, Florida, Medical treatment, H1N1, Blood donation, Microcephaly, H1N1 outbreak, NY & NJ quarantines, Mexico, Media
B	Hospitals & doctors, Thomas E. Duncan, Disaster response, Dr. Kent Brantly, Screening Passengers, Ebola toll, Hygiene, Liberians
C	Schools, Flu narratives, Sport events, Legal issues, Withdrawing athletes, Rio games, Midterm elections, Tourism, Ebola team, Funding, International cooperation, Markets and stocks

RQ2b examined the differences between diseases in the prevalence of themes.

Prevalence was calculated using the Theta object derived from the topic model. Theta is the per-document probability of a topic, and it “has the posterior probability of a topic given a document that this function uses”²². The diseases were relatively similar on the existence of Theme C, its relative percentage ranging from 44.1% (Ebola) to 45.2% (Zika). More substantial differences were found for the other two themes. Theme A was most prominent in H1N1 (42.2%) and Zika (36.9%) coverage, while it was relatively lower in Ebola (21.7). Theme B was most prominent in Ebola (34.2%) and relatively low in Zika (17.7%) and H1N1 (12.8%) coverage. The prevalence of each theme in each disease can be seen in Table 4:

Table 4. The relative prevalence of themes by disease.

	H1N1	Ebola	Zika	Grand mean
Theme A	42.2%	21.7%	36.9%	32.4%
Theme B	12.8%	34.2%	17.7%	22.9%
Theme C	44.7%	44.1%	45.2%	44.5%

²² <https://cran.r-project.org/web/packages/stm/vignettes/stmVignette.pdf>

Crisis communications are time-dependent and time-sensitive (Seeger, Sellnow, & Ulmer, 2003). Crisis are dynamic and crisis communication frameworks and theories emphasized the need for change in messaging over time, to accommodate to events and developments in knowledge regarding risks and behavioral recommendations (Sellnow & Seeger, 2013). RQ2c examined the change in prevalence of themes over time. As can be seen in Figure 4, the use of themes changed over time in the coverage of all diseases. The interpretation of these changes will be discussed later on, after the content of each theme is analyzed.

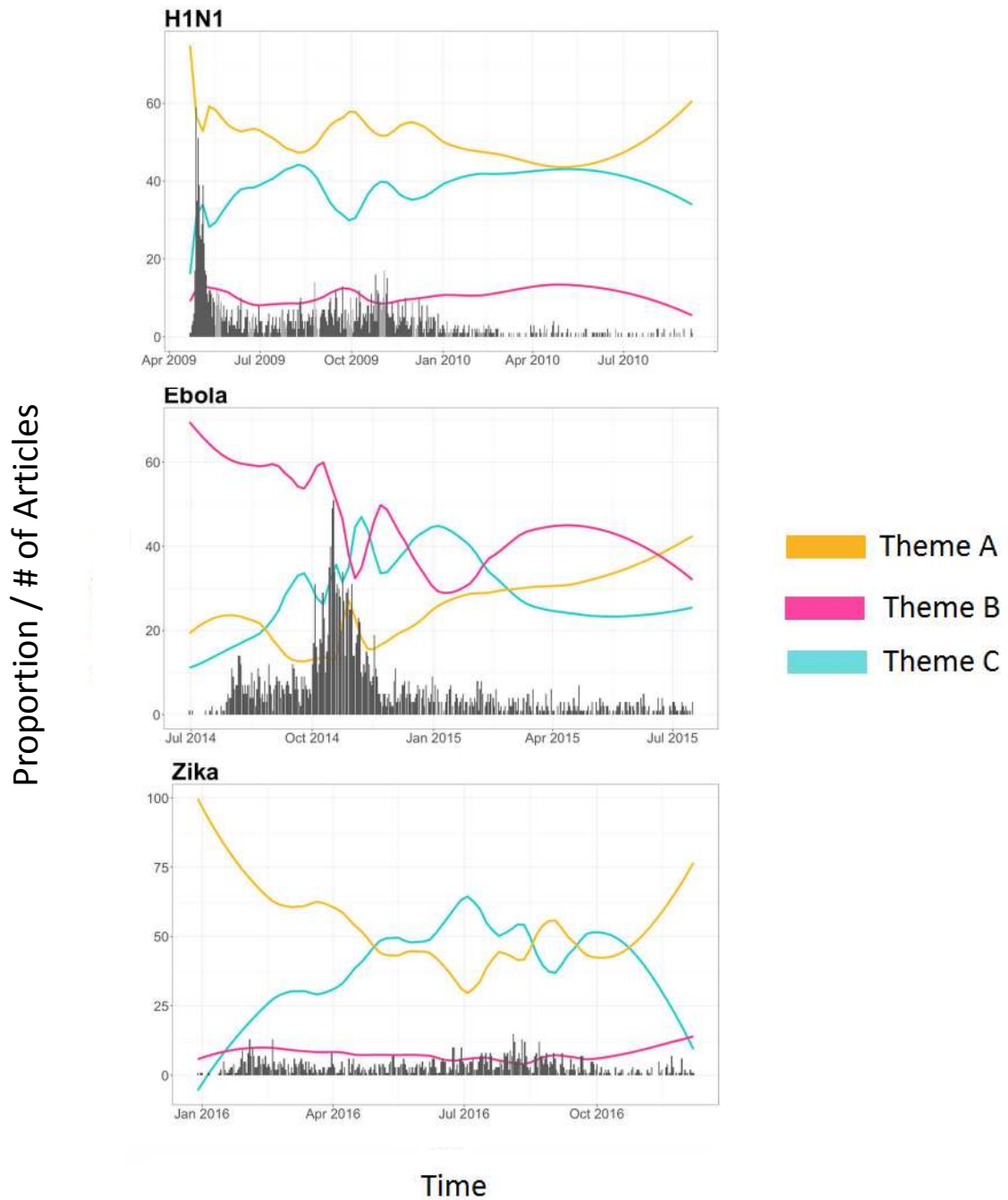


Figure 4. Themes prevalence over time for each disease, with a local-regression (Loess) smoothing of span=0.3. Prevalence is calculated as the accumulated Theta values for all the topics in each theme in all the articles in any point in time. Since the irrelevant topic was omitted, for each article the sum of theme A, B, and C is always equal to 1. Black bars represent amount of coverage per day.

Chapter 4 – Validation: Manual Content Analysis

Next, manual content analysis was conducted to examine the content and meaning of each theme in light of CERC. According to CERC, communications should focus on risks and steps that can be taken to mitigate them. Risks include medical/health risks as well as social/economic disruptions. Mitigating steps can be taken by individuals or by health organizations or other official institutions (Quinn et al., 2008; Reynolds, 2016; Veil et al., 2008). The analysis aimed to answer the question:

RQ3a. Did the prominence of crisis information recommended in CERC (medical/health risks, social/economic disruptions, individual response, and organizational response) differ by themes?

Most work on crises and epidemics focused on single case studies. Another goal of this study was to examine whether the kinds of information CERC views as important during outbreak differed across the three cases studied:

RQ3b. Did the prominence of crisis information recommended in CERC differ by disease?

Method

Procedure

To understand the content of each theme, a sub-corpus for coding was created, consisting the articles that are most representative for each theme in each disease. In structural topic modeling, each article is composed of words associated with all topics. For each article, the model provides Theta values, representing the per-document probabilities of each topic. In each article, Theta values for all topics always sum to 1. The calculation of representativeness was done by summing up the Theta values of all the topics included in that cluster. For example, an article with a Theta value of 99.9 for cluster A is an article that 99.9% of its words are most dominant in Cluster A. Specifically, the sub-corpus included 126 articles, with 42 articles per disease (14 from cluster A, 14 from cluster B, and 14 from Cluster C). Articles shorter than 100 words or longer than 2,000 words were omitted and replaced by the next most representative ones. A codebook was created based on the model of effects described in CERC. The codebook is described in the next section, and the full instructions can be seen in Appendix A.

Three human coders were randomly assigned to 84 articles each. After several training sessions, done on a separate set of articles (that still represented the clusters in each disease, but not the top, most represented ones). Next, the codebook was refined and corrected based on the coders' comments. After reaching a satisfactory reliability on all key variables (Krippendorff's Alpha > .80) the coders used the refined codebook to analyze the sub-corpus of 126 articles. The final codebook can be seen in Appendix A. Examples for the articles by theme and disease can be seen in Appendix B.

Measures

The codebook was built around the information needs described in CERC: medical/health risks, social/economic disruptions, individual response, and organizational response (Reynolds & Seeger, 2014).

Medical/health risks information was measured using items about health effects, tolls, vulnerability, symptoms, connection to previous outbreaks, technical information, and use of narratives. Specifically, the following items were used: “Which health effects of the disease are mentioned in the article (check all that apply)”, “Did the article mention number of cases (i.e., provide a specific number or estimation)”, “Did the article mention probability of dying in terms of percentages (e.g., 5% of those infected will die)”, “Did the article mention probability to other health effects in terms of percentages (e.g., 5% of mothers infected will have babies with birth defects)”, “Which symptoms are mentioned in the article (check all that apply)”, “According to the article, which populations are at higher risk of getting infected with the virus (check all that apply. Check only if explicitly written as vulnerability in the article)”, “According to the article, which populations are at higher health risks if infected with the virus (check all that apply)”, “Does the article discuss previous outbreaks of the same virus (e.g., an article about Swine flu might mention the 1918 influenza outbreak)”, “Does the article include technical details or information about the virus, including its biology, chemical structure, mechanism for attachment to cells, etc.”, “Does the article include personal stories of infected people with specific identifiable characters (i.e., including at least one of the following: a name, occupation, age, gender, location of a specific person)”.

Medical/health risks centrality - After answering all these questions regarding an article, the coder was asked for the centrality of this dimension in the article: “You've just answered questions about Facts and risk Information (prognosis, symptoms, biology, and history of viruses, risk information, description of cases and transmissions, death tolls, susceptibility, health consequences). How central would you say the topic of Facts and Risk Information to the article?” With the following possible answers: “Not central at all – there are no mentions of such information in the article”, “Slightly central – there are some mentions, but they are not central to the main topic”, “Central – the information is important to the main topic of the article but there are other kinds of information that are also important”, and “Very central – the information is the main topic of the article”.

Reliability was calculated for centrality questions as well and can be seen Table 5 below.

Individual response information was measured using the following item: “According to the article, what can individuals (citizens, not doctors etc.) do to avoid infection or ameliorate risks? (Check all that apply)”. An example for an answer is “getting vaccinated”.

Individual response centrality - After answering all these questions, the coder was asked for the centrality of this dimension in the article: “You've just answered questions about Decision Making and Efficacy Information (information that directs readers to take an appropriate action to reduce or eliminate risks. These DO NOT INCLUDE actions by official organizations, CDC, government etc.). How central would you say the topic of Decision Making and Efficacy Information was to the article?” with the same possible answers used for facts and risk.

Organizational response information was measured using the following item:

“Which steps taken by countries, organizations, and institutions to reduce risks and avoid infections are mentioned in the article? (Check all that apply)”. An example for an answer is “improving safety in laboratories”.

Organizational response centrality - After answering this question, the coder was asked for the centrality of this dimension in the article: “You've just answered questions about Resource Allocation Information (information that explain to readers what was done by official governmental or non-governmental organizations to reduce or eliminate risks. These DO NOT INCLUDE actions by unofficial individuals - citizens etc.). How central would you say the topic of Resource Allocation Information was to the article?” with the same possible answers used for the other dimensions.

Social/economic disruption information was measured using the following item:

“Does the article mention the impact of the disease on the following? (Check all that apply)”. An example for an answer is “Sport events or athletes”.

Social/economic disruption centrality - After answering this question, the coder was asked for the centrality of this dimension in the article: “You've just answered questions about Normalcy and Well-being information (information that the non-health consequences of the disease, such as impact on cultural events, politicians, economies etc.). How central would you say the topic of Normalcy and Well-being Information was to the article?” with the same possible answers used for the other dimensions.

Validation Results

Each coder coded 84 articles, randomly selected from the corpus of 126 most representative articles. Since this analysis is not concerned with the specific items but rather in the existence or absence of categories of information (i.e., the existence of health effects in general, rather than the existence of specific health effects such as death), all items except for the centrality variables were coded as binary (for example, if any health effect was mentioned in the article, the item “health effects” was coded as “yes”). Centrality items remained in the form of a 4-point Likert scale.

Table 5 presents the intercoder reliability using Krippendorff’s Alpha levels for the variables of interest. Most variables were recoded as binary, indicating the existence or absence of a type of information, for example, symptoms information. Centrality questions remained in the original Likert scales of 1-4.

Table 5. Reliability scores for content analysis.

Variable	Alpha	Variable	Alpha
Health effects (Yes/No)	.90	Tolls (Yes/No)	.90
Vulnerability (Yes/No)	.80	Individual response (Yes/No)	.78
Symptoms (Yes/No)	.73	Organizational response (Yes/No)	.77
Social/economic disruption (Yes/No)	.82	Political sources (Yes/No)	.80
Scientific/Health sources (Yes/No)	.80	Centrality medical/health risks	.84
Centrality individual response	.80	Centrality organizational response	.82
Centrality social/economic disruption	.78		

For each article, an average of centrality score across coders was calculated. In case of disagreements on binary variables, where one coder indicated a textual feature was present and the other did not, I personally examined the direct quotes from the text provided by the coder who argued for existence of information and if there was evidence in the article (as was the case in all disagreements on binary variables) the article was coded as including this type of information.

Next, RQ3a examined differences in prominence of crisis information between themes. The following analysis is structured around the categories derived from CERC: medical/health risks, social/economic disruptions, individual response, and organizational response:

Medical/health risks – ANOVA tests showed significant differences between themes in terms of the centrality of information about medical/health risks ($p < .01$). In terms of the evaluation of centrality on a 1-4 scale, it was most central to Theme A (average centrality for articles from this theme was $M = 3.27$, $SD = .65$), where 78.5% of the articles included information about health effects, 69% information about subgroups' vulnerability, 57.1% information about tolls, and 28.5% information about symptoms. Medical/health risks were central, although to a lower degree, to Theme B ($M = 2.27$, $SD = .89$), where 64.2% of the articles included health effects information, 30.9% symptoms information, 35.7% presented information about disease tolls, and only 16.6% vulnerability information (the widest gap from Theme A on medical/health risks). For theme C, on the other hand, medical/health risks were not central at all ($M = 1.04$, $SD = .18$), where none of the articles included any information about health effects, symptoms, tolls, or vulnerability.

Individual response – ANOVA tests showed significant differences between themes in terms of the centrality of individual response information. It was evaluated as most central in articles from Theme A ($M = 1.77$, $SD = .97$), followed by Theme B ($M = 1.17$, $SD = .50$), and not central at all to Theme C ($M = 1.00$, $SD = 0.0$). 50% of the articles in Theme A consisted of individual response information, while only 14.2% of those in Theme B included such information. No articles in Theme C included any individual response information.

Organizational response – ANOVA tests showed significant differences between themes in terms of the centrality of information about organizational response. It was evaluated as most central to articles in Theme B ($M = 3.50$, $SD = .81$), followed by Theme A ($M = 2.09$, $SD = .98$). It was least central to Theme C ($M = 1.04$, $SD = .24$). 97.6% of the articles in Theme B included organizational response information, compared to 71.4% in Theme A, and 2.3% in Theme C.

Social/economic disruption – ANOVA tests showed significant differences between themes in terms of the centrality of information about social/economic disruption. It was evaluated as most central to Theme C ($M = 3.16$, $SD = .64$), followed by Theme A ($M = 1.5$, $SD = .71$) and least central to Theme B ($M = 1.09$, $SD = .31$). 100% of the articles in Theme C included social/economic disruption information, compared to 40.4% in Theme A, and 9.5% in Theme B.

Sources – Although not stated as a research question in advance, coders kept track of the sources cited in each article, similarly to the analysis of sources in environmental risk articles done by Greenberg and colleagues (Greenberg et al., 1989). During crises, journalists combine sources of information, some of which come from health

organizations such as CDC, and some from non-official or non-scientific sources (Coombs, 2009). There were differences in the use of sources between themes. Political sources were used mostly in Theme C (21.4% of the articles), less often in Theme B (9.5%), and not at all in Theme A (0%). Scientific and health organization sources were used extensively in articles from Theme A (78.5%) and Theme B (66.6%) but almost never in Theme C (2.3%). Table 6 and Figure 5 sums up the differences between themes in terms of centrality of CERC variables:

Table 6. Centrality of CERC components by theme

	Grand Mean	Theme A	Theme B	Theme C	p value (F)
Individual response	1.317	1.773	1.178	1.00	< .001
Medical/health risks	2.198	3.274	2.274	1.048	< .001
Organizational response	2.214	2.095	3.500	1.048	< .001
Social/economic disruption	1.920	1.095	1.500	3.167	< .001

Note: Centrality was measured on a 4 point Likert scale from 1 (Not central at all to the article) to 4 (Very central to the article).

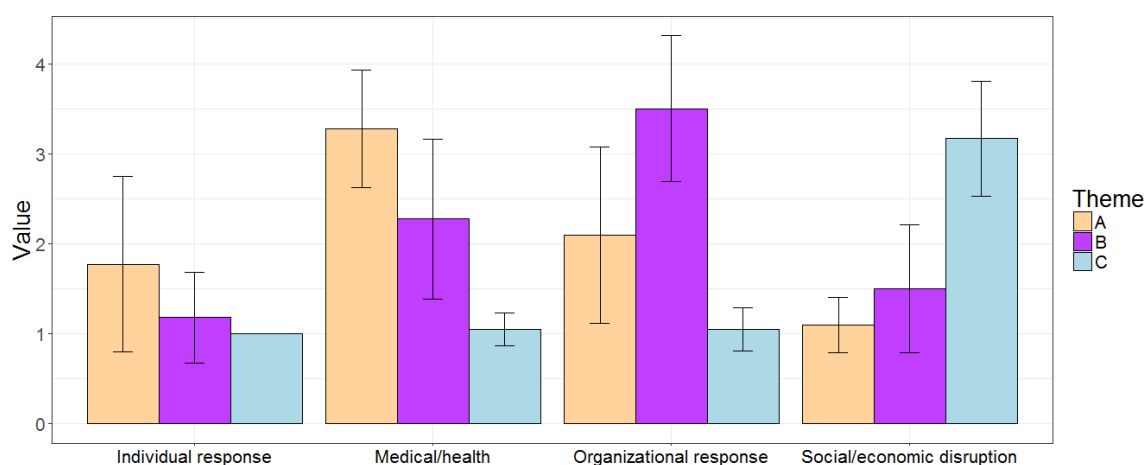


Figure 5. Centrality of CERC components by theme.

RQ3b examined whether there were differences in the prominence of crisis information recommended in CERC between the coverage of different diseases. As

opposed to the differences found between themes, ANOVA tests found no significant differences on any of the variables between the three diseases, as can be seen in Table 7:

Table 7. Centrality of CERC components by disease

	Grand Mean	Ebola	H1N1	Zika	p value (F)
Individual response	1.317	1.226	1.381	1.345	.584
Medical/health risks	2.198	2.321	2.166	2.107	.667
Organizational response	2.214	2.190	2.190	2.261	.956
Social/economic disruption	1.920	1.928	1.916	1.916	.998

Note: Centrality was measured on a 4 point Likert scale from 1 (Not central at all to the article) to 4 (Very central to the article).

Discussion of the Manual Content Analysis of Themes and Articles

In this analysis, three human coders evaluated the existence or absence of objective textual features in a sub-corpus of 126 articles, representing the most typical articles for each theme by each disease. The results of the coding process demonstrated that the three themes that were constructed based on the empirical data from clustering topics, did differ in the prominence of CERC related information, as well as in their use of sources. These results advance our understanding of the routines used by journalists when covering different outbreaks. Specifically, Theme A emphasized risk information and facts, and also included the highest levels of individual response information, appearing in about half of its articles (however indicated by the coders not to be a central component of the articles). It included a relatively high prominence of organizational response information and almost no information on social/economic disruptions. More than 78% of the articles in this theme cited a scientific or health-related sources and none cited politicians. Theme B included moderate-to-high levels of medical/health risks

information, low levels of individual response information, moderate-low levels of information on social/economic disruptions and a very frequent use of information about organizational response, as more than 97% of its articles included information on actions taken by the government or other organizations to cope with the crisis. About 10% of the articles in this theme cited politicians, and 66% cited scientific or health sources. Theme C included no medical/health risks information, nor any information regarding individual response. A very small percentage of the articles in this theme included information about organizational response. All of its articles included information about social/economic disruptions. Less than 3% of the articles cited scientific sources, while more than 21% cited politicians. As opposed to findings regarding differences between themes, there were no significant differences between coverage of different diseases in terms of any of the variables of interest.

The coders mentioned to the researcher that some of the articles have dealt with the disease only tangentially, and in some cases, the percentage of the article that dealt directly with the disease was very small. An auxiliary analysis found that these articles tended to be in Theme C. More specifically, 37 out of the 42 articles representing Theme C did not mention the disease in the first paragraph, compared to 9 articles in Theme A, and 6 in Theme B, that failed to mention the disease at the outset. However, it is important to remember that the coders analyzed the articles representing the most extreme prevalence of each theme. All the articles analyzed to represent Theme C included more than 99% unique language that can be attributed by the model to Theme C. The analysis suggest that these extreme cases of Theme C articles tended to discuss the diseases only tangentially. However, additional analysis found that many articles where

more than 80% of the language was attributed to Theme C (i.e., still dominated by Theme C but not as extreme as the cases where 99% of the language is attributed to it), did tend to discuss the disease as their main topic. What this finding does suggest, is that articles that use language attributed almost exclusively to Theme C do tend not to be about the disease itself. However, if we think of the themes as variables, it seems from the analysis that an increase in the amount of language from Theme C reduces the probability that the article will be mainly about the disease.

Based on the findings from the content analysis, I labeled each theme. Theme A emphasized medical/health risks, individual response, and organizational response information. It often cited scientific sources. It consisted of topics about diseases abroad, mostly Ebola, narratives about specific people (doctors and patients) who could bring the disease into the U.S, and attempts to respond to potential American disaster by screening passengers at airports and by promoting attention to personal hygiene. As this theme is mostly about a disease abroad and the attempts to prevent it from spreading in the U.S, I labeled this theme “The pandemic theme”.

Theme B emphasized the allocation of resources to organizational coping with the diseases. It includes moderate amounts of information about medical/health risks and about social/economic disruptions, and little information on individual response. Writers of articles in this theme used both scientific and to a lower degree political sources. The theme consisted of topics such as vaccinations, quarantines, research, drugs, biosafety, blood donations, and medical treatment, but also topics about mosquitoes, Mexico, microcephaly, the media, and Florida. As this theme is primarily about scientific attempts

to cope with the medical conditions through research and development of treatments, I labeled this theme “The scientific theme”.

Theme C was devoted almost completely to discussions of social/economic disruptions. It included no health or scientific information, and used more political sources than the other themes. Its topics included impact on tourism, stock markets, sports events, legal issues, schools, elections, and also topics about international cooperation, funding, and personal stories. As this theme is primarily about the impact on cultural, economic, and political institutions, it was labeled “The social theme”. Table 6 described the prevalence of CERC information by themes, before they were named.

Table 8 will therefore reiterate Table 6, this time with the labels given to each theme:

Table 8. Centrality of CERC components by theme

	Grand Mean	Scientific	Pandemic	Social	p value (F)
Medical/health risks	2.198	3.274	2.274	1.048	< .001
Individual response	1.317	1.773	1.178	1.00	< .001
Organizational response	2.214	2.095	3.500	1.048	< .001
Social/economic disruption	1.920	1.095	1.500	3.167	< .001

Figure 6 presents word clouds for articles used for manual content analysis for each theme:

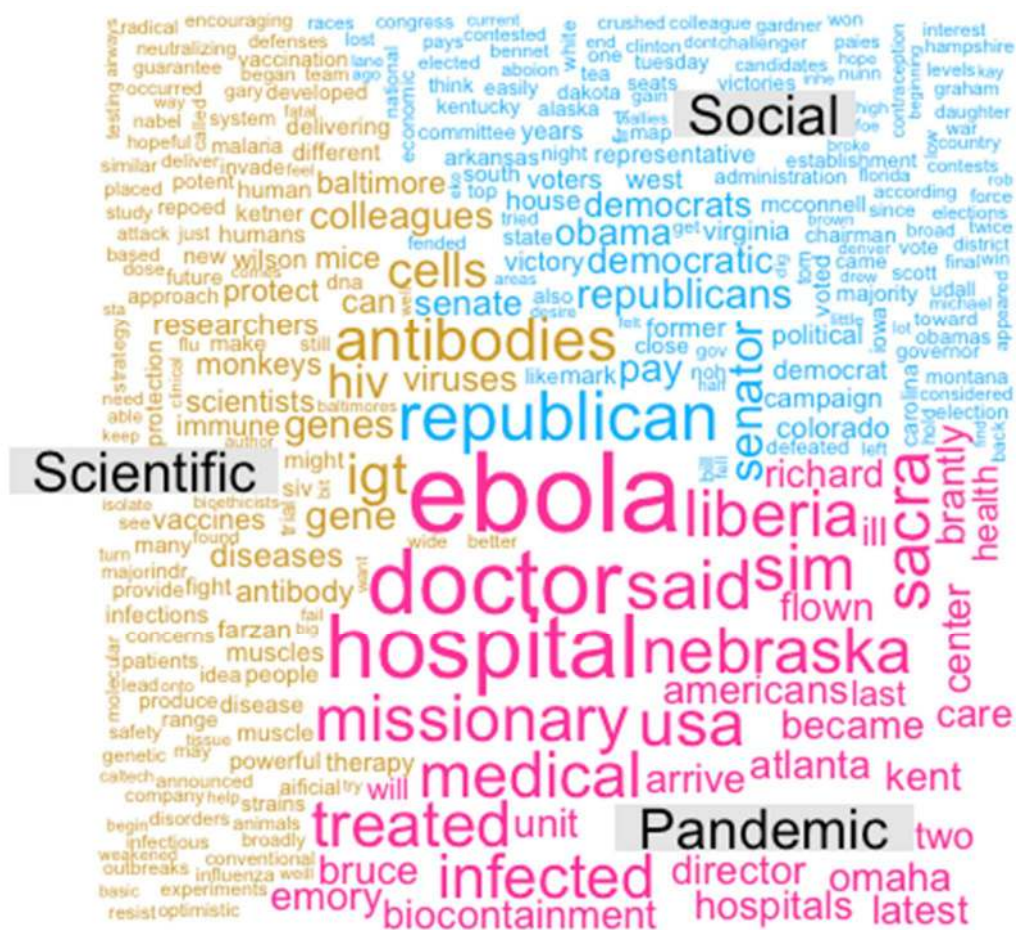


Figure 6. Word clouds for the corpus analyzed in the manual content analysis. Each word is ascribed to the theme where it is most frequent. Size of words represents frequency in the theme to which it was ascribed.

Chapter 5 - From Theoretical Assumptions to Naïve Audience's Responses: Representational and Construct Validity

In the previous sections, I used a network analysis to cluster topics that shared similar vocabularies. A manual content analysis by three coders, driven by the theoretical assumptions made in CERC, indicated that articles representing different themes included varying levels of CERC-related information; medical/health risks, social/economic disruptions, individual response, and organizational response. Based on the manual content analysis the clusters were analyzed as representing three distinct themes: pandemic, scientific, and social.

The systematic analysis and categorization of content, that is guided by a codebook based on a priori theoretical assumptions are important steps toward understanding the meaning and function of messages (Poole & Folger, 1981). However, the process represents the researcher's reading and interpretation of the messages. It is certainly possible that naïve audiences derive different meanings from the same messages (Cappella & Jamieson, 1997; Folger & Poole, 1981). The similarity between researchers' theory-driven interpretations and those made by naïve audiences was called "representational validity" (Poole & Folger, 1981b). In this study, an assessment of representational validity will test whether members of the target audience attribute the same characteristic differences to articles from different themes as the researcher (and coders) did while following CERC guidelines. Establishing the similarity between audience's shared interpretations of the messages and the researchers coding scheme will support future explanations for the effect of CERC component on audience beliefs, attitudes, and intentions (Jamieson & Cappella, 1996).

A second aim of this section is to establish construct validity (Cronbach & Meehl, 1955). Construct validity ascertains whether “the socially-shared constructs identified by the scheme should act as effective predictor variables for interpretively-defined outcome variables” specified “by the researcher’s theory” (Folger & Poole, 1981, p. 243). In the context of this study, CERC posits that providing audiences with information about medical/health risks, social/economic disruptions, individual response, and organizational response may “counter some of the harmful behaviors and perceptions that are common during a public health crisis” (Reynolds & Seeger, 2014, p. 15), including uncertainty, and perceived lack in self and organizational efficacy, as well as trust in CDC (Reynolds & Seeger, 2005). These harmful perceptions will be used in this study to establish construct validity by correlating them with exposure to articles from different themes that were found in the content analysis to include different levels of CERC components.

In order to establish representational and construct validity, participants were recruited from a crowdsourcing website (Amazon Mechanical Turk) and were randomly assigned to evaluate articles representative of different themes. Each participant read three articles, randomly selected from the 126 articles (32 per theme) that were used in the content analysis. Participants reported their beliefs and intentions after reading each article. The choice of crowdsourcing for the purpose of validation has advantages and disadvantages. mTurk subjects tend to be more representative of the general population than other commonly studied populations (e.g., college students) and are substantially less expensive to recruit (Berinsky, Huber, & Lenz, 2012). On the other hand, some scholars raised concerns regarding mTurk participants’ attentiveness (Berinsky, Margolis,

& Sances, 2014). Nevertheless, using mTurk ‘workers’ have been found to be a generally reliable, accurate and efficient alternative for researchers (Tosti-Kharas & Conley, 2016).

Variables Used to Establish Construct Validity

Perceived Uncertainty - Science, by its nature, is uncertain, and scientists make progress by falsifying hypotheses based on slowly accumulating evidence (Oreskes & Conway, 2011; Popper, 2005). Nowhere is this notion more evident than in coping with public health crises, and specifically with epidemics (Birnbrauer et al., 2015; Brashers et al., 2000). Crises are chaotic and diseases interact with technological, social, political, economic, and natural factors in ways that make them hard to predict (Seeger & Reynolds, 2008). Moreover, new strains of viruses show resistance to drugs and vaccines that were once considered strong enough to stop them (Youngerman, 2008). Perceptions of uncertainty among the public are a great source of anxiety (Kuang & Wilson, 2017; Santacroce, 2002) and influence decision making during emergencies (Conrado, Neville, Woodworth, & O’Riordan, 2016). Exposure to uncertain and contradictory information may lead people to believe that scientists who “keep changing their minds” (Nagler, 2014, p. 35) are incompetent, lack knowledge, and are unable to cope with the complexities of the domain (Dieckmann et al., 2015). Hence, perceived uncertainty can lead to fatalism and inaction, cognitive overload (Niederdeppe et al., 2014), and refusal to comply with suggested behaviors (Brouwers & Sorrentino, 1993). Therefore, crisis communications strive to reduce perceived uncertainty by providing timely and accurate information about the risks and what can be done to ameliorate them (Coombs, 2007).

The manual content analysis showed that the social theme included no information about risks and facts, nor about ways to reduce risks, by individuals or by

organizations. It was therefore expected to increase perceptions of uncertainty among readers regarding the disease mentioned in the article. The difference between the pandemic and scientific themes, however, was harder to predict as the scientific theme included more risk and individual response information, but the pandemic theme included more information about organizational resources allocated toward coping with the diseases:

H1. People reading articles from the social theme express higher uncertainty than people reading articles from the pandemic and scientific themes.

RQ4. Is there a difference in perceived uncertainty between people who read articles from the pandemic and scientific themes?

Perceived Self-Efficacy and Organizational-Efficacy – Avoiding helplessness, “the feeling that people have that they, themselves, have no power to improve their situation or protect themselves”, is a vital communication objective during a crisis (Reynolds & Seeger, 2014, p. 25). CERC suggests that helplessness can lead people to become less motivated and less able to take actions that could help themselves. The importance of perceived efficacy-- the belief an action’s ability to achieve goals-- and especially self-efficacy-- the belief in one’s own ability to achieve goals by taking specific actions-- was stressed in many psychological theories of decision making. Social Cognitive Theory (Bandura, 1986) emphasized the centrality of people’s “belief in their efficacy to exert control over their level of functioning and events that affect their lives”

(Bandura, 2001, p. 270). For example, Bandura demonstrated the role of self-efficacy in translating informed concerns about infectious diseases toward preventive action (Bandura, 1990). Similar arguments were made in the Theory of Planned Behavior (Ajzen, 1991), the Extended Parallel Processing Model (Witte, 1992), the Protective Motivation Theory (Prentice-Dunn & Rogers, 1986), and the Health Belief Model (Rosenstock, 1974). Common to all of these theories and models is the assumption that health behavior is influenced by the perceived “relative effectiveness of known available alternatives in reducing the disease threat to which the individual feels subjected” (Rosenstock, 1974, p. 331) and the perceived “capacity for self-direction” (Bandura, 2001, p. 267). Indeed, exposure to individual response information encourages healthy behavior (Dahlstrom et al., 2012; Moyer-Gusé, Chung, & Jain, 2011; Strecher, McEvoy DeVellis, Becker, & Rosenstock, 1986). The association between perceived efficacy and actual behavior and performance was supported in several meta-analyses as well (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Multon, Brown, & Lent, 1991; Stajkovic & Luthans, 1998). In the context of risk communication, perceived personal control was hypothesized to reduce hostility towards risk-communicators and subsequently increase compliance (Lundgren & McMakin, 2013).

The manual content analysis showed substantial differences between the three themes in terms of the prominence of individual response information. The Social theme included almost no information about what individuals or organizations can do to reduce the risks of the diseases. While both the scientific and pandemic themes included response information, the pandemic theme included more information about what organizations and governmental agencies can do and are doing, and the scientific theme

included more information about what individuals can do. It was therefore hypothesized that:

H2a. People reading from the scientific theme express higher perceived self-efficacy than people reading from the pandemic theme, that in turn express higher levels than those reading from the social theme.

H2b. People reading from the pandemic theme express higher perceived organizational-efficacy than those reading from the scientific theme that in turn express higher levels compared to the social theme.

Perceived Trust – Another central factor explaining compliance and support is trust, or specifically to CERC, trust in CDC (Reynolds & Seeger, 2014). Although it is central to various theories from different disciplines, trust in previous studies was defined in different ways by different scholars (Kramer, 1999). In this study it is defined as a person's "expectations, assumptions, or beliefs about the likelihood that another's future actions will be beneficial, favorable, or at least not detrimental to one's interests" (Robinson, 1996, p. 576). Trust is considered a primary route to cooperation and compliance (Jamieson, 2015; M. B. Rogers, Amlôt, Rubin, Wessely, & Krieger, 2007). Therefore, during crises, communicators and crisis-managing organizations thrive to earn the public's trust (Covello, 2003). However, broadly speaking, trust in governmental agencies (Lundgren & McMakin, 2013) and in science (Gauchat, 2012) is in decline, and is even harder to achieve under the circumstances of a crisis (Reynolds & Quinn, 2008; Veil et al., 2008).

According to CERC, public trust can be gained, in part, by communicating information about the organization's understanding of the risks, the steps it takes toward ameliorating them, and by providing useful advice for individuals to reduce their own risks (Reynolds, 2016; Reynolds & Seeger, 2014). Studies in the realm of crisis communication showed that providing information about organizational response, demonstrating competence (Reynolds, 2007), and providing science-driven solutions to the public is expected to increase trust (Reynolds & Quinn, 2008). On the other hand, lack of information, or the presentation of uncertain information, can reduce trust during public health crises (Covello, Peters, Wojtecki, & Hyde, 2001; Quinn et al., 2008). The social theme was expected, based on the content analysis, to induce less trust than the scientific and pandemic themes. As for the difference between the scientific and pandemic themes, since the pandemic theme focused more on the CDC and its direct coping with the risks, it was hypothesized to lead to higher trust in comparison to the scientific theme that focused on risk information without providing information on ameliorating actions. It was hypothesized that:

H2c. People reading from the pandemic theme express higher trust than those reading from the scientific theme, that in turn express higher trust than those reading the social theme.

Method

Procedure

A total of 576 participants (296 females, 480 non-Hispanic whites, 299 college graduates, 297 with an annual income of less than \$25,000, 141 self-defined as conservatives, 323 as liberal), between 19-71 years old ($M = 38.98$, $SD = 10.86$) evaluated three articles each, resulting in 1728 evaluations. Participants were recruited through a crowdsourcing platform, Amazon Mechanical Turk (mTurk) that is not representative of adult U.S. populations (Berinsky et al., 2012). Participants read three articles, randomly selected from the same 126 articles that were evaluated by the coders in the manual content analysis process. As explained in the content analysis section, for each article in the complete corpus of 5,006 articles, the topic model provided Theta values, representing the per-document probabilities of each topic. In that way, each article was scored for its use of language attributed to each theme. This allows the researcher to determine which articles were the most representative of themes, i.e., the articles that have the highest relative use of language from that theme, but not from other themes. The 42 most-representative articles for each theme were used, a total of 126 articles corpus.

Participants were exposed to the survey through an advertised HIT (a Human Intelligence Task). Participants accepting the HIT were directed to an online survey, where they were randomly assigned to read three articles out of the 126. Importantly, participants were not assigned to read articles from one theme and not the others but were randomly exposed to three articles out of the 126. In other words, participants could either read articles coming from the same theme or from different themes, assigned

through a completely randomized design. After reading each article, participants provided their evaluations of the article and were then presented with the next article. After evaluating all three articles, participants filled a demographic questionnaire. All procedures were approved by the Institutional Review Board of the University of Pennsylvania.

Representational Validity Measures

Medical/health risks and Social/economic disruptions – were measured using categorical variable “the disease described in the article was presented by the journalist mainly as a problem because it is a...” with the following options – (a) a health risk to Americans, (b) a health risk to people living outside of the U.S, (c) a scientific mystery, (d) a political problem, (e) an economic problem, or (f) a threat to normalcy and well-being. Answers were collapsed into a binary variable – mainly a health risk (a, b, c), or mainly as a risk to normalcy and well-being (d, e, f).

Individual response – was measured using the following items: “the article told me what to do in order to avoid getting infected with the disease”, and “the article told me what to do in case I think I’m getting infected with the disease”. Both items were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (agree).

Organizational response – was measured using the item “according to the article, scientists and public-health organizations know what needs to be done to fight the disease”, ranging from 1 (strongly disagree) to 5 (strongly agree).

Construct Validity Measures

Self-efficacy was measured through a 2 items scale ($r = .53$), ranging from 1 (strongly disagree) to 5 (strongly agree) based on social cognitive theory (Bandura, 1986): “if I’d get infected with the disease described in the article, I’d be able to cope with it”, and “I believe that following health organizations’ recommendations when coping with the disease described in the article will protect me and keep me healthy”.

Organizational-efficacy was measured using a four items scale ($\alpha = .89$), ranging from 1 (strongly disagree) to 5 (strongly agree): “According to the article, scientists and public-health organizations can stop the disease from spreading”, “scientists and public-health organizations are able to cope with the disease described in the article”, “according to the article, scientists and public-health organizations can reduce the health risks the disease imposes”, and “ I believe scientists and public-health organizations can cope with the disease”.

Perceived uncertainty was measured through a 2 items scale ($r = .50$) ranging from 1 (strongly disagree) to 5 (strongly agree): “The article provided a full picture of the disease” (reversed), and “According to the article, scientists know all the necessary information about the disease” (reversed).

Trust – was measured using the item, ranging from 1 (strongly disagree) to 5 (strongly agree): “I trust the Centers for Disease Control (CDC) will know how to cope with the disease if an outbreak will occur in the United States”.

Results

Representational Validity

In order to test whether articles from different themes were rated differently in terms of their presentation of the main problem as either a medical/health risks or social/economic disruptions, a Chi-Square test was conducted. The test was significant, $\chi^2(2, 576) = 121.27, p < .001$. As can be seen in Table 9, participants who rated articles from the scientific and pandemic themes were more likely to rate the main problem described in the article as a health problem. 501 out of 574 of the articles from the scientific theme, and 461 out of the 597 articles from the pandemic theme, were rated as mainly about medical/health risks. Articles from the social theme, on the other hand, were more likely to be rated as presenting the disease mainly as causing social/economic disruptions (333 articles out of 557). These results correspond to the ratings made by coders, who found medical/health risks to be most central to the scientific theme, then the pandemic theme, and least to the social theme. Similarly, the topic of social/economic disruptions was rated by the coders as highly central to articles in the social theme, but as not central to the scientific and pandemic themes (See Table 8 for coders' ratings).

Table 9. Main problem caused by the disease as presented in the article

	Social	Scientific	Pandemic	Total
Medical/health risks	224	501	461	1186
Social/economic disruption	333	73	136	542
Total	557	574	597	1728

Next, I tested whether articles from different themes were perceived differently in terms of the use of information guiding individual response. Since every participant rated three articles, a cross-classification random-intercepts only (for participant and article)

model using REML (with p value approximations using Satterthwaite method, see Luke, 2017) was calculated. The results revealed significant differences in the average ratings of articles from different themes. For the item “the article told me what to do in order to avoid getting infected with the disease”, ratings were highest for articles from the scientific theme (predicted marginal means $M = 2.86$, $SE = .04$), followed by the pandemic theme ($M = 2.11$, $SE = .04$), and the social theme ($M = 1.40$, $SE = .04$). All differences were significant ($p < .001$). Similarly, for the item “The article told me what to do in case I think I'm getting infected OR I am getting infected with the disease”, ratings were highest for articles from the scientific theme ($M = 2.43$, $SE = .04$), followed by the pandemic theme ($M = 2.08$, $SE = .04$), and the social theme ($M = 1.38$, $SE = .04$). All differences were significant ($p < .001$). These results correspond to the ratings made by the coders, who found individual response to be most central to the scientific theme, then the pandemic theme, and least central to the social theme.

Similar REML model was used for organizational response. The results of the model showed that ratings were highest for articles from the pandemic theme ($M = 3.39$, $SE = .04$), followed by the scientific theme ($M = 3.26$, $SE = .04$), and lowest for the social theme ($M = 2.07$, $SE = .04$). The differences between the social theme and the other two themes were significant ($p < .001$), and the difference between the pandemic and scientific was not significant ($p = .31$). Again, these results correspond with the manual content analysis, indicating that organizational response information was most central to the pandemic theme, followed closely by the scientific and rated lowest for the social.

Construct Validity

On average, perceived-uncertainty was moderately-low ($M = 2.55$, $SD = 1.04$). Self-efficacy was relatively low on average ($M = 2.81$, $SD = 1.03$) but organizational-efficacy was moderately-high ($M = 3.01$, $SD = .99$). Trust was relatively high ($M = 3.48$, $SD = 1.02$). As expected, organizational-efficacy is positively correlated with self-efficacy, and both are negatively correlated with uncertainty. The correlations between the three perception variables can be seen in table 10:

Table 10. Pearson correlations between perception variables

	Self-efficacy (SE)	Organizational-efficacy (OE)	Certainty
SE			
OE	.64***		
Certainty	.52***	.55***	
Trust	.50***	.63***	.36***

*** $p < .001$

To test whether exposure to articles from different themes yielded different evaluations, a set of cross-classification random-intercepts only models using REML (with p value approximations using Satterthwaite method, see Luke, 2017) were calculated.

H1 predicted that people reading articles from the social theme express higher uncertainty than people reading articles from the pandemic and scientific themes. RQ4 asked whether perceived uncertainty differs for those reading the pandemic and scientific articles. To test whether exposure to articles from different themes yielded different evaluations, a set of cross-classification random-intercepts only models using REML

(with p value approximations using Satterthwaite method, see Luke, 2017) was calculated. For perceived-uncertainty, exposure to articles from the social theme yielded the highest ratings of uncertainty (predicted marginal means $M = 3.34$, $SE = .03$), and the differences from the pandemic ($M = 2.36$, $SE = .03$) and scientific ($M = 1.97$, $SE = .03$) themes were significant ($p < .001$). The difference between the scientific and pandemic was also significant ($p < .001$). H1 was supported, and the difference inquired in RQ4 was found to be significant.

H2a predicted that people reading from the scientific theme express higher perceived self-efficacy than people reading from the pandemic theme, that in turn express higher levels than those reading from the social theme. For self-efficacy, exposure to articles from the scientific theme ($M = 3.30$, $SE = .04$) yielded statistically significant ($p < .001$) higher evaluations compared to the pandemic ($M = 2.83$, $SE = .04$) and social ($M = 3.28$, $SE = .04$) themes. The difference between the pandemic and social was also significant ($p < .001$). H2a was supported.

H2b predicted that people reading from the pandemic theme express higher perceived organizational-efficacy than those reading from the scientific theme, that in turn express higher levels compared to the social theme. For organizational-efficacy, exposure to articles from the pandemic theme ($M = 3.35$, $SE = .03$) yielded similar ($p = .83$) evaluations as exposure to the scientific theme ($M = 3.30$, $SE = .03$), and both were statistically different ($p < .001$) from the lower evaluations for the social theme ($M = 2.35$, $SE = .03$). H2b was partially supported.

H2c predicted that people reading from the pandemic theme express higher trust than those reading from the scientific theme, that in turn express higher trust than those

reading the social theme. As expected, exposure to articles from the social theme yielded the lowest trust in CDC ($M = 3.04$, $SE = .04$) and its difference from the scientific ($M = 3.71$, $SE = .04$) and pandemic ($M = 3.71$, $SE = .04$) was significant ($p < .001$). The difference between the pandemic and scientific themes was not significant ($p = .140$).

Discussion– Scale Development, Relationship between CERC Components, and Effects of Exposure to Articles from Different Themes

Previous chapters demonstrated differences in the prominence of CERC components between themes, as found by coders based on a codebook derived from the theoretical underpinning of CERC. However, the complexity of texts extracted from real world coverage may result in different readings and interpretations by different groups. This section and the study it described aimed to establish representational and construct validity following the manual content analysis of the three themes; scientific, pandemic. The validation provides support for subsequent observed effects of exposure to the themes, supporting the attribution of these effects to the characteristics of the themes (i.e., the existence and absence of CERC components). The validation study supported the existence of differences between themes, demonstrating naïve audience's evaluations that correspond with the theory-driven analysis done by the coders. Specifically, coding of the centrality of CERC components (medical/health risks, social/economic disruptions, individual response, and organizational response) corresponded to evaluations by naïve audiences. These findings provide evidence for representational validity. Similarly, perceptions following the reading of articles corresponded with the expectations based on CERC, thus providing evidence for construct validity. Associations between exposure and perceptions of self-efficacy, organizational-efficacy, uncertainty, and trust

corresponded to the hypothesized differences that were stated based on CERC. The exception is the lack of significant difference on perceived organizational-efficacy and trust between the pandemic and scientific themes (although, as expected, both were higher on both variables than the social theme). These findings will support arguments for a causal mechanism in the following section, the experimental design.

Several limitations should be discussed. First, participants read articles about real and relatively familiar diseases that received ample attention from the media in recent years (Zika, H1N1 and Ebola). Prior knowledge and familiarity with the diseases may have influenced people's ratings of the articles. For example, people's prior knowledge might influence their perception of diseases as certain or uncertain. However, the wording of the questions ameliorated this concern by directing attention to the articles and not the disease (e.g., "the article provided a full picture of the disease").

Second, participants were randomly assigned to read articles about different diseases from different themes. Such a design may lead to spill-over effects between articles, themes and diseases. However, randomized order and exposure ameliorate this concern.

Third, as explained in the discussion of the manual content analysis, effects were tested in extreme cases where articles were very strongly dominated by one theme. As a result, many of the articles in the Social theme were not primarily focusing on the disease to begin with, and thus included low levels of information about risk and individual response. However, these articles represent a common phenomenon in the corpus, where the disease is discussed tangentially, as part of the coverage of other issues and it was

therefore important to test their effects on audiences, especially in light of past arguments that media events may be beneficial to crisis communicators.

Lastly, although mTurk provides a cost-effective and relatively reliable source for data collection, its sample is not representative of the general U.S population. Additional worries were raised by scholars regarding the levels of attention to tasks given by mTurkers. Nevertheless, the platform is often used by researchers and was found to be reliable and efficient.

Despite these caveats, this study provides support for the argument about differences between articles from different themes in terms of CERC components. It also provides preliminary evidence for potential effects of exposure to these themes. Nevertheless, “content differences are not effects (Cappella & Jamieson, 1996, p. 15). Understanding audiences’ reactions are key to improving the effectiveness of CDC’s messages during crises (Reynolds & Seeger, 2014). Therefore, the next section will examine the effects of themes on audiences’ perceptions and behavioral intentions using a controlled experimental design. To increase the ability to detect effects, it will use new articles about new diseases that emulate the content differences found in the real articles. In addition to conditions representative of the scientific, pandemic, and social themes, a control conditions will be added, exposing participants to a news article about the disease without providing any of the information recommended in CERC (worst-case scenario coverage) and an additional condition that will provide all the information recommended in CERC (ideal-scenario coverage). This design will allow to test the effects of real world coverage, and to test the effectiveness of a combination, that while not prevalent in the real world, is hypothesized in CERC to be effective.

Chapter 6 – Experiment: The Effects of Epidemics News Coverage

CERC was designed by CDC in order to inform the public about risks and the organization's reactions to it, and persuade individuals to modify their behavior to reduce risk (Veil et al., 2008). According to CERC, providing the public with information it needs to make sense of the crisis (Weick, 1988), i.e., information about medical/health risks, social/economic disruptions, individual response, and organizational response (Reynolds & Seeger, 2014) increases self and organizational efficacy, reduces uncertainty, and, in turn, yields trust. Trust, subsequently, leads to compliance and support (Seeger et al., 2009). Previous chapters established the existence of three distinct themes, found through automated content analysis to be systematically used by the media to cover epidemics; these were labeled scientific, pandemic, and social. Manual content analysis found substantial differences between themes in the prevalence of CERC information components. Specifically, articles in the scientific theme tended to focus on medical/health risks, articles in the pandemic theme on organizational response, and articles in the social theme on the social/economic disruption. The crowdsourcing-based validation indicated that naïve audiences interpreted articles representing each theme in ways similar to those analyzed by the researcher and the coders, based on the theoretical assumptions of CERC. It also demonstrated correlations between exposure to different themes and perceptions of efficacy and uncertainty. Chapter 6 examines whether the perceptions that result from exposure to different themes affect trust, and whether trust leads to compliance and support, as expected in CERC. Next, measuring the levels of trust, compliance, and support respondents brought to the study could help establishing causality (Jamieson & Cappella, 1996). A controlled experimental design will allow for

these base-rate levels as well as for the content to which participants are exposed. This chapter describes an experiment testing the effects of exposure to articles representative of the three themes, while also comparing them to the effects of articles that contain all the information recommended in CERC (the ideal-CERC condition), and a control condition including the basic articles without CERC features (the no-CERC condition).

From coverage to perceptions of efficacy, certainty, and trust

A central goal of CERC is improve compliance and support in the organization through the removal of psychological barriers, including low levels of certainty, self-efficacy, organizational-efficacy, and trust. The expected effects of coverage, and specifically differences in the prevalence of risk and individual response information, was discussed in earlier chapters. To summarize that discussion, the content analysis demonstrated that themes differed in their use of these CERC components, and the mTurk study suggested that exposure to articles from different themes might yield different perceptions of uncertainty and self and organizational efficacy.

Specifically, the manual content analysis showed that the social theme included no information about risks and facts, nor about ways to reduce risks, by individuals or by organizations. It is hence expected to decrease perceptions of certainty regarding the disease mentioned in the article (CERC discusses perceptions of uncertainty, as well as lack of efficacy. To avoid confusion and for convenience of discussion and measurement, these will be discussed from now on as levels of certainty and efficacy, i.e., high levels of uncertainty will be discussed as low levels of certainty). As for the difference between the other two themes, the mTurk study suggested that certainty will be higher among

readers of articles from the scientific theme (emphasizing individual response), compared to the pandemic theme (consisting of more information about organizational response). It was hypothesized that:

H3a. People reading articles from the social theme express lower certainty than people reading articles from the pandemic theme, and those reading from the pandemic theme express lower certainty than those reading from the scientific theme.

Certainty (and uncertainty) results from the scope and amount of information about the disease. Since all themes include more information about the disease than the control condition that includes no CERC information components at all (no-CERC condition), and all include less components than the ideal-CERC condition, it was also hypothesized that:

H3b. People reading articles from the ideal-CERC condition express the highest certainty (compared to all other conditions), and those reading from the no-CERC condition express the lowest certainty.

The manual content analysis showed differences between the three themes in the prevalence and centrality of individual response information. The social theme included almost no information about what individuals or organizations might do in order to reduce risks. The pandemic theme included more information about what organizations

can and are doing, and the scientific theme focused more on what individuals can do. The results of the mTurk study demonstrated that exposure to articles from the scientific theme yielded higher levels of self-efficacy, compared to the pandemic theme that yielded higher levels than the social theme. The ideal-CERC condition is the only one to include individual response information and thus its readers are expected to be highest on self-efficacy. This increase in self-efficacy is expected to be mediated through efficacy beliefs. The no-CERC condition provides very little information about the disease and thus is expected to lead to the lowest self-efficacy, as its readers will not be exposed to individual response information, but also to no information that can allow them to infer what behaviors can be taken to ameliorate risks. It was hypothesized that:

H4a. People reading from the scientific theme express higher perceived self-efficacy than people reading from the pandemic theme, and those reading from the pandemic theme express higher levels than those reading from the social theme.

H4b. People reading from the ideal-CERC condition express highest perceived self-efficacy and those reading from the no-CERC condition express the lowest self-efficacy.

H4c. The effect of condition on self-efficacy will be mediated by the belief that one knows what to do in case of an outbreak, in a way that people reading articles

containing efficacy information will believe they know what to do, that in turn will increase their perceptions of self-efficacy.

As for organizational-efficacy, in the mTurk study, exposure to articles from the pandemic theme (rich in information about organizational response) yielded higher perceived organizational-efficacy than exposure to the scientific theme that in turn yielded higher efficacy compared to the social theme. Again, providing the richest information on the disease, the ideal-CERC condition is expected to lead to the highest organizational-efficacy, while the information-scarce no-CERC condition is expected to lead to the lowest. It was therefore hypothesized that:

H5a. People reading from the pandemic theme express higher perceived organizational-efficacy than those reading from the scientific theme that in turn express higher levels compared to the social theme.

H5b. People reading from the ideal-CERC condition express highest perceived organizational-efficacy and those reading from the no-CERC condition express the lowest organizational-efficacy.

H5c. The effect of condition on organizational-efficacy will be mediated by the belief that one knows what CDC is doing in case of an outbreak, in a way that people reading articles containing organizational response information will

believe they know what CDC is doing, and that belief will in turn will increase their perceptions of self-efficacy.

Another primary route to cooperation and compliance is trust (Jamieson, 2015; M. B. Rogers et al., 2007). According to CERC, public trust can be gained, in part, by communicating information about the organization's understanding of the risks, the steps it takes toward ameliorating them, and by providing useful advice for individuals to reduce their own risks (Reynolds, 2016; Reynolds & Seeger, 2014). The ideal-CERC condition is the only one to present readers with suggested actions individuals can take to ameliorate risks, while also discussing organizational response, and providing risk information (both health and social risk). It was hypothesized to lead to the highest trust among conditions. The no-CERC condition consisted of none of that information and was hypothesized to lead to the lowest levels of trust. The social theme, while providing more information than the no-CERC condition (albeit only on the social disruptions caused by the disease) was expected, based on the findings from the mTurk study, to perform worse than the scientific and pandemic themes. Since the pandemic theme describe how CDC is acting towards ameliorating risk, it was hypothesized to lead to higher trust in comparison to the scientific theme that focused on risk information without providing information on ameliorating actions. It was hypothesized that:

H6. Exposure to the ideal-CERC condition leads to the highest trust in CDC, followed by the pandemic, scientific, social, and no-CERC conditions, in that order.

Compliance with and Support in CDC

In order to reduce risks during a crisis, CDC's CERC aims to increase compliance with its behavioral recommendations and support in the organization and its efforts. During a crisis, CDC often attempts to persuade people to change their behavior and follow the organization's behavioral recommendations. According to the Theory of Planned Behavior (Ajzen, 1985), the strongest determinants of behaviors are intentions, which are summaries of people's motivation to engage in a behavior (Elliott, Armitage, & Baughan, 2005). Intentions, in turn, are influenced by beliefs about the disease and the behavior (e.g., the belief that taking action can ameliorate the risk, as measured through perceived self-efficacy).

TPB and other theories of health behavior emphasize the importance of beliefs about personal control (Ajzen, 1985), measured in this study through self-efficacy. Another key factor in health-related decision making processes is trust in health workers and organizations (Cooper, Larson, & Katz, 2008; Gilson, 2006; Meredith, Eisenman, Rhodes, Ryan, & Long, 2007). During crises, trust increases the acceptance of the risk presented by the organization and thus encourages taking action to avoid it (Covello et al., 2001). Uncertainty, on the other hand, may reduce intentions to adopt a behavior (Sia, Teo, Tan, & Wei, 2004). Since differences in coverage are expected in CERC to influence perceptions of certainty, self-efficacy, and trust, it was hypothesized that the effect of coverage on intention to comply will be mediated through these perceptions:

H7 (a) Trust in CDC, (b) self-efficacy, and (c) perceived-certainty are positively associated with intentions to comply with the organization's behavioral recommendations during a crisis.

H8. The effect of exposure to conditions on intentions to comply will be mediated through (a) trust, (b) self-efficacy, and (c) perceived-certainty.

Another goal of crisis communications according to CERC is to “persuade the public to support public policy and resource allocation to the problem” (Reynolds & Seeger, 2014, p. 9). Trust was found to be one of the most important predictors of acceptance of organizational decision making during crises (Cvetkovich & Winter, 2003) and an important determinant of support in governmental spending (Rudolph & Evans, 2005). Perceived organizational-efficacy, the belief in the organization's ability to cope with the disease, was also hypothesized to increase intentions to support the organization. As in H8, the effect of exposure to conditions on intention to support was hypothesized to be mediated through perceptions. It was hypothesized that:

H9 (a) Trust in CDC and (b) perceived organizational-efficacy are positively associated with intentions to support the organization and its efforts during a crisis.

H10. The effect of exposure to conditions on intentions to support will be mediated through (a) trust and (b) organizational-efficacy.

Information seeking

The following set of hypotheses is not part of CERC but was added by the researcher due to importance and centrality of information seeking and sharing to theories of crisis, risk, and health communications. Recent decades, especially during the digital age of the Internet (Cline & Haynes, 2001), have witnessed an increase in the active consumption of health information by laypersons (Niederdeppe et al., 2007). Despite its growing importance in literature of health behavior and communications, information seeking is mentioned in CERC only in passing. Specifically, CERC considers information seeking an individual response that can mitigate threats. Since crises are often characterized by an information deficit, CERC advises health communicators to “share how and where [the public] can find more information” (p. 11). During public health crises, people seek information from various sources, including family, friends, and online sources (N. Lewis et al., 2012; Ramírez et al., 2013). Studies have shown that people who seek health information are also more likely to engage in healthy behavior (Ramírez et al., 2013). Previous studies on the relationship between perceived-risk and information search demonstrated the ability of perceived risk to increase information search (Gemünden, 1985). Similarly, studies have shown that during epidemic outbreaks, anxiety can increase information seeking (Tausczik, Faasse, Pennebaker, & Petrie, 2012). In the absence of prior knowledge about the effect of CERC-information components on information seeking, a research question was also added:

H11. Perceived (a) severity and (b) vulnerability are positively associated with intentions to seek further information about the disease.

RQ5. Does exposure to different conditions affect intentions to seek information?

Similarly, since the information people seek is not necessarily from the CDC, it was not clear if trust in the organization will increase intentions to seek further information elsewhere. The following research question was added:

RQ6. Does trust in CDC increase intentions to seek information about the disease?

Information sharing

Despite its growing importance for the information dissemination process (Stieglitz & Dang-Xuan, 2013), the importance of information sharing by laypersons in social media is also mentioned only briefly in CERC (p.225). CERC acknowledges that “social media channels are increasingly important. In many cases, the first news of a crisis will probably be shared via Twitter or Facebook” (p. 239). However, the framework does not detail ways to increase information sharing. CERC is mostly concerned with CDC’s use of social media during crises. However, information sharing among offline and online communities can extend the reach of its messages. In some cases, users who share messages can become “health advocates” (p. 275). While I could not find studies examining the relationship between perceived-risk and information

sharing, studies have shown that articles are more likely to be shared when they include emotional language (Cappella, Kim, & Albarracín, 2015; Stieglitz & Dang-Xuan, 2013) and evoke strong emotional responses (J. Berger, 2011), such as strong fear (J. Berger, 2014). Since perceived risk is expected to be correlated with fear (Slovic, Fischhoff, & Lichtenstein, 1980) it was hypothesized that:

H12. Perceived (a) severity and (b) vulnerability are positively associated with intentions to share information about the disease with friends and family.

Again, in the lack of prior knowledge, a research question was put forward regarding the effect of condition on intention to share information:

RQ7. Does exposure to different conditions affect intentions to share information?

RQ8. Does trust in CDC increase intentions to share information?

Overview of experimental procedures

A total of 321 people (167 females, 262 whites) between the ages of 18 and 86 years ($M = 40.22$ years, $SD = 15.35$ years) participated in an online study in exchange for monetary compensation. Participants were recruited via Survey Sampling International (SSI) that uses a panel of more than two million individuals who, while varying in characteristics, cannot be considered representative of the U.S population. Participants

were randomly assigned to one of five conditions: the no-CERC, scientific, pandemic, social, and ideal-CERC conditions. Participants in each condition read two articles each, the first describing the outbreak of a new disease in West Africa, called Acute Tropical Syndrome (ATS). The disease was invented for the purposes of the study, and no real disease with such name exists in reality. The second article described the personal story of a Canadian missionary who contracted ATS while volunteering in Senegal, and was moved to a Canadian facility in Toronto for further treatment. Stories in all conditions shared the same base story, and the manipulation occurred only in the headers and concluding paragraphs for each article. For example, participants in all conditions read the same first three paragraphs about the outbreak in West Africa, but the headers they read, as well as the last paragraph, were manipulated based on condition. The stories in the no-CERC condition included no information about medical/health risks, social/economic disruptions, individual response, or organizational response. Stories in the ideal-CERC condition included information about all of these components. The rest of the conditions were manipulated to represent the themes identified in content analysis; the scientific condition included information about medical/health risks, the pandemic condition information about organizational response, and the social condition information about social/economic disruptions. After reading the two articles participants answered a questionnaire, and were then debriefed before being paid. The full articles for all conditions can be seen in Appendix B.

Due to the use of multiple comparisons, the analysis that follows is using a Bonferroni adjustment when comparing the effects of conditions on perceptions and intentions. However, it is important to note that this is a conservative approach, as all

comparisons were hypothesized in advance based on theoretical grounds. All mediation analyses were done using the “mediation” package in R (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014), estimating average causal mediation effect (ACME) and average direct effect (ADE) using simulations with a Monte Carlo method, based on normal approximation (Imai, Keele, & Tingley, 2010).

Measures

Intention to comply was measured using five items, measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The five items scale ($\alpha = .88$) included the following items: “If the ATS outbreak reached my city/town, I would follow the CDC’s recommendations strictly”, “If the ATS outbreak reached my city/town I would do what the CDC says”, “I will take preventive action suggested by the CDC to avoid getting infected with ATS”, “It is very likely that I would follow CDC’s recommendations during an ATS epidemic”, and “If CDC were to recommend a vaccine that could protect me from getting ATS, I would get vaccinated”.

Intention to support was measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), adapted from the Science & Engineering Indicators (Bond et al., 1993). The four items scale ($\alpha = .86$) included the following items: “I would support shifting funds from other health issues to conduct research on the ATS disease”, “I would support more taxes for the purpose of funding research on the ATS disease, even if it meant that my taxes would go up”, “Scientists should prioritize researching diseases such as ATS, at the expense of other research projects”, and “Scientific research

that advances the knowledge about the ATS disease should be supported by the federal government, even if research funds for other diseases have to be reallocated to ATS”.

Trust was measured on a 5-point Likert scale from 1 (no confidence at all) to 5 (complete confidence), adapted from the Science & Engineering Indicators (Bond et al., 1993) and from the Annenberg Public Policy Center’s Zika study (Ophir & Jamieson, 2018). The four items scale ($\alpha = .88$) included the following items: “How much confidence do you have in CDC’s ability to respond effectively to an ATS outbreak in the United States”, “How much confidence do you have in the people running the CDC”, “How much confidence do you have in the scientists working for the CDC”, and “How much confidence do you have in the head of CDC, DR. Anne Schuchat”.

Perceived-Certainty was measured on a 5-point Likert scale (Mishel, 1981). One item. “The ATS disease was described in the articles in ways that could have many meanings”, was excluded from the scale due to very low correlated between the item and the rest of the scale ($r = .28$). The 7-items scale ($\alpha = .77$) included the following items: “I have a full picture of the ATS disease in my mind”, “Scientists know all the necessary information about the ATS disease”, “Current knowledge about the ATS disease is certain”, “It is clear how bad the ATS disease is”, “I have a lot of unanswered questions about the ATS disease” (reversed), “It is clear to me what happens to people who get infected with the ATS disease”, “I don’t know what is wrong with people who are infected with the ATS disease” (reversed).

Self-efficacy was measured on a 5-point Likert scale (Bandura, 2006) from 1 (strongly disagree) to 5 (strongly agree). The four items scale ($\alpha = .70$. Removing any of the items reduced the Alpha even further) included the following items: “If I were to be

infected with ATS I would be able to cope with it”, “Protective behavior will reduce my risk of getting infected with ATS”, and “I am certain that taking action based on what I’ve learned about the ATS disease from the articles will keep me safe”.

Efficacy belief was measured on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The three items scale ($\alpha = .87$) included the following items: “I know what to do in order to avoid getting infected with the ATS disease”, “I know what to do if I suspect that I have been infected with the ATS disease”, and “I know what citizens need to do to fight ATS disease”.

Organizational-efficacy was measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The four items scale ($\alpha = .85$) included the following items: “I’m confident that CDC can stop the ATS disease from spreading”, “CDC can effectively reduce risks and harm caused by the ATS disease”, “The CDC can stop the ATS disease from reaching my home state”, and “The CDC can cope with the ATS disease”.

Organizational role belief was measured on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The two items scale ($r = .66$) included the following items: “I am clear about what the CDC is doing in order to reduce the number of infections during the outbreak of the ATS disease” and “I know what the CDC’s responsibilities are during the outbreak of the ATS disease”.

Intention to seek information was measured on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The four items scale ($\alpha = .83$) included the following items: “I intend to go online and seek more information about the ATS disease”, “I intend to talk with my doctor about the ATS disease to get more

information”, “I intend to learn more about ATS by talking to family and friends”, and “I intend to read more articles that I come across about ATS disease”.

Intention to share information was measured on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). The four items scale ($\alpha = .91$) included the following items: “I intend to inform my friends and family about the ATS disease”, “I intend to write about the ATS disease on social media (Facebook, Twitter, email, etc.)”, “I intend to share news articles I find about the ATS disease on social media (Facebook, Twitter, email, etc.)”, and “I intend to share official information from the CDC’s website about ATS on social media (Facebook, Twitter, etc.)”.

Due to its centrality to theories of crisis and risk communications (B. M. Rogers & Pearce, 2016) and evidence for its effect on adoption of protective behavior during pandemics (Potts, Michie, & Rubin, 2010), and intentions to use vaccines (Brewer et al., 2007; Smailbegovic, Laing, & Bedford, 2003) risk perception was measured in order to serve as a covariate in the models. The two dimensions of perceived-severity and perceived-vulnerability (Rothman & Kiviniemi, 1999) were measured:

Perceived-severity was measured on a 5-point Likert scale, from 1 (extremely low) to 5 (extremely high agree). The three items scale ($\alpha = .85$) included the following items: “To the best of your knowledge, if someone is infected with ATS, what is the chance that this person will die?”, “To the best of your knowledge, if someone is infected with ATS, what is the chance that this person will suffer severe physical damage from the disease”, and “To the best of your knowledge, if someone is infected with ATS, what is the chance that this person will suffer permanent physical damage from the disease”.

Perceived-vulnerability was measured on a 5-point Likert scale, from 1 (extremely unlikely) to 5 (extremely likely). The two items scale ($r = .82, p < .001$) included the following items: “How likely do you think it is that you will get the ATS disease in the next 6 months” and “How likely do you think it is that you will get the ATS disease sometime in the future”.

Results

Descriptive Statistics

Means, standard deviations, sample sizes, and correlations between the variables can be seen in Table 11:

Table 11. Pearson correlations between variables of interest

	M (SD)	n	1	2	3	4	5	6	7	8	9
1	2.63 (.72)	321									
2	3.47 (.70)	321	0.63*								
3	3.29 (.85)	321	0.50*	0.60*							
4	3.49 (.80)	321	0.35*	0.53*	0.57*						
5	4.08 (.81)	318	0.23*	0.39*	0.33*	0.52*					
6	3.39 (.88)	321	0.49*	0.58*	0.54*	0.51*	0.42*				
7	3.44 (.92)	321	0.44*	0.47*	0.44*	0.41*	0.35*	0.63*			
8	3.04 (1.05)	320	0.50*	0.52*	0.48*	0.47*	0.32*	0.61*	0.76*		
9	2.26 (1.08)	321	0.32*	0.30*	0.34*	0.28*	0.02	0.42*	0.44*	0.53*	
10	3.07 (.82)	321	0.29*	0.29*	0.35*	0.32*	0.29*	0.38*	0.44*	0.41*	0.50*

1. Certainty 2. Self-efficacy 3. Organizational-efficacy 4. Trust 5. Intention to comply 6. Intention to support 7. Intention to seek information 8. Intention to share information 9. Vulnerability 10. Severity.

Note. * $p < .001$.

Hypotheses

H3a predicted that people who read articles from the social theme express lower certainty than people reading articles from the pandemic theme, that express lower certainty than those reading from the scientific theme. H3b predicted that the ideal-CERC condition yield the highest and no-CERC the lowest perceptions of certainty, compared to other conditions. An analysis of variance ($F = 5.73, p < .001$) was conducted and found that the ideal-CERC condition did yield the highest levels of certainty ($M = 2.91, SD = .65$), followed by the scientific ($M = 2.72, SD = .68$), social ($M = 2.72, SD = .69$), and pandemic ($M = 2.40, SD = .81$). The lowest certainty was expressed by those reading from the no-CERC condition ($M = 2.47, SD = .62$). Using a Bonferroni adjustment, the difference between the ideal-CERC condition and the no-CERC and between the ideal-CERC and the pandemic condition were statistically significant ($p < .01$). The difference between the pandemic and the scientific condition was marginally significant ($p = .081$). Against expectation, the social condition yielded higher uncertainty compared to the pandemic theme, a difference that was marginally significant ($p = .07$). Other conditions did not differ significantly ($p > .05$). H3a was partially supported. H3b was supported.

H4a predicted that people who read from the scientific theme express higher self-efficacy than people reading from the pandemic theme, that in turn express higher levels than those reading from the social theme. H4b predicted that the ideal-CERC condition yields the highest and the no-CERC condition the lowest perceptions of self-efficacy. An analysis of variance ($F = 2.71, p = .03$) found that the ideal-CERC condition yielded the highest self-efficacy ($M = 3.67, SD = .59$), followed by the social ($M = 3.57, SD = .76$),

pandemic ($M = 3.42$, $SD = .78$), no-CERC ($M = 3.39$, $SD = .61$), and scientific ($M = 3.30$, $SD = .70$) conditions. Using a Bonferroni adjustment, the difference between the ideal-CERC and the scientific condition was significant ($p = .05$). Differences between all other conditions were not significant. H4a was partially supported and H4b was supported.

H4c predicted that the effect of condition on self-efficacy will be mediated by the belief that one knows what to do in case of an outbreak. A mediation analysis was conducted, using bootstrap (1000 simulations) comparing the ideal-CERC condition and the control no-CERC condition. There was a significant negative direct effect from condition to self-efficacy (95% confidence intervals between $-.35$ and -0.01), but a significant and positive indirect effect through the belief ($.32$, $.61$). The total effect, however, was significant and positive ($.06$, $.50$). H4c was supported.

H5a predicted that those reading from the pandemic theme express higher organizational-efficacy than those reading from the scientific theme that in turn express higher levels compared to the social theme. H5b predicted that the ideal-CERC will yield the highest and the no-CERC the lowest organizational-efficacy. Analysis of variance ($F = 1.40$, $p = .23$) found no significant differences ($p > .05$) between any of the conditions. The order of conditions from highest organizational-efficacy to lowest was no-CERC ($M = 3.41$, $SD = .73$), social ($M = 3.39$, $SD = .91$), pandemic ($M = 3.31$, $SD = .86$), ideal-CERC ($M = 3.16$, $SD = .86$), and scientific ($M = 3.12$, $SD = .89$). H5a and H5b were not supported.

H5c predicted that the effect of condition on perceived organizational-efficacy will be mediated by the belief one knows what the organization does during an outbreak. A mediation analysis was conducted (bootstrap, 1000 simulations) and found that, similar to self-efficacy, the condition had a significant negative direct effect on perceived

organizational-efficacy (.10, .42) and a significant positive indirect effect through the belief (.10, .42). The total effect, however, was not significant (-.50, .04). This finding is congruent with the results of H5a and H5b. H5c was supported as the indirect effect was significant.

H6 predicted that trust in the CDC will be highest among readers of articles from the ideal-CERC condition, followed by the pandemic, scientific, social, and no-CERC conditions, in that order. An analysis of variance found no significant differences ($F = 1.30, p = .26$) between conditions on trust in CDC. Trust levels were similar among readers of the pandemic ($M = 3.58, SD = .76$), social ($M = 3.57, SD = .83$), and ideal-CERC ($M = 3.55, SD = .68$) conditions. The scientific ($M = 3.36, SD = .92$) and the no-CERC ($M = 3.35, SD = .79$) conditions yielded slightly lower levels of trust, but the differences between all conditions were not significant ($p > .05$). H6 was not supported.

H7 predicted that (a) trust in CDC, (b) self-efficacy, and (c) perceived-certainty will be positively associated with intentions to comply with the organization's behavioral recommendations during a crisis. A multiple regression showed that when controlling for demographic variables, as well as perceived-severity ($\beta = .23, p < .001$) and perceived-vulnerability ($\beta = -.22, p < .001$), trust ($\beta = .41, p < .001$) and self-efficacy ($\beta = .19, p = .001$) predicted intentions to comply with CDC. Perceived-certainty did not have a significant effect on intentions to comply ($\beta = .06, p = .416$). The model explained 40.2% of the variance in intention to comply (Adjusted $R^2 = .37$). H7a and H7b were supported. H7c was not supported.

H8 predicted that the effect of exposure to conditions on intentions to comply will be mediated through (a) trust, (b) self-efficacy, and (c) perceived-certainty. First, an

ANOVA found only marginal difference between conditions on intention to comply ($F = 1.89, p = .11$). A Bonferroni adjusted comparison between conditions showed that only the difference between the ideal-CERC ($M = 4.31, SD = .67$) and the no-CERC condition ($M = 3.94, SD = .91$) was marginally significant ($p = .10$). The differences between the social ($M = 4.11, SD = .83$), pandemic ($M = 4.05, SD = .74$), and scientific ($M = 4.00, SD = .84$) conditions and all other conditions were not statistically significant ($p > .1$).

Second, a mediation analysis (bootstrap, 1000 simulations) was conducted and found that exposure to the ideal-CERC condition (compared to the no-CERC control condition) had a positive direct effect on intentions to comply (.009, .53) and a significant total effect (.009, .65), but no significant indirect effect through trust (-.02, .24). A mediation analysis through self-efficacy found that exposure to ideal-CERC (compared to no-CERC) had an indirect effect through self-efficacy (.03, .21) and a significant positive total effect (.10, .64). A mediation analysis through perceived-certainty found a significant positive indirect effect (.04, .18) and a significant positive total effect (.07, .65). H8a was not supported. H8b and H8c were supported.

H9 predicted that (a) trust in CDC and (b) perceived organizational-efficacy will be positively associated with intentions to support the organization and its efforts during a crisis. Controlling for demographic variables, as well as perceived severity ($\beta = .19, p = .133$) and vulnerability ($\beta = .19, p < .001$), trust had a significant association with support ($\beta = .15, p = .003$), and so did organizational-efficacy ($\beta = .16, p = .005$). The model explained 51.2% of the variance in intention to support CDC and its efforts (Adjusted $R^2 = .47$). H9a and H9b were supported.

H10 predicted that the effect of exposure to conditions on intentions to support will be mediated through (a) trust and (b) organizational-efficacy. First, an ANOVA found no statistically significant difference between conditions on intention to support CDC ($F = 0.34, p = .85$). A Bonferroni adjusted comparison between conditions showed no statistically significant differences between any conditions ($p > .05$). The order of conditions on support was as follows: scientific ($M = 3.46, SD = .85$), social ($M = 3.45, SD = .91$), pandemic ($M = 3.40, SD = .94$), ideal-CERC ($M = 3.35, SD = .77$), and no-CERC ($M = 3.30, SD = .90$).

Second, a mediation analysis (bootstrap, 1000 simulations) of the effect of condition on support through trust found no direct ($-.31, .18$) nor indirect ($-.03, .26$) effects. A mediation analysis through organizational-efficacy also found no direct ($-.07, .46$) nor indirect ($-.30, .02$) effects on intentions to support. H10 was not supported.

H11 predicted that perceived (a) severity and (b) vulnerability will be positively associated with intentions to seek further information about the disease. Controlling for demographics and trust (for the purpose of RQ6), severity predicted an increase in intention to seek information ($\beta = .12, p < .001$). Vulnerability also predicted an increase in information seeking ($\beta = .36, p < .001$). None of the demographic variables predicted intention to seek information. Trust positively predicted an increase in intention to seek information ($\beta = .27, p < .001$). The model explained 32.0% of the variance in intention to seek information (Adjusted $R^2 = .31$). H11a and H11b were supported.

To test the differences between conditions (RQ5), an analysis of variance found no significant differences between conditions on intentions to seek information ($F = 1.11,$

$p = .35$). Similarly, no significant differences were found between any of the conditions using Bonferroni adjustments.

Finally, H12 predicted that perceived (a) severity and (b) vulnerability will be positively associated with intentions to share information about the disease with friends and family. Controlling for demographic variables and trust (for RQ8), severity predicted an increase in intention ($\beta = .12, p = .015$) and so did vulnerability ($\beta = .36, p < .001$). H12a and H12b were supported. Trust in CDC predicted an increase in intentions to share information ($\beta = .32, p < .001$). The model explained 41.3% of the variance in intentions to share (Adjusted $R^2 = .40$).

As for differences between conditions (RQ7), an analysis of variance found no differences between conditions on intentions to share information ($F = 2.02, p = .09$), with no significant differences between conditions. The only difference that was marginally significant (using Bonferroni adjustment) was between intentions to share articles after reading from the social theme condition ($M = 3.30, SD = 1.08$) and no-CERC conditions ($M = 2.83, SD = .97$).

Discussion

The purpose of the experiment was to test the effects of exposure to different themes, representing real-world coverage themes, on perceptions that are positively associated with intentions to comply with and support CDC during outbreaks. The effects of conditions mimicking themes found in the content analysis were also compared to an ideal-CERC condition that included all types of information, and a control no-CERC condition, consisting of none of these components. The effects on intentions to comply

with and support CDC were hypothesized to be mediated through perceptions of certainty, self-efficacy, organizational-efficacy, and trust in CDC. In addition, the experiment examined the effects of exposure on perceived risk, and on intentions to seek and share information.

As expected based on the content analysis and the mTurk study, the data showed that not all coverage of epidemics yields the same outcomes. Articles representing the scientific theme led to higher perceived-certainty than those representing the pandemic theme. However, this theme, emphasizing health risk without providing decision-making information, yielded the lowest perceptions of self-efficacy. As expected, the effect of the ideal-CERC condition on self-efficacy was mediated through efficacy-beliefs. No differences were found between any of the conditions on organizational-efficacy. However, when comparing the effect of exposure to the ideal-CERC to no-CERC, there was a significant indirect effect of condition on organizational-efficacy through organizational-efficacy belief. Finally, trust in CDC did not differ between readers of different conditions.

Interestingly, the effect of the social theme on perceptions was more positive than expected, especially since this theme did very poorly in the mTurk study. Although the differences between the social theme and other conditions were not statistically significant, the direction of its effect suggested it did better than the pandemic theme on certainty, and yielded self-efficacy that was second only to the ideal-CERC condition. These differences between the experiment and the mTurk study may be explained by the differences in the articles used in each study. In the mTurk study, participants read real-world articles representing extreme cases of social-theme language use. Therefore, some

of the articles discussed the disease only briefly and tangentially. In the experiment, in order to maximize experimental control, all conditions shared most of the language, and manipulation only occurred in the headline and last paragraph of each article. In other words, the social condition articles in the experiment included lower relative levels of social theme language, compared to those used in the mTurk study. However, despite not performing worse than other conditions, the social theme did not perform significantly better than any of the other conditions in the experiment.

Regarding the conditions that did not represent themes and were created by the researcher to represent an ideal-CERC coverage, and coverage that consisted of none of the CERC components, the results supported their hypothesized effects. The ideal-CERC condition performed well, leading to the highest levels of certainty and self-efficacy. The no-CERC condition performed very poorly, leading to the lowest certainty and self-efficacy.

As for the behavioral intentions of interest, trust and self-efficacy, as well as perceived severity and vulnerability, were positively associated with intentions to comply with CDC's recommendations during an outbreak. Perceived certainty was not associated with intentions to comply. Comparing the ideal-CERC and no-CERC conditions, positive indirect effects of condition on intentions to comply were found through self-efficacy and perceived-certainty (although the causal direction of the association between perceptions and intentions cannot be detected in this experiment). Trust and organizational-efficacy, as well as perceived severity and vulnerability, predicted increase in intentions to support CDC and its efforts. However, no indirect effects of condition on support were found through perceptions. Intentions to engage in two more behaviors, that are less central to

CERC, but are prominent in theories of health behavior, information seeking and sharing, were also associated with trust in CDC, as well as with perceived severity and vulnerability. Exposure to articles from different conditions did not affect intentions to seek or share information.

Taken together, the results of the experiment demonstrate the importance of crisis communications during epidemics, the different effects of different coverage patterns, and the potential of news coverage that aims to include all the information recommended in CERC (i.e., the ideal-CERC condition) to improve communications, and subsequently support in and compliance with CDC during crises. The conclusions derived from this study and the ones presented earlier, as well as their implications, will be discussed more fully in the next chapter.

Several limitations of the experiment should be discussed. First, while random assignment to conditions can support the causal effect of exposure to themes on perceptions, the relationships between perceptions and intentions could be discussed only in terms of associations. For example, it is possible that trust led to perceptions of self-efficacy and organizational-efficacy. However, the fact that condition did not have a direct effect on trust but did have direct effects on perceptions as well as an indirect effect on trust through perceptions, supports the directionality of the model suggested in the hypotheses. The data could support a causal direction for the relationship between trust and intentions, and it might be the case that higher intentions led to increased trust. However, this route is less plausible theoretically.

A second limitation is the possibility of case-category confounding (Jackson, 1992). Since each condition was manipulated using two articles without a randomization

of messages within condition, it might be the case that the results found in the experiment are due to the individual properties of the case belonging to each category. In other words, it might be that these specific articles, and not the themes they represent, were responsible for the effects. However, such concern is ameliorated by the congruency between the results of the experiment and those of the mTurk study, where the number of articles evaluated was larger and more realistic since it was derived from real world coverage.

A third limitation is the lack of ability to examine the long-term effects of a continuous and developing coverage and the ability of articles from different themes to complement each other simultaneously and over time. Participants in the experiment were exposed to articles discussing new diseases that just allegedly began spreading. In all conditions, the disease described in the articles did not yet reach the United States. In the real-world, people who are exposed to articles about epidemics are expected to be exposed to multiple messages, from different themes, and potentially to different themes at different points in the lifecycle of the epidemic (as was demonstrated in the analysis of prevalence of themes over time for each disease). In that pattern of exposure, exposure to new articles interact with what participants already know and feel about the disease from previous exposures. For example, reading an article about the health effects of a disease without any decision-making information (a representation of the scientific theme) might not harm self-efficacy as it did in the experiment, if the reader already read about actions she can take to ameliorate risks the week before in another article, or in another source (e.g., social media). An examination of such interactions requires the use of other methods that are beyond the scope of this study. However, while this caveat ameliorates

some of the worries about the inadequate coverage of epidemics, it is important to remember that individual-response information was scarce across all themes and diseases. Therefore, even the consumption of multiple themes over time is not expected to expose audiences to adequate amount of information about what they can do to ameliorate risks. This information is shown in the content analysis to be slightly more common in articles from the scientific theme, but the coders found this information to be tangential and not central to these articles. Since the ideal-CERC condition demonstrated that even the mere inclusion of efficacy information can improve crisis communications, some articles from the scientific theme, especially those emphasizing individual response, are expected to have more beneficial effects in the real world, compared to articles from the social and pandemic theme, and articles from the scientific theme that lack this information component.

Finally, each article in the original corpus of 5006 articles used for content analysis was composed from a mixture of the three themes. Some articles used language almost exclusively from a single theme, representing an extreme case of theme use (e.g., an article where 99.8 of the language was attributed by the model to the social theme) and some used the themes in more balanced way (e.g., an article where 35.2% of the language was attributed to the social theme, 31.9% to the scientific them, and 32.8% to the pandemic theme). However, the experiment mimicked only the extremes cases, creating articles that are strongly inclined toward one theme and not the others. In order to assess the distribution of themes within articles in the original corpus, a measurement of uncertainty (Gini coefficient) was calculated for each article. In the case of three categories (i.e., three themes), the minimum value of the coefficient is equal to 0 (when

an article uses exactly the same amount of language attributed to each of the three themes), and the maximum is equal to .66 (an article uses only language from one theme. Not using any language from other two). When an article uses only two themes (and uses them equally) without using the third theme at all, the coefficient is equal to .33. On average, the Gini coefficient for articles in the corpus was .45 and the median was .47 and the distribution was skewed to the left. Findings were virtually the same using other measures of uncertainty (such as entropy using maximum likelihood method). These findings indicate that most articles were unequal in their use of themes, with more articles using only one or two themes than a balanced combination of all three. Figure 7 presents the distribution of coefficients for the full corpus.

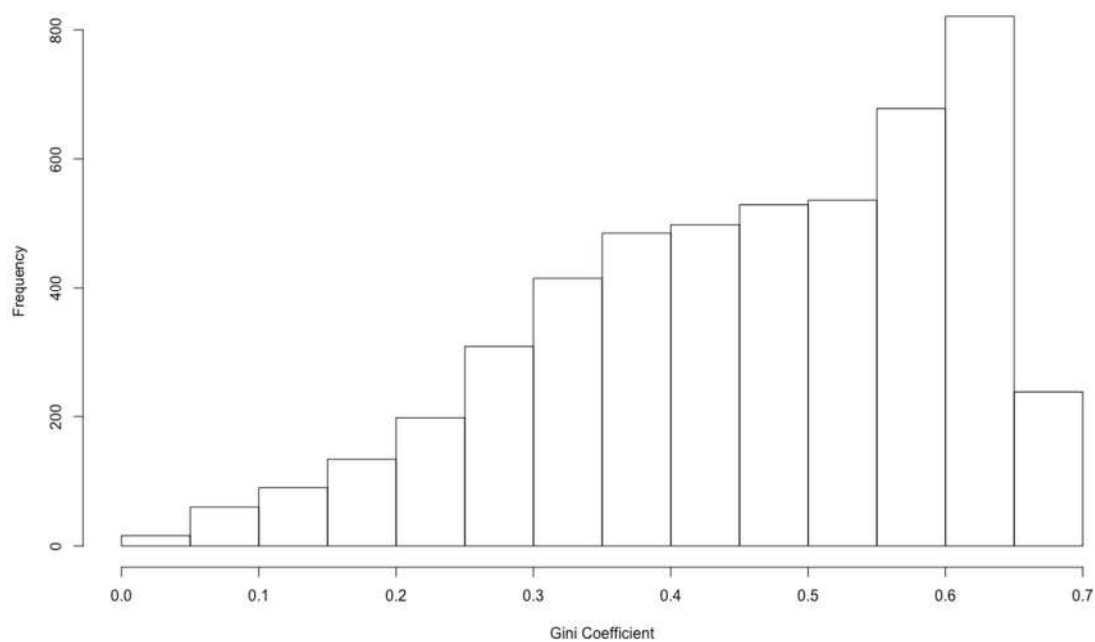


Figure 7. A histogram of Gini coefficients across the full corpus. A coefficient of 0 indicate a perfect balance between themes.

To summarize the findings of the experiment, Figure 8 presents the hypotheses and results regarding the main outcomes of interest, intentions to comply with and support CDC. Figure 9 presents the secondary outcomes of interest, intentions to seek and share information:

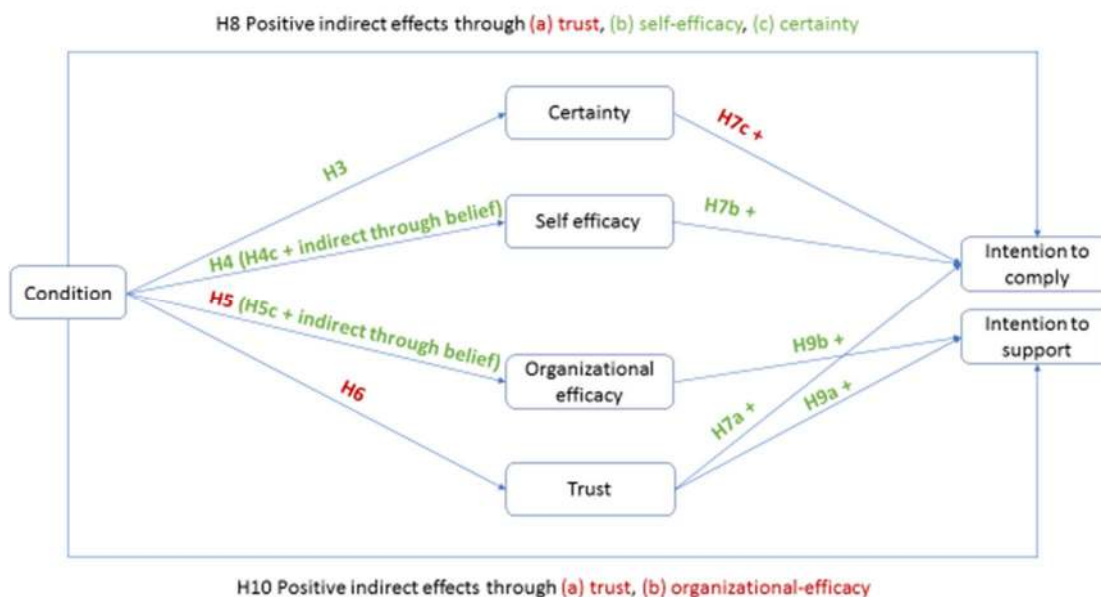


Figure 8. Summary of findings for hypotheses H3-H10. Green color indicates a statistically significant relationship ($p < .05$) and red color a non-significant relationship ($p > .05$).

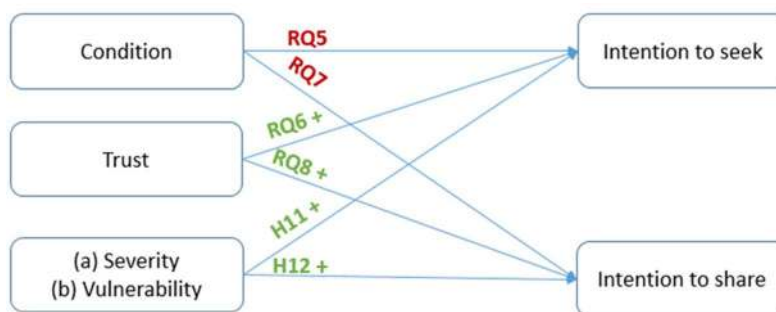


Figure 9. Summary of findings for hypotheses H11-H12. Green color indicates a statistically significant relationship ($p < .05$) and red green non-significant relationship ($p > .05$).

Chapter 7 – Conclusions

Like other public health crises, large scale outbreaks of infectious diseases may cause severe physical, psychological, economic and social impact. Epidemics are dynamic, unexpected, and their course is often unpredictable. Under these conditions, adequate and effective crisis communications become vital for mitigation of risks. In the Crisis and Emergency Risk Communication (CERC) framework, CDC declares that its workers “job as public health and emergency communicators is to offer the information the public needs and counter some of the harmful behaviors that are common during an emergency” (Reynolds & Seeger, 2014, p. 1). Based on theories of crisis and risk communications, as well as health behaviors and decision making, CERC asserts that these harmful behaviors, including lack of compliance and support, result from harmful perceptions. These include perceptions of low certainty, efficacy and trust. To counter these perceptions, and increase compliance and support, CERC recommends that communicators deliver timely and accurate information to the public. Specifically, according to CERC, CDC should deliver information about medical and health risks, social disruptions, and about what individuals and organizational do and can do to ameliorate risks.

Despite the growth in the amount and availability of communication channels, the news media remain CDC’s “best mechanism for reaching [its] audience” (p. 160). (Reynolds & Seeger, 2014, p. 160). As put by the authors of CERC, “even with the advent of social media, most people will still want to confirm information through television and radio” (p. 179). Reynolds and Seeger conclude that “it is imperative that emergency operation centers (EOCs) and all government and nongovernmental

organizations involved in crisis response understand the appropriate needs of the media and how to fulfill those needs as an ongoing and well thought-out part of the response plan.” (p. 179).

Despite these claims, CERC provides very little detail regarding the needs and agenda of the media, including their routinization of the coverage of crisis in general, and epidemics specifically, instead briefly mentioning that health communicators should respect journalists deadlines (p. 37) and provide them with “timely answers to their questions” (p. 183). These recommendations, while important, cannot guide communicators to a better understanding of the media's informational needs. The document does clarify, however, that the media have and should have their own agenda: “public health and emergency management professionals sometimes expect the media to report in way that supports official goals. However, the media are not an adjunct to public emergency response organizations. They have their own place in a free society and their own commitment to the public” (p. 179). CERC concludes that a better understanding of the media’s role in an emergency will improve the relationship between the organization and journalists, and subsequently improve communications with the public during crises (p. 177).

To fill this gap in our understanding of the media’s needs and agenda during epidemics, this study examined the coverage of three epidemic outbreaks in recent years, H1N1, Ebola, and Zika, in four leading American newspapers. With varying degrees, the three diseases had an impact on the United States and the CDC and were covered extensively in the newspapers. It was expected that newspapers would treat each disease somewhat differently, as they varied in terms of spread, lethality, severity and other

aspects. However, due to journalistic routines, especially when covering the unexpected, and the commonalities that diseases share, it was also expected that broader themes could be extracted by analyzing a combined corpus consisting of the coverage of all three. For example, while the social implications of Zika differ from those of H1N1 and Ebola, they all have social implications that generally use similar language, as can be demonstrated in the existence of the social theme. To account for that, this study used a multi-method approach to examine both the topical (structural topic modeling) and thematic (an analysis of topics network) coverage patterns.

The topic modeling procedure identified 34 specific and general topics that were clustered into three themes, based on shared linguistic choices, using a community detection module. Next, the content of themes was analyzed by human coders to evaluate the centrality of crisis information emphasized in CERC. The analysis showed differences between themes in the use of crisis information. The social theme focused almost exclusively on social and economic disruptions. The scientific theme focused strongly on health and medical consequences and to a lesser degree on organizational efforts to contain the disease. The pandemic theme was dominated by a discussion of organizational action, mostly in response to threats outside of the United States. An examination of the prevalence of themes over the timeline of each disease revealed a dynamic use that also changed between diseases.

Importantly, an examination of prevalent information also reveals what was absent from coverage. Instead of providing readers with a comprehensive depiction of a disease, articles dominated by different themes emphasized specific information types and omitted others. For example, articles emphasizing social and economic disruptions

tended to lack a discussion of health implications. Articles that focused on medical and health implications, on the other hand, tended not to discuss social implications. Both articles that focused on health or social implications tended not to discuss what can be done, either by organizations or individuals, to ameliorate risks. These were most prevalent in articles about organizational response that in turn tended not to include information about health or social consequences.

Perhaps most alarming is the finding that individual response information was extremely scarce in articles from all themes and about all diseases. Information about what individuals could do to ameliorate risks is an essential and central component of crisis communication, as well as of most theories of health behavior and decision making. It was found to be crucial for the formation of self-efficacy and the promotion of healthy behaviors. Unfortunately, while CERC guidelines aim to empower members of the public to act in order to mitigate their own risk by informing decision making, the actual news coverage failed to provide readers with such essential information on a regular basis. According to CERC, this lack is expected to increase feelings of powerlessness and helplessness. Feeling they do not have power to improve their own situation or protect themselves, people are expected to be less motivated and less able to take actions that could help themselves. CERC's solution to this problem is to set people on a course of action through individual response information (Reynolds & Seeger, 2014, p. 25).

Another substantial gap between CERC and media coverage can be seen in the news media's focus on the social and economic impact of diseases. CERC barely discusses these implications, mentioning that public health crises may lead to widespread social and economic disruptions. Instead, the lion's share of CERC is dedicated to health

consequences and to actions that can be taken to ameliorate them. The prevalence of social and economic topics in the news, on the other hand, is very high. In fact, the social theme was the most dominant one in the texts, as the model ascribed 44.5% of the language in the corpus to this theme. It was used equally in all three diseases. In all three diseases the relative use of the social theme increased over time, decreasing again only towards the end of the crisis. While the medical threats and organizational responses to them dominate coverage at early stages of outbreaks, the social impact of diseases seems to unfold over time, to a point where towards the end of the maintenance phase diseases are mostly discussed in newspapers in terms of the social and economic disruptions they cause. While CERC acknowledges that the media may be interested in political implications of a risk (p. 36), the magnitude and centrality of it in coverage is unexpected.

While the automated and manual content analysis studies identified differences in coverage between themes, the experiment demonstrated the effects of these gaps in coverage on people's perceptions and behavioral intentions. As expected, conditions emphasizing different aspects of CERC crisis information led to different levels of perceived certainty and self-efficacy. Against expectation, organizational-efficacy and trust in CDC were not influenced by condition. In most cases, the no-CERC condition performed worse and the ideal-CERC condition better than the conditions that represented real world coverage, i.e., the social, pandemic, and scientific themes.

The findings regarding the two main outcomes of interest, intentions to comply and to support CDC, emphasize a difference between effects on perceptions and intentions that relate to the self (the reader) and those relating to CDC. On one hand, the

effect of exposure on certainty and self-efficacy, that are positively associated with compliance, demonstrate the ability of themes to influence how people perceive their own understanding of the disease and potential remedies (individual response), and how these can increase their intentions to act in order to reduce threats. On the other hand, the lack of effect of exposure on organizational-efficacy and trust, that are associated with intentions to support CDC, may point to the inability of the texts to affect perceptions about CDC and its potency during crises. This difference in results may be due to familiarity. When exposed to new information, about a new disease, people's perceptions of their understanding of it (certainty) and their ability to cope (self-efficacy) were affected by the information provided in the articles. However, when exposed to information about an organization they already know, and probably have prior knowledge and opinions about (see for example, Ophir & Jamieson, 2018), people's perceptions are less susceptible to change as a result to exposure to additional information. This pattern may suggest that adequate crisis communications, and CERC specifically, will be more useful for driving behavioral change during infectious disease outbreaks, and less useful for improving people's trust and confidence in CDC. Nevertheless, these aspects might be improved through other guidelines provided in CERC that do not focus on the information itself but on the method of delivery, for example, the advice to communicate with empathy and compassion (Reynolds & Seeger, 2014). In real world outbreaks, though, it might be expected that trust in CDC will also depend on the ability of CDC to provide timely and accurate information to the public. For example, trust in CDC is expected to reduce as if CDC is to admit that a previously endorsed behavioral advice was found to be ineffective or even harmful. In other words, trust in CDC during a

developing event is expected to be dynamic and to depend, in part, on external events. It is important, however, to remember that when exposed to real world articles in the validation study, mTurkers did differ on trust in CDC and in perceived organizational-efficacy. In both cases, the pandemic and scientific themes did better than the social theme. This difference between the validation study and the experiment may be the result of the relative similarities between conditions in the experiment (only differences in headlines and last paragraph), compared to the substantial differences between articles in the real world (where many of the social theme articles discussed the disease only tangentially). Lastly, two additional outcomes that are less central to CERC, intention to seek and share information, were not affected by exposure to different conditions.

The results of the experiment point to the potential benefits of improved communications (ideal-CERC condition). However, they also shed light on the consequences of currently prevalent coverage patterns. Specifically, in the experiment, exposure to articles representing the scientific and social themes, with their focus on medical/health and social/economic impact, led to higher certainty than exposure to the pandemic theme, with its focus on organizational response. However, the scientific theme that presented medical risks but no suggestions for individual response, led to lower levels of perceived self-efficacy, compared to the pandemic and social themes, and even compared to the control no-CERC theme. This finding, especially the comparison to the control condition, emphasizes the potential detrimental effect of presenting threatening health information without providing mitigating actions. Nevertheless, there were no differences between any of the conditions that mimicked real world coverage on intentions to comply with and support CDC.

What could CDC and crisis management organizations learn from these findings and how communications during crises could be improved

As argued earlier, a central aim of this study is to fill the gap in CDC's understanding of journalistic practices and routines during epidemics. A central practice used by journalists, especially when covering unexpected events, is the use of recurring categories. It was therefore expected that similar broad themes will be used in the coverage of epidemics. Using automated and manual content analysis techniques, the study identified three distinct themes that were used constantly by all newspapers studied in all outbreaks under scrutiny. The study also found that the newspapers dedicated a substantial part of their space to the examination of the social impact of diseases, an aspect that is recognized in CERC, but receives relatively less attention by the organization. Unfortunately, another practice used by journalists is the omission of important information, namely the lack of efficacy-inducing information about what individuals can do during epidemics to mitigate threats. Through a detailed description of the categories used in newspapers, the relative prevalence of their appearance in articles about epidemics and an analysis of their potential effects, this study contributes to our understanding of the role mass media play during epidemic outbreaks, and crises in general.

CDC and other organizations stressed the importance the media during public health crises, but acknowledged the limited information currently held regarding the media's needs and agenda during such events. As argued by Tuchman, unexpected events require news organizations to adapt by routinizing the process and release of information,

“for without some routine method of coping with unexpected events, news organizations, as rational enterprises, would flounder and fail.” (Tuchman, 1973, p. 111). Relying on ideas developed in the sociology of work, Tuchman suggests that journalists categorize the objects of their work to control it. Such classification decreases the variability of the raw material processed by news organizations. The classification of news serves as principles of selection, emphasis, and presentation, based on the journalists perceptions of “what exists, what happens, and what matters”(Gitlin, 1980, p. 6). These practices, norms, and routines result in recurring coverage patterns (Scheufele, 1999). However, as opposed to Tuchman’s approach to studying journalistic routines, that relied on ethnography and interviews with journalists, this study studies routines of journalists through an examination of their final products – the articles they have published. The analysis of news articles identified reoccurring themes used by journalists during the coverage of three recent epidemics. Articles relying on and emphasizing similar themes, use similar linguistic choices. However, it is beyond the scope and ability of this study to argue that journalists’ choices to use these themes when covering epidemics are intentional or to determine whether they are aware of the existence of these categories. Indeed, it was Tuchman who pointed to substantial gaps between how she and the journalists envisioned the routinization process (1973). Future work using other methodological approaches may complement these findings by shedding light on the ways journalists perceive their work and routines during crises.

Whether journalists are aware or not of their use of the social, pandemic, and scientific themes, these findings shed light on their practices and routines, and on their role and agenda during public health crises in general, and epidemic outbreaks

specifically. This knowledge should be taken into consideration by CDC communicators when interacting with journalists during crises, and also when preparing their own communication strategy for a crisis. CERC dedicates a whole section to maintaining good work relationships with journalist. The framework encourages communicators to provide journalists with information tailored to the needs of the media. It advises them to agree with reporters in advance about specific topics, based on key messages prepared in advance. The findings of this study suggest that journalists will tend to classify events and information about epidemics through the lenses of the social, pandemic, or social themes. The study demonstrated how the choice of a central theme is likely to increase the use and prevalence of some crisis components and decrease others. Knowing how journalists tend to process information about epidemics can improve the communications between the media and the organization, and subsequently improve communication with the public during crises.

Specifically, the results of the experiment suggest that some coverage patterns do more than others in terms of advancing CDC's goals during a crisis. The study shows that exposure to articles from the ideal-CERC condition, consisting of all CERC components, including information health risks, social disruptions, individual response, and organizational response, leads to higher levels of trust that in turn can increase intentions to comply with CDC's recommendations, to seek further information about the disease, and to share information with others. These findings suggest that CDC's communication efforts during crises could be improved if the media would use messages similar to those envisioned in the ideal-CERC condition. Of course, changing journalists' routines is expected to be a challenge, and most journalists are expected to stick with the categories

identified in this study when covering the next outbreak. However, as argued in CERC, the organization does believe that good relationships with journalists can strengthen the organization's ability to shape coverage. A caveat to this recommendation is that the results of the experiment cannot support the argument that all information components have to appear in the same articles (as was the case in the ideal-CERC condition). In reality, it might be the case that exposure to several articles from different themes would complement the readers' knowledge and reduce psychological barriers to compliance. For example, a person may be exposed to health information (and in some cases individual response) from an article emphasizing the scientific theme, and then read about organizational response in another article on a subsequent day that emphasizes the pandemic theme. These combinations could be less, more, or as useful as the ideal-CERC condition, but such comparisons could not be made using the current data.

The findings suggest that organizations working with journalists should encourage rich and multi-layered articles that provide information about risk (health and social) along with actions (by individuals and organizations) to mitigate it. Ideally, these components will prevail even when the disease is mentioned tangentially in articles, for example in articles about the economic effects of a disease. The data suggest an increase in media attention to diseases around events such as the Olympic Games, as the Zika virus had an impact on athletes and fans. However, it also shows that these events are likely to be covered through the lens of the social theme, providing very little information about health risks and mitigating responses. Fortunately, the results of the experiment suggest that even the addition of a single short paragraph about the health consequences of the disease or an additional information box about ways individuals can act to mitigate threats might go a

long way towards improving crisis communications and increase healthy behavior during crises. As the study suggest that journalists adhere to the practice of focusing much of their newspapers' space to discussing social and economic implications, it is important for CDC to emphasize and explain to journalists how these specific articles, that are of interest to newsperson, can be harnessed for improving public health through the addition of efficacy information.

In addition to attempts to shape media coverage, CDC and other organizations could use the findings of this study when developing their own direct communications during crises. According to CERC, CDC can communicate with the public through multiple channels, including social media, flyers, newsletters, mobile phones messaging, community mailing, emails, websites. Accepting that media coverage could only be changed to a certain degree, CDC should use these direct channels to close the information gaps created by the mass media. This is especially true for information that can inform decision making. The content analysis reveals how little individual response information is provided to readers of newspapers during outbreaks. The experiment demonstrates how the consumption of risk information, in the lack of individual response information, can lead to detrimental consequences. CDC and other health organizations should therefore attempt to compensate for this absence by emphasizing these aspects in their direct communications with the public.

Finally, CDC as well as other agencies that aim to promote healthy and safe behaviors, communities and environment, should educate the public about the media environment in which people consume health information, in general, and about infectious diseases specifically. The results of this study point to the limitations of media

coverage. In addition, recent years have seen an increase in the number of communication channels available for the public, some of which are ripe with misinformation, disinformation, rumors, and so-called fake-news (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). Misinformation tends to prevail under the circumstances of epidemics (Fung et al., 2016), but, as this study demonstrated, even news coverage in mainstream outlets by media professionals, who “generally accept their community and professional responsibilities, especially during a crisis” (Reynolds & Seeger, 2014, p. 160), tend to be incomplete, limited by journalists’ agenda and practices. In this ever changing environment, health organizations should aim to improve the public’s media literacy, not in its traditional form as the ability to understand a text, but in its modern iteration as an essential skill for navigating complex media landscapes. In times of epidemic outbreaks, or other public health threats, people should have the ability to access, analyze, and evaluate messages (Livingston, 2004). Cultivating critical literacy involves “attaining competencies in practices in contexts that are governed by rules and conventions” (Kellner & Share, 2005, p. 369). Teaching the public how to read and interpret news articles about epidemics, based on the conventions identified in this study, and encouraging them to expand their information diet to include other sources, such as official governmental communications or practitioners, could improve people’s ability to cope with public health crises.

Methodological implications – Harnessing computational power to investigate social phenomena

For decades, researchers have been debating about the most effective and accurate ways to systematically analyze the content of news coverage. The rapid increase in our

ability to store and process data in recent years has led to the adoption of computational tools, that allow researchers to shed light on traditional and new communication theories. The use of structural topic modeling allowed the analysis of a corpus consisting of all the articles published about three epidemic outbreaks in three newspapers over months of coverage. Topic modeling offers several advantages, beyond cost efficiency and the ability to cope with large corpora. First, as the model considers each document to be a mixture of topics, it allowed the evaluation of the relative prevalence of each topic in each document (rather than assigning each document to a single central topic). Second, as topic modeling examines the co-occurrence of words over a large amount of texts, it can expose linguistic relationship that a human reader might not be able to uncover due to its scope and complexity (Soroka, 2014). Third, in contrast to dictionary-based approaches to automated text analysis, topic modeling allows words to have different meanings in different contexts (and therefore in different topics). The clustering of topics into themes, through the process of communities-detection in a network of topics, allowed the examination of broader categories that were not idiosyncratic and specific to single diseases, and were instead used across diseases, and are expected to reappear in the coverage of future ones.

Nevertheless, to reduce the bias and influence of the researcher on the interpretation of the themes, two additional studies were conducted to support the validity of the findings of the automated process. A systematic coding, a crowdsourcing survey, and an experiment supported the argument that the coverage of epidemics in the media was dominated by three distinct themes, each consisting of different levels of CERC-recommended information, and each with different effects on readers. The combination

of automated and traditional tools thus allowed a rich examination of the phenomenon, with a focus on both the message and audiences.

Limitations

Despite the use of several methodological tools, this study has focused on two links in the communication chain – the message, and the audience. However, in order to fully understand the communication process during public health crises, one should also look at the communicator (CDC) and the mediator (the journalists). As argued earlier, the work done in newsroom during epidemics could be better understood through additional ethnographic work and interviews with journalists, who can shed light on their perspective on their role during crises, and the ways they understand their work and their use of categories. In order to understand CDC and its implementation of CERC, one should also examine the organization's official press releases, websites, seminars, webinars, and press conferences. Such examination would make it possible to determine whether the gaps found in this study between CERC and real-world coverage are the result of inadequate communications on the part of CDC, or the processing of information by journalists or in the editorial room. For example, an examination of CDC's press releases might reveal that the organization did emphasize individual response information to journalists, but that the information was removed by the journalists or editors before being transmitted to the public.

As explained in the discussion section of the experiment, another limitation of the method used in this study is the lack of ability to test message effects in their natural environment and context. The experiment could only tell us about the effects of coverage

of a completely new disease, about which the public had never heard before. It is possible that during the developing and continuous coverage of real world epidemics, new information interacts with that which already exists. For example, the lack of information about health risks in coverage during specific period of time might be less consequential if such information was published extensively a few months earlier. In other words, people might use the knowledge they acquired before about the disease when interpreting and processing new information. Moreover, this study looked exclusively at printed articles. It is possible that the online version of the articles (e.g., from nytimes.com) include links to previously published articles, or even to external websites, such as official CDC websites. In this case, readers of the online version may be directed to further information, that may differ from the information that appeared in the printed version. Nevertheless, exposure to additional information is conditioned on the reader's actively clicking on the links. Future studies might contribute to our understanding of such dynamics and interactions by following public opinions, attitudes, and intentions in real time, using different methodological approaches, and looking at other media outlets, including digital media. Lastly, as is the case in most experiments in the realm of media effects, the results may be due to a case-category confound (Jackson, 1992), due to the fact that categories (themes) were represented by one message only (two articles for each condition, but always the same two articles). This threat is ameliorated by the fact that a larger sample of articles in the mTurk study pointed to some similar patterns. However, future replications could mitigate the threat the validity further.

The role of news media during crises: part of larger changes and dynamics in the centrality of mediated communications

In a 2001 article, provocatively titled “The end of mass communication?” Chaffee and Metzger argued that “people’s everyday mass media experience will become more individualized as the new media continue to evolve and diffuse throughout society”. The rapid development of the Internet exacerbated the fragmentation of the media even further (Messing & Westwood, 2014), leading scholars to focus on the perils of selective exposure (Knobloch-Westerwick, 2012) and misinformation in social media (Starbird, Maddock, Orand, Achterman, & Mason, 2014) and other niche channels (Allcott & Gentzkow, 2017; Berghel, 2017).

However, CERC recognizes the continuing role of the news media in the evolving digital age, saying “social media, such as Twitter and Facebook, are increasingly important, and a very fast form of communication. However, the mainstream media, particularly television and radio, still have the widest distribution” (Reynolds & Seeger, 2014, p. 160). Empirical evidence from recent studies supports the argument that mass communication channels retain an influence on public agenda. King and colleagues, using a field experiment, recently demonstrated how news coverage drives public agendas and conversations, noting that “the effects of the news media are approximately the same across citizens of different political parties, genders, regions, and influence in social media.” (King, Schneer, & White, 2017). Similarly, Southwell and colleagues demonstrated the effects of news coverage about Zika on social media activity (Southwell, Dolina, Jimenez-Magdaleno, Squiers, & Kelly, 2016).

These studies, as well as others, suggested that the answer to the question put forward by Chaffee and Metzger is “no”. Despite developments and changes in the media environment, traditional mass communication outlets keep exerting power over the mediation of the world outside in to the “pictures in our heads” (Lippmann, 1922, p. 3). These studies have also demonstrated that social media discourse is still influenced and in some cases driven by the discourse of the mainstream media, and that the effects of social media resembles in many cases the mechanism of the two-step flow suggested by Katz and Lazarsfeld (E. Katz & Lazarsfeld, 1966; Turcotte, York, Irving, Scholl, & Pingree, 2015). These data support the argument made in CERC that the media remain “a primary transmitter of risk information” (Reynolds & Seeger, 2014, p. 36). CERC claims that a better understanding of the media’s role in an emergency will improve the cooperation between the organization and journalists, and by so doing will improve public health and mitigate risks. The results of this study are an important step in that direction.

Appendix

Appendix A. Codebook for Human Coders

- Which coder are you?

A

B

C

- Article's number (header, e.g., 93)
-

- First five words in the article (for identifying purposes)
-

- What diseases are mentioned in the article (check all that apply)

- Avian flu / Bird flu
- Cancer
- Chikungunya
- Cholera
- Cystic fibrosis
- Dengue
- Ebola
- Hepatitis (B or other)
- Herpes
- HIV / AIDS
- Malaria
- Measles

- Mumps
 - Polio
 - Rubella
 - SARS
 - Seasonal flu
 - Swine flu / H1N1
 - Tuberculosis
 - Yellow fever
 - Zika
 - Other (name all) _____ -
 - None
-
- Please check all information sources cited in the article, only if the article provides a direct quote from the source (e.g., specific doctors, specific infected individuals, the World Health Organization, etc.).
You don't need to mention the specific names, just their occupations (doctors, health officials, politicians, athletes, etc.)
 - Medical doctors
 - Scientists
 - Health organization representatives
 - Citizens
 - Industry representatives (e.g., workers in a hotel)
 - Politicians
 - None
 - Other (please specify) _____
-
- Please indicate whether the article mentioned locations in the US and/or outside of the US (e.g., "Yes- both in and outside of the US")
 - U.S only

- Outside of the U.S only
- Both in the U.S and outside of it
- None
- The following items are about Facts and Risk Information. It focuses on information about the prognosis, symptoms, biology, and history of viruses. It includes the discussion of risk information, description of cases and transmission, personal stories of infections and victims, death tolls, susceptibility, and expected health consequences of infection and spread.
 - Death
 - Does not commonly cause death
 - Permanent damage / long-term effects
 - Psychological effects (e.g., trauma, anxiety)
 - Birth defects / microcephaly
 - Guillain-Barre Syndrome / GBS
 - Other (name all) _____ -
 - None
- Did the article mention **number of cases?** (I.e., provide a specific number or estimation)? Even if the article describe one patient, and explicitly says that this is the only patient right now, consider it a number of cases.
 - No
 - Yes – death toll inside the U.S
 - Yes – death toll outside the U.S
 - Yes – infections inside the U.S
 - Yes – Infections outside the U.S
 - Yes – estimated death toll by the end of the outbreak (e.g., “thousand might die by the end of the current outbreak”)
 - Yes – estimated infections by the end of the outbreak (e.g., “thousands might get infected by the end of the current outbreak”)
- Did the article mention probability of dying in terms of **percentages?** (e.g., "5% of those infected will die")
 - No
 - Yes

- Did the article mention probability to other health effects in terms of **percentages?** (e.g., "5% of mothers infected will have babies with birth defects")
 - No
 - Yes (please detail) _____

- Which symptoms are mentioned in the article (Check all that apply)
 - Fever / changes in body temperature
 - Rash
 - Flu-like symptoms
 - Muscle pain
 - Headache
 - Weakness or fatigue
 - Diarrhea
 - Vomiting
 - Abdominal pain
 - Hemorrhage (bleeding or bruising)
 - Lack of appetite
 - Coughing
 - Sore throat
 - Eye irritation
 - Nausea
 - Running nose
 - Other (name all) _____
 - None

- According to the article, which populations are at higher risk of **getting infected** with the virus? (Check all that apply). Please check only if **explicitly written** as vulnerability in the article.
 - Children
 - Young adults (18-30)
 - Elderly
 - Pregnant women
 - Fetuses
 - Travelers
 - Doctors
 - Volunteers (e.g., doctors working abroad)
 - Other _____
 - None

- According to the article, which populations are at **higher health risks** if infected with the virus? (Check all that apply)
 - Children
 - Young adults (18-30)
 - Elderly
 - Pregnant women
 - Fetuses
 - Travelers
 - Doctors
 - Volunteers (e.g., doctors working abroad)
 - Other _____
 - None

- Does the article discuss previous outbreaks of the same virus? For example, an article about Swine Flu might mention the 1918 influenza outbreak
 - No
 - Yes (which?) _____

- Does the article include technical details or information about the virus, including its biology, chemical structure, mechanism for attachment to cells etc.?
 - No
 - Yes (which?) _____

- Does the article include personal stories of infected people with specific identifiable characters (i.e., including at least one of the following: a name, occupation, age, gender, location of a specific person)? (Check all that apply)
 - None
 - Doctors
 - Patients
 - American citizens
 - Infection cases in Europe
 - Infection cases in Central or South America
 - Infection cases in Africa
 - Infection cases in Asia
 - Other (name all) _____

- You've just answered questions about Facts and risk Information (prognosis, symptoms, biology, and history of viruses, risk information, description of cases and transmissions, death tolls, susceptibility, health consequences).

How central would you say the topic of Facts and Risk Information to the article?

- Not central at all - There are no mentions of such information in the article
- Slightly central - There are some mentions, but they are not central to the main topic
- Central - The information is important to the main topic of the article but there are other kinds of information that are also important
- Very central - The information is the main topic of the article

The following items are about Decision Making and Efficacy information. It focuses on information that can directly guide readers to behaviors that ameliorate threats by preventing infection or by coping with an existing condition. These items focus on the efficacy of individuals and stakeholders to reduce risks and threats, independently from institutional efforts.

- According to the article, what can individuals (citizens, not doctors etc.) do to avoid infection or ameliorate risks? (Check all that apply)
 - Getting vaccinated
 - Avoid travel to infected areas
 - Seek medical advice
 - Avoid contact with infected people
 - Avoid public places
 - Avoid sending kids to school
 - Wearing protective clothes (e.g., against mosquito bites)
 - Using insect repellent
 - Disposing of standing water
 - Mosquito netting
 - Install window screens
 - Wash hands
 - Use a hand sanitizer
 - Delay conception / avoid pregnancy
 - Use condoms or other contraception during sexual intercourse
 - Other (name all) _____
 - None

- You've just answered questions about Decision Making and Efficacy Information (information that directs readers to take an appropriate action to reduce or eliminate risks. These DO NOT INCLUDE actions by official organizations, CDC, government etc.).

How central would you say the topic of Decision Making and Efficacy Information was to the article?

- Not central at all - There are no mentions of such information in the article
- Slightly central - There are some mentions, but they are not central to the main topic
- Central - The information is important to the main topic of the article but there are other kinds of information that are also important
- Very central - The information is the main topic of the article

The following items are about Resource Allocation information. It focuses on information about the ways in which institutions, including governments, organizations, researchers, and agencies attempt to prevent, slow down, or eliminate the threats of the epidemic, in its various stages of development.

- Which steps taken by countries, organizations, and institutions to reduce risks and avoid infections are mentioned in the article? (check all that apply)
 - Writing or updating safety guidelines (e.g., for blood donation)
 - Improving safety in laboratories
 - Improving safety in hospitals
 - Providing medical treatment to infected people
 - Developing drugs
 - Using pre-existing drugs
 - Developing vaccines
 - Using pre-existing vaccines
 - Screening air-passengers in airports
 - Screening other visitors from infected areas (not in airports)
 - Improving hygiene conditions in public places
 - Closing down schools
 - Imposing quarantines
 - Funding
 - Proposing bills and legislation
 - Conducting international cooperation
 - Appointing response teams or personnel (e.g., a special Ebola response team)
 - Other _____
 - None

- You've just answered questions about Resource Allocation Information (information that explain to readers what was done by official governmental or

non-governmental organizations to reduce or eliminate risks. These DO NOT INCLUDE actions by unofficial individuals - citizens etc.).

- Not central at all - There are no mentions of such information in the article
- Slightly central - There are some mentions, but they are not central to the main topic
- Central - The information is important to the main topic of the article but there are other kinds of information that are also important
- Very central - The information is the main topic of the article

The following items are about Normalcy and Well Being information. It focuses on information about the interruptions to day-to-day activities, routines, and well-being of stakeholders and societies, caused by the disease. These include interference with normalcy in the working place, educational systems, political systems, financial systems, and cultural and leisure activities. These items do not deal with what these institutions do, but with the implications and consequences of crises on them.

- Does the article mention the impact of the disease on the following? (check all that apply)
 - Sport events or athletes
 - Non-sport cultural events (movies, theater shows, concerts, etc.)
 - Political stability in countries or cities (e.g., the infectious disease as part of a larger state crisis)
 - Politicians (e.g., a mayor who's reelection might be influenced by the disease)
 - Elections
 - Schools
 - Academic institutes
 - Legal issues (e.g., paying for infected people during leave from work)
 - Markets, shares, and financial growths
 - Prices (of products such as food)
 - The media / journalists
 - Tourism (hotels, airlines, boat ride companies, etc.)
 - Travelers
 - Food industries (e.g., pork)
 - Other industries _____
 - Other _____
 - None

- You've just answered questions about Normalcy and Well-being information (information that the non-health consequences of the disease, such as impact on cultural events, politicians, economies etc.).

How central would you say the topic of Normalcy and Well-being Information was to the article?

- Not central at all - There are no mentions of such information in the article
- Slightly central - There are some mentions, but they are not central to the main topic
- Central - The information is important to the main topic of the article but there are other kinds of information that are also important
- Very central - The information is the main topic of the article

Appendix B. Top-articles for each theme by each disease

A1. Social theme

Swine flu / H1N1

For the better part of two weeks, the Washington Capitals had been eking out wins over opponents they should have beaten convincingly.

On Friday night, it caught up to them on home ice against one of the league's worst clubs. The Capitals surrendered a one-goal lead late in the second period, then defenseman Mark Streit of the New York Islanders hammered a shot past goaltender Josi Theodore 53 seconds into overtime to hand the Capitals a humbling, miscue-riddled 4-3 defeat.

The victory was only the Islanders' third of the season and it halted Washington's six-game winning streak, stunning a capacity crowd at Verizon Center.

"A lot of these games we've escaped," veteran center Brendan Morrison said. "We haven't played our best hockey. I think what we have to worry about is the process -how we're winning games. If we go about that the right way, we'll come out on top most nights."

Winger Tomas Fleischmann, in his second game back from a blood clot in his leg, scored two goals, the second of which came on the power play and gave the Capitals a 3-2 lead with 3 minutes 17 seconds remaining in the second period.

But instead of building on that edge, the Capitals gave the goal right back when Frans Nielsen scored his second goal of the game from the top of the circles with an ordinary-looking wrist shot that appeared to fool Theodore. It was the third-liner's first career two-goal game.

Coach Bruce Boudreau defended his team's effort, saying it was better than Thursday's in Atlanta, where the Capitals hung on for an ugly 4-3 win.

"I thought tonight was a lot better than last night," Boudreau said. "It was the first game we had 40 shots on goal. I thought the power play was moving the puck around extremely well. I thought [Islanders goalie Dwayne] Roloson played well. I thought we had breakdowns. Mike [Green] just over-skated the puck."

Boudreau was referring to a gaffe by Green in the second period that led directly to the Islanders' second goal.

Green, who earlier in the game set up Alex Ovechkin's 14th goal of the season, took his eye off the puck momentarily as he surveyed the ice on front of him, then whiffed on the pass. The puck went right to Nielsen, who flicked it over Theodore at 7:12 to put the Islanders ahead, 2-1. "You can't get mad at that," Boudreau said. "It was a physical mistake. It happens."

Green's mistake was costly, but it wasn't the Capitals' only deficiency.

For the second straight game, the Capitals' top line of Ovechkin, Nicklas Backstrom and Alexander Semin dazzled fans with its ability to make beautiful passes.

But for the second straight night, the trio appeared more intent on making the highlight shows than scoring goals.

"I thought they came wanting to play," Boudreau said. "But they were way too fancy and way too cute. They could have had four or five goals if they were really sharp. But they weren't."

Boudreau conceded that he considered disbanding the line after a three-on-one late in the first period didn't yield a shot on Roloson.

At the other end of the ice, Theodore had a number of big saves, including highlight stops in the third period on John Tavares and Sean Bergenheim. But Boudreau said he wasn't too pleased with the Islanders' first goal. Kyle Okposo hustled into the Capitals' zone and beat Theodore between the pads to answer Ovechkin's power-play strike, which came just 4:41 into the

contest.

"Josi© has been so good for us," Boudreau said. "He probably would have loved to have had the first one back. That last goal was from the circles with no one around him. "

It wasn't all bad for the Capitals, however.

The power play scored twice for the second straight game, giving the previously beleaguered unit five goals in the past three games.

There was also Fleischmann's performance. In addition to his two goals, he had a number of other scoring chances that just missed.

"I thought he was very good," Boudreau said. "He's going to be a great asset to have and he was a main reason the power play was clicking the way it was."

Fleischmann said he felt better than he did in Atlanta, particularly from a timing standpoint. Even though he has been back for only two games, he recognizes that the Capitals still must learn to close out wins with consistent efforts.

"It's something we have to figure out in our team," Fleischmann said. "We have to play for 60 minutes."

Capitals notes: Six of the past eight games between the Capitals and Islanders have gone to overtime. . . .

Green has points in eight straight games, the longest streak for a defenseman this season. . . .

Quintin Laing (swine flu), Eric Fehr (sore ribs), John Erskine (bruised hand) and Boyd Gordon (back spasms) were sidelined. . . .

Michael Nylander played his final game with the American Hockey League's Grand Rapids Griffins on Friday. His two-week conditioning stint ends Tuesday.

Ebola

Resurgent Republicans took control of the Senate on Tuesday night, expanded their hold on the House, and defended some of the most closely contested governors' races, in a repudiation of President Obama that will reorder the political map in his final years in office.

Propelled by economic dissatisfaction and anger toward the president, Republicans grabbed Democratic Senate seats in North Carolina, Colorado, Iowa, West Virginia, Arkansas, Montana and South Dakota to gain their first Senate majority since 2006. Senator Mitch McConnell of Kentucky, a shrewd Republican tactician, cruised to re-election and stood poised to achieve a goal he has pursued for years -Senate majority leader.

An election that started as trench warfare, state by state and district by district, crested into a sweeping Republican victory. Contests that were expected to be close were not, and races expected to go Democratic broke narrowly for the Republicans. The uneven character of the economic recovery added to a sense of anxiety, leaving voters in a punishing mood, particularly for Democrats in Southern states and the Mountain West, where political polarization deepened.

The biggest surprises of the night came in North Carolina, where the Republican, Thom Tillis, came from behind to beat Senator Kay Hagan, and in Virginia. There, Senator Mark Warner, a former Democratic governor of the state, was thought to be one of the safest incumbents in his party, and instead found himself clinging to the narrowest of leads against a former Republican Party chairman, Ed Gillespie.

Those contests were measures of how difficult the terrain was for Democrats in an election where Republicans put together their strategy as a referendum on the competence of

government, embodied by Mr. Obama.

House seats where Democrats had fought off Republican encroachment for years were finally toppled. Gov. Scott Walker, a Republican, was easily re-elected in Wisconsin, a state that voted twice for Mr. Obama. In Florida, Gov. Rick Scott, once considered endangered, finished the night on top. And states that had seemingly been trending Democratic, like Colorado and Iowa, fell into Republican hands.

With at least a nine-seat gain and most likely more, House Republicans will have close to 245 seats, the largest Republican majority since the Truman administration.

"Barack Obama has our country in a ditch, and many of his lieutenants running for the Senate were right there with him," said Reince Priebus, chairman of the Republican National Committee. "The punishment is going to be broad, and it's going to be pretty serious."

The breadth of the Republican victories also reset the political landscape ahead of the 2016 presidential campaign. And it left Mr. Obama with a decision to make: Will he move toward Republicans in his final years in areas of common interest, such as tax reform and trade, or will he dig in and hope Republican overreach will give his party a lane for a comeback?

"Just because we have a two-party system doesn't mean we have to be in perpetual conflict," vowed Mr. McConnell, in a victory speech.

White House officials accepted the overture and said Mr. Obama had invited the bipartisan leadership of Congress to the White House on Friday.

For Republicans, the victories piled up, winning not only Senate Democratic seats they were expected to take - Montana, West Virginia, South Dakota and Arkansas - but also in states that were supposed to be close. Representative Cory Gardner, a Republican, crushed Senator Mark Udall in Colorado. In Georgia, the Democrat Michelle Nunn, daughter of former Senator Sam Nunn, was widely expected to force David Perdue, a Republican businessman, into a runoff for the Senate seat of Saxby Chambliss, a retiring Republican. Instead, Mr. Perdue won more than half the vote to take the race outright.

Senator Pat Roberts, a Kansas Republican, also fended off the independent challenger Greg Orman, who just weeks ago appeared headed to victory.

And for Democrats, it could get worse. Votes were still being tallied in Alaska, where Senator Mark Begich, a Democrat, was trying to hold back the wave. Senator Mary L. Landrieu of Louisiana was able to force her strongest Republican foe, Representative Bill Cassidy, into a Dec. 6 runoff. But the combined vote of the top two Republicans in the race easily eclipsed hers.

"I think it's a message from the American people about their concern about the direction of the country, and the competency of the current administration," said Senator Rob Portman of Ohio, vice chairman of the National Republican Senatorial Committee. "Most people have voted to end the dysfunction and to get back to legislating on issues that will help them and their families, and I think that's something that both parties need to listen to."

One bright spot for Democrats came in New Hampshire, where Senator Jeanne Shaheen, the Democratic incumbent, fended off Scott Brown, the former Republican senator from Massachusetts, according to projections by The Associated Press. In Pennsylvania, Tom Wolf, a Democrat and political novice, easily defeated the Republican governor, Tom Corbett.

And in the panhandle of Florida, Gwen Graham, daughter of a former Democratic senator and governor, defeated Representative Steve Southerland, a Tea Party favorite.

But those high notes were swamped by the lows for the president's party. In Arkansas, Representative Tom Cotton, a freshman Republican and an Iraq War veteran, defeated Senator Mark Pryor, despite the efforts of former President Bill Clinton.

In Colorado, Mr. Udall tried to replicate the storied ground game that helped propel his Democratic colleague, Senator Michael Bennet, to an unexpected victory in 2010. He was not

even close, and drew further criticism for running a campaign that some felt was too focused on abortion rights and contraception.

And in West Virginia, Representative Shelley Moore Capito, a Republican, won the Senate seat long held by Jay Rockefeller, a Democrat, to become that state's first female senator and the first Republican elected to the Senate from West Virginia since 1956. In Iowa, Joni Ernst also made history by becoming the first woman to be elected in that state's congressional delegation.

Two years after handing Democrats broad victories, voters again seemed to be reaching for a way to end Washington inertia. Yet the results on Tuesday may serve only to reinforce it. Voters appeared unsure of just what they wanted, according to surveys. Among those who voted for a Democrat, only one out of eight expressed an unfavorable opinion of the Democratic Party. Republican voters were more conflicted; among those who voted Republican, one of four viewed the party unfavorably.

Mr. Obama is left with the prospect of finding a new path to work with Republicans, something for which he has shown little inclination, and Republicans must find a way to demonstrate they are more than the party of "no."

Even though a record \$4 billion poured into the election -from the campaigns, parties and outside groups for advertising and other candidate support -the money did little to stir enthusiasm as the campaign set a more dubious mark for its low levels of voter interest.

For their part, Democrats were hindered by their inability to persuade members of the coalition that delivered the White House to Mr. Obama -young voters, women and minorities -to turn out at levels seen in presidential elections. Decisions like Mr. Obama's delay of executive action on behalf of illegal immigrants also angered crucial constituencies.

Even the president conceded the steep climb his allies faced.

"This is possibly the worst possible group of states for Democrats since Dwight Eisenhower," Mr. Obama told a Connecticut public radio station on Tuesday. "There are a lot of states that are being contested where they just tend to tilt Republican."

Democratic midterm losses during the Obama presidency now rival those of both Richard M. Nixon in 1974 and Bill Clinton in 1994 as the most destructive to his party's political standing in Congress in the post-World War II era. It was a stunning reversal for the president, who was the first Democrat since Franklin D. Roosevelt to twice win a majority of the national vote.

"The top issue is not jobs and the economy; it's ending gridlock in Washington," said Mr. Portman. "Second, there is a desire to hold the administration accountable for incompetence on issues like ISIS and Ebola. I don't think those goals are inconsistent."

With the political climate and the electoral map playing to their decided advantage, Republicans were determined not to relive the elections of 2010 and 2012, when infighting between establishment Republicans and Tea Party insurgents damaged the party's brand and elevated candidates who could not win.

From the beginning, party officials decided to take sides when fierce primary challenges emerged. The party establishment crushed challengers to Mr. McConnell in Kentucky, and to Senators Lindsey Graham in South Carolina and Lamar Alexander in Tennessee.

The establishment also sent reinforcements to help Senator Thad Cochran eke out a runoff victory against a Tea Party firebrand in Mississippi; cleared the Republican field for Mr. Gardner in Colorado; and backed winning primary candidates in Iowa, North Carolina, New Hampshire and Alaska.

Democrats tried to distance themselves from the president's health care law and economic policies, despite signs that both may be working. In Colorado, Mr. Udall relied on the playbook that propelled his Colorado colleague and Democratic Senatorial Campaign Committee

chairman, Senator Michael Bennet, to victory in 2010, speaking almost exclusively about abortion rights and contraception. That cost him the endorsement of The Denver Post, which castigated him for an "obnoxious, one-issue campaign."

Lost was Mr. Udall's work in the Senate opposing Mr. Obama's policies on security surveillance and privacy.

In Kentucky, Alison Lundergan Grimes, considered a strong challenger to Mr. McConnell, lost some support when she refused to say whether she voted for Mr. Obama, and ran a risk-averse campaign.

But mainly, Democrats were working off a map heavily tilted toward Republicans in states like West Virginia, South Dakota, Montana, Arkansas and Alaska, in a year when disengaged, frustrated voters and Mr. Obama's low approval ratings were inevitably going to be a millstone.

Zika

Lower house votes for Impeachment

Political crisis deepens as Olympic Games near

BRASILIA - President Dilma Rousseff lost a crucial impeachment vote in Brazil's lower house on Sunday evening, making her removal ever more likely and deepening the country's political crisis less than four months before the opening ceremony of the Summer Olympics in Rio de Janeiro. Rousseff's opponents easily obtained the two-thirds majority of votes in the 513-member Chamber of Deputies needed to pass the impeachment measure. Voting one by one in a rollicking marathon session broadcast live on television to a rapt Brazilian public, the pro-impeachment lawmakers celebrated wildly on the floor of parliament as they vaulted past the minimum threshold needed to repudiate her.

"To rescue the hope that was stolen from the Brazilian people, I vote yes," said Sheridan de Anchieta, one of the many anti-Rousseff lawmakers whose statements brought rowdy applause and jeers to the chamber. One lawmaker fired confetti into the air from a toy pistol after voting to sack the president.

The cascade of votes to boot Rousseff from office less than two years after her reelection was a powerful display of her abject political collapse and the extremes of her unpopularity. Rousseff, 68, is the hand-picked successor of iconic former president Luiz Inacio Lula da Silva, and their leftist Workers' Party once seemed unassailable as it led Brazil through a period of prosperity that lifted tens of millions out of poverty.

She and her supporters repeatedly denounced the impeachment attempt as "a coup" tantamount to an interruption of Brazilian democracy, which was restored in 1985 after 21 years of military rule.

Yet with Rousseff's approval rating hovering around 10 percent, Sunday's vote turned into a visceral repudiation of the 13 years that she and Lula have been in power. It was a stunning reversal of fortune in a country where everything seemed to be going right just a few years ago, when a global commodity boom had the Brazilian economy purring.

Now Brazil is mired in its worst economic slump since the 1930s. A frightening Zika epidemic continues to spread. With the country's leaders consumed by political combat and a broad corruption scandal, Brazil today is a far angrier and more divided country than the one picked in 2009 to host this summer's Olympics.

The impeachment measure will now move to Brazil's Senate, where only a simple majority is needed to force Rousseff to step down. Senators would have 180 days to conduct formal impeachment hearings before a final vote to determine her fate while Vice President Michel Temer - Rousseff's former running mate and now rival - assumes temporary control.

"It was a battle," said Miguel Hadad, an opposition leader who voted for Rousseff's removal. "So

it is a moment of satisfaction for us, and also for the millions who went to the streets to demand impeachment."

Lindberg Farias, a Rousseff ally in the senate, said that the politicians who could end up in power would frighten Brazilians, and that the president could prevail in the upper house, where a vote has yet to be scheduled.

Rousseff isn't accused of stealing, but her opponents said she should be impeached because her administration allegedly tried to cover up budget gaps with money from government banks. She has denied any wrongdoing.

The specifics of those charges were barely referred to during Sunday's proceedings. Lawmakers voting for impeachment concentrated on attacking corruption and Rousseff's economic record in 10-second speeches that were screamed as often as they were spoken.

"Lula and Dilma in jail! I vote yes for impeachment!" shouted Soraya Santos, a deputy from the state of Rio de Janeiro.

But many Brazilians unhappy with Rousseff also are wary of the lawmakers leading the impeachment push, more than half of whom are under investigation themselves on suspicion of corruption, bribery and other misdeeds, including Eduardo Cunha, the speaker of the lower house, who orchestrated the vote.

Said Communist Party deputy Marcivania Flexa, before voting against impeachment: "I have never seen so much hypocrisy."

Brian Winter, a Brazil expert and the vice president of the Americas Society and Council of the Americas, said that Rousseff's impeachment was a process from which few winners would emerge.

"I worry history may take a dim view of both President Rousseff and this impeachment," he said.

"Brazil's economy is in its worst recession in at least 80 years in large part because of mistakes Rousseff made. But it's hard to see how this impeachment - under dubious circumstances, by a Congress just as unpopular as she is - will lead to solutions in the near term," Winter said.

"In coming weeks, I think you'll see Rousseff pull out every legal and political means at her disposal to stay in office," he added. "It's going to be a messy transitional period of weeks or months, full of protests and polarization. Brazil's economy needs strong leadership to pass a new wave of reforms, pull out of this mess and get back on the path it was on last decade when it dazzled the world."

Demonstrators on both sides of Brazil's political divide held rallies and street protests here and nationwide Sunday. Many followed the voting in Congress on big screens as if watching a soccer match.

According to police estimates, the crowd of more than 50,000 impeachment supporters at a rally Sunday outside Congress was twice as large as the anti-impeachment group that marched through Brasilia in Rousseff's defense.

Those demonstrators have camped out near a soccer stadium here in the capital, many of them from activist groups, unions and left-wing movements that belong to Rousseff's coalition. Maria da Silva, 47, traveled from Maceio, in northeastern Brazil, where she works for the bus drivers trade union. She said the lives of tens of millions of poorer Brazilians like her improved immeasurably under Workers' Party governments.

"There is more opportunity for the poor," she said, adding that she had been able to buy her house through a government financing scheme that built low-cost housing. "To take out [Rousseff] and put the others in will be horrible," she said. "This is a coup."

But those working to remove Rousseff before the end of her second term, in 2018, say this movement is different and entirely democratic.

Pro-impeachment demonstrators are camped here in a city park, many wearing the yellow-and-

green jerseys of Brazil's national soccer team. On the whole, they are more middle class and lighter-skinned, reflecting some of the racial and economic undercurrents in the impeachment battle.

Tiago Medina, 28, was in a group that had traveled from Porto Alegre, in Brazil's more prosperous south, a bastion of anti-Rousseff sentiment. He said the pro-impeachment side is made up of people "who defend the values of freedom, with less state intervention in the economy."

Medina said their movement is part of the rightward shift across Latin America after more than a decade of dominance by leftist leaders. "We're standing up for liberal values," he said.

A2. Scientific theme

Swine flu / H1N1

Evolutionary biology may sometimes seem like an arcane academic pursuit, but just try telling that to Gavin Smith, a virologist at Hong Kong University. For the past week, Dr. Smith and six other experts on influenza in Hong Kong, Arizona, California and Britain have been furiously analyzing the new swine flu to figure out how and when it evolved.

The first viruses from the outbreak were isolated late last month, but Dr. Smith and his colleagues report on their Web site that the most recent common ancestor of the new viruses existed 6 to 11 months ago. "It could just have been going under the radar," Dr. Smith said.

The current outbreak shows how complex and mysterious the evolution of viruses is. That complexity and mystery are all the more remarkable because a virus is life reduced to its essentials. A human influenza virus, for example, is a protein shell measuring about five-millionths of an inch across, with 10 genes inside. (We have about 20,000.)

Some viruses use DNA, like we do, to encode their genes. Others, like the influenza virus, use single-strand RNA. But viruses all have one thing in common, said Roland Wolkowicz, a molecular virologist at San Diego State University: they all reproduce by disintegrating and then reforming.

A human flu virus, for example, latches onto a cell in the lining of the nose or throat. It manipulates a receptor on the cell so that the cell engulfs it, whereupon the virus's genes are released from its protein shell. The host cell begins making genes and proteins that spontaneously assemble into new viruses. "No other entity out there is able to do that," Dr. Wolkowicz said. "To me, this is what defines a virus."

The sheer number of viruses on Earth is beyond our ability to imagine. "In a small drop of water there are a billion viruses," Dr. Wolkowicz said. Virologists have estimated that there are a million trillion viruses in the world's oceans.

Viruses are also turning out to be astonishingly diverse. Shannon Williamson of the J. Craig Venter Institute in Rockville, Md., has been analyzing the genes of ocean viruses. A tank of 100 to 200 liters of sea water may hold 100,000 genetically distinct viruses. "We're just scratching the surface of virus diversity," Dr. Williamson said. "I think we're going to be continually surprised."

Viruses are diverse because they can mutate very fast and can mix genes. They sometimes pick up genes from their hosts, and they can swap genes with other viruses. Some viruses, including flu viruses, carry out a kind of mixing known as reassortment. If two different flu viruses infect the same cell, the new copies of their genes get jumbled up as new viruses are assembled. Viruses were probably infecting the earliest primordial microbes. "I believe viruses have been around forever," Dr. Wolkowicz said.

As new hosts have evolved, some viruses have adapted to them. Birds, for example, became the main host for influenza viruses. Many birds infected with flu viruses do not get sick. The viruses replicate in the gut and are shed with the birds' droppings.

A quarter of birds typically carry two or more strains of flu at the same time, allowing the viruses to mix their genes into a genetic blur. "Birds are constantly mixing up the constellation of these viruses," said David Spiro of the J. Craig Venter Institute.

From birds, flu viruses have moved to animals, including pigs, horses and humans. Other viruses, like H.I.V. and SARS, have also managed to jump into our species, but many others have failed. "It's a very rare event when a virus creates a new epidemic in another species," said Colin Parrish of Cornell University. In Southeast Asia, for example, a strain of bird flu has killed

hundreds of people in recent years, but it cannot seem to move easily from human to human. Only a few strains of influenza have managed to become true human viruses in the past century. To make the transition, the viruses have to adapt to their new host. Their gene-building enzymes have evolved to run at top speed at human body temperature, for example, which is a few degrees cooler than a bird's.

Influenza viruses also moved from bird guts to human airways. That shift also required flu viruses to spread in a new way: in the droplets we release in our coughs and sneezes.

"If the virus settles down on the floor, then it's gone," said Peter Palese, chairman of microbiology at Mount Sinai School of Medicine. Winter is flu season in the United States, probably because dry air enables the virus-laden droplets to float longer.

Up to a fifth of all Americans become infected each flu season, and 36,000 die. During that time, the flu virus continues to evolve. The surface proteins change shape, allowing the viruses to evade the immune systems and resist anti-flu drugs.

Dr. Spiro and his colleagues have also discovered that human flu viruses experience a lot of reassortment each season. "Reassortment may be the major player in generating new seasonal viruses," Dr. Spiro said.

From time to time, a new kind of flu emerges that causes far more suffering than the typical swarm of seasonal flu viruses. In 1918, for example, the so-called Spanish flu caused an estimated 50 million deaths. In later years, some of the descendants of that strain picked up genes from bird flu viruses.

Sometimes reassortments led to new pandemics. It is possible that reassortment enables flu viruses to escape the immune system so well that they can make people sicker and spread faster to new hosts.

Reassortment also played a big role in the emergence of the current swine flu. Its genes come from several ancestors, which mainly infected pigs.

Scientists first isolated flu viruses from pigs in 1930, and their genetic sequence suggests that they descend from the Spanish flu of 1918. Once pigs picked up the flu from humans, that so-called classic strain was the only one found in pigs for decades. But in the 1970s a swine flu strain emerged in Europe that had some genes from a bird flu strain. A different pig-bird mix arose in the United States.

In the late 1990s, American scientists discovered a triple reassortant that mixed genes from classic swine flu with genes from bird viruses and human viruses. All three viruses -the triple reassortant, and the American and European pig-bird blends -contributed genes to the latest strain.

It is possible that the special biology of pigs helped foster all this mixing. Bird flu and human flu viruses can slip into pig cells, each using different receptors to gain access. "We call the pig a mixing vessel because it can replicate both avian and mammalian influenza virus at the same time," said Juergen Richt of Kansas State University. "The mixing of these genes can happen much easier in the pig than in any other species."

Fortunately, the new swine virus seems to behave like seasonal flu in terms of severity, not like the 1918 Spanish flu. "Right now it doesn't have what it takes to be a killer virus," Dr. Palese said. But could it? Dr. Palese said it was highly unlikely.

If the swine flu peters out in the next few weeks, virus trackers will still pay close attention to it over the next few months. As flu season ends in the Northern Hemisphere, the virus may be able to thrive in the southern winter or perhaps linger in the tropics, only to return to the north next fall. It will no doubt change along the way as its genes mutate, and it may pick up new genes.

The scientists will be watching that evolutionary journey with a mixture of concern and respect.

"Viruses are incredibly adaptable," Dr. Spiro said. "They have managed to exploit our modern culture and spread around the world."

Ebola

Last month, a team of scientists announced what could prove to be an enormous step forward in the fight against H.I.V.

Scientists at Scripps Research Institute said they had developed an artificial antibody that, once in the blood, grabbed hold of the virus and inactivated it. The molecule can eliminate H.I.V. from infected monkeys and protect them from future infections.

But this treatment is not a vaccine, not in any ordinary sense. By delivering synthetic genes into the muscles of the monkeys, the scientists are essentially re-engineering the animals to resist disease. Researchers are testing this novel approach not just against H.I.V., but also Ebola, malaria, influenza and hepatitis.

"The sky's the limit," said Michael Farzan, an immunologist at Scripps and lead author of the new study.

Dr. Farzan and other scientists are increasingly hopeful that this technique may be able to provide long-term protection against diseases for which vaccines have failed. The first human trial based on this strategy -called immunoprophylaxis by gene transfer, or I.G.T. -is underway, and several new ones are planned.

"It could revolutionize the way we immunize against public health threats in the future," said Dr. Gary J. Nabel, the chief scientific officer of Sanofi, a pharmaceutical company that produces a wide range of vaccines.

Whether I.G.T. will succeed is still an open question. Researchers still need to gauge its safety and effectiveness in humans. And the prospect of genetically engineering people to resist infectious diseases may raise concerns among patients.

"The reality is we are touching third rails, and so it's going to take some explanation," said Dr. David Baltimore, a Nobel Prize recipient and virologist at Caltech who is testing I.G.T. against a number of diseases.

Conventional vaccines prompt the immune system to learn how to make antibodies by introducing it to weakened or dead pathogens, or even just their molecular fragments. Our immune cells produce a range of antibodies, some of which can fight these infections. In some cases, these antibodies provide strong defenses. Vaccinations against diseases such as smallpox and measles can lead to almost complete protection.

But against other diseases, conventional vaccines often fail to produce effective antibodies. H.I.V., for example, comes in so many different strains that a vaccine that can protect against one will not work against others.

I.G.T. is altogether different from traditional vaccination. It is instead a form of gene therapy. Scientists isolate the genes that produce powerful antibodies against certain diseases and then synthesize artificial versions. The genes are placed into viruses and injected into human tissue, usually muscle.

The viruses invade human cells with their DNA payloads, and the synthetic gene is incorporated into the recipient's own DNA. If all goes well, the new genes instruct the cells to begin manufacturing powerful antibodies.

The idea for I.G.T. emerged during the fight against H.I.V. In a few people, it turned out, some antibodies against H.I.V. turn out to be extremely potent. So-called broadly neutralizing antibodies can latch onto many different strains of the virus and keep them from infecting new

cells.

Dr. Philip R. Johnson, a virologist at the University of Pennsylvania, had an idea: Why not try to give broadly neutralizing antibodies to everybody?

At the time, Dr. Johnson and other researchers were experimenting with gene therapy for disorders like hemophilia. Researchers had figured out how to load genes into viruses and persuade them to invade cells, and it occurred to Dr. Johnson that he might be able to use this strategy to introduce the gene for a powerful antibody into a patient's cells.

After the cells began producing antibodies, the patient in effect would be "vaccinated" against a disease.

The idea represented a radical new direction for gene therapy. Until then, researchers had focused on curing genetic disorders by providing working versions of defective genes. I.G.T., on the other hand, would protect healthy people from infectious diseases.

And there was no guarantee that it would succeed. For one thing, the best virus Dr. Johnson had for delivering genes worked only to invade muscle cells -which normally would never make antibodies.

In 2009, Dr. Johnson and his colleagues announced that the approach worked after all. In their experiment, they sought to protect monkeys from S.I.V., a primate version of H.I.V. To do so, they used viruses to deliver powerful genes to the monkeys' muscles.

The muscle cells produced S.I.V. antibodies, as Dr. Johnson and his colleagues had hoped. Then they infected the monkeys with S.I.V. The monkeys produced enough antibodies in their muscles to protect them from S.I.V. infections, the scientists found. Without the I.G.T. procedure, monkeys dosed with the virus died.

Dr. Johnson's study persuaded Dr. Farzan that I.G.T. has great promise. "I started drinking the Kool-Aid," he said. Dr. Farzan and his colleagues have been modifying H.I.V. antibodies to develop more potent defenses against the virus.

Meanwhile, in 2011, Dr. Baltimore and his colleagues showed that antibodies delivered into cells with viruses could protect mice against injections of H.I.V., suggesting that I.G.T. could protect people against H.I.V. in contaminated needles.

But most H.I.V. infections occur through sex. So Dr. Baltimore and his colleagues also infected female mice with H.I.V. through their vaginal membranes. Last year, they reported that the technique also protected mice from infection in this way.

"We're going around the immune system, rather than trying to stimulate the immune system," Dr. Baltimore said. "So what we're doing is pretty fundamentally different from vaccination, although the end result is pretty similar."

Gary W. Ketner, a microbiologist at the Johns Hopkins Bloomberg School of Public Health, was intrigued by Dr. Baltimore's results and wondered if I.G.T. could be marshaled against another major disease that has eluded vaccines: malaria.

Dr. Ketner, Dr. Baltimore and their colleagues found a potent antibody against malaria and used a virus to deliver the gene for making it into mice. Last August, they reported that when malaria-laden mosquitoes bit the mice, up to 80 percent of the treated animals were protected.

"It is encouraging," Dr. Ketner said. "It's good for a first shot of an unproven method, but it should be better." Now Dr. Ketner is searching for better antibodies that provide more protection in a smaller dose.

These experiments suggest that antibodies created by I.G.T. could help against diseases that have resisted vaccines for decades. Other studies suggest that I.G.T. might also help against sudden outbreaks in the future.

Dr. James M. Wilson, a pathologist at the University of Pennsylvania, and his colleagues have investigated using gene therapy to treat cystic fibrosis by delivering genes into the cells lining

patients' airways. It occurred to him that many fast-spreading viruses, such as influenza and SARS, also attack the same cells.

In 2013, Dr. Wilson and his colleagues reported that viruses carrying antibody genes into airway cells can enable mice and ferrets to fight off a wide range of flu strains. Since then, he and his colleagues have tested I.G.T. against other viruses causing deadly outbreaks -including Ebola. Dr. Wilson and his colleagues teamed with Mapp Biopharmaceutical, a company that has developed an antibody against Ebola called ZMapp. The scientists have synthesized a gene for the ZMapp antibody and have delivered the gene into mouse muscles. The experiments are only in their early stages, but "we have encouraging data," Dr. Wilson said.

For Dr. Johnson, the growing interest in I.G.T. is gratifying. "It's catching on, but it's certainly not mainstream," he said. That seems likely to change, and soon.

Last February, Dr. Johnson began the first clinical trial of I.G.T. in humans. His team has placed H.I.V. antibody genes into the muscles of volunteers to see if the treatment is safe. The researchers expect to finish gathering the results this spring. "We're optimistic. We're hopeful," Dr. Johnson said.

Dr. Baltimore is collaborating with the National Institutes of Health to start a similar trial of an I.G.T.-engineered virus against H.I.V. Dr. Wilson is preparing to test I.G.T. against the flu later this year.

There is no guarantee that the successes in the animal trials can be replicated in humans.

"Humans are not just big mice," said Dr. Ronald G. Crystal, chairman of genetic medicine at Weill Cornell Medical College.

Human immune systems may attack the artificial antibodies or the viruses delivering them, destroying their protection. Or muscle cells might make too many antibodies, because they do not have the built-in regulation that immune cells do.

Dr. Farzan and other researchers are investigating molecular switches that can turn off the production of antibodies, or just adjust their dose. "If we really want to see this blossom, we need regulatory 'off' switches," he said.

Despite the lingering concerns about I.G.T., Dr. Nabel says he remains optimistic. "There are safety concerns that have to be addressed, but there are logical ways to approach them," he said.

Bioethicists do not foresee major ethical hurdles to I.G.T., because it is based on gene therapy, which has been developed for more than 30 years. "It doesn't strike me as a radical departure," said Jonathan Kimmelman, an associate professor at McGill University.

Still, Dr. Baltimore says that he envisions that some people might be leery of a vaccination strategy that means altering their own DNA, even if it prevents a potentially fatal disease.

"But my feeling, as a basic scientist, is that it's our responsibility to take things into the clinic that we feel will make a difference," he said.

Zika

Federal health officials confirmed Wednesday that the Zika virus causes a rare birth defect and severe fetal abnormalities, marking a turning point in an epidemic that has spread to more than 40 countries and territories in the Americas and elsewhere.

Scientists at the Centers for Disease Control and Prevention conducted a careful review of existing research and agreed that the evidence was conclusive, Director Thomas Frieden said. It is the first time a mosquito-borne virus has been linked to congenital brain defects.

"It is now clear, and CDC has concluded, that the virus causes microcephaly," Frieden said. The

CDC is launching more studies to determine whether children with that rare condition, which is characterized at birth by an abnormally small head, represent what Frieden said might be the "tip of the iceberg of what we could see in damaging effects on the brain and other developmental problems."

The outcome validates the growing research of past months that strongly implicated Zika as the culprit behind a broad set of complications in pregnancy. The pathogen is also increasingly linked to neurological problems in adults. The CDC report, published in the *New England Journal of Medicine*, focused only on reviewing the evidence linking Zika to fetal anomalies.

Global health officials had already assumed that the virus was to blame for the problems being seen in various countries. Since January, many have advised women who were pregnant or hoping to become so to avoid travel to Zika-affected areas or to take steps to avoid Zika infection. That medical advice expanded over time to include women's partners, especially as it became clear that sexual transmission of the virus was more common than had been known. The research released Wednesday will not change that advice, officials said. But they are hoping it will help educate the public about the virus and its potential for harm - particularly in the United States.

"We do know that a lot of people aren't concerned about Zika infection in the United States, and they don't know a lot about it," said Sonja Rasmussen, director of the CDC's division of public health information. "It's my hope that we can be more convincing that Zika does cause these severe birth defects in babies and hope that people will focus on prevention more carefully." The research is likely to help scientists developing a vaccine for Zika, she said.

The agency said there was no "smoking gun" or single definitive piece of evidence that confirmed the virus as causing microcephaly, calcifications within the fetal brain and severe vision and hearing problems in newborns. Rather, the findings of recently published studies and a thorough evaluation by CDC researchers using established scientific criteria led them to the conclusion. Frieden likened the process to putting together pieces of a puzzle.

The World Health Organization had said in recent weeks that there was scientific consensus about the connection of the virus to microcephaly, as well as Guillain-Barre syndrome, a neurological condition that can lead to paralysis. Researchers in Brazil, the hardest-hit country, said this week that Zika also may be associated with a second serious condition similar to multiple sclerosis. In a few cases with adults, they found swelling of the brain and spinal cord involving the coating around nerve fibers.

CDC officials said they worked independently of the WHO. The U.S. agency is conducting studies on Guillain-Barre syndrome, and officials said they are also likely to make a conclusive link between that condition and Zika. "I think we're on the same page as the WHO," Rasmussen said. There are still many outstanding questions about the risk facing pregnant women infected with Zika. A limited number of studies show the risk ranges from about a 1 percent chance of having a baby with microcephaly to the fetuses of almost 30 percent of pregnant women having abnormalities. A study in Brazil identified that upper range, with women having "grave outcomes," Rasmussen said.

Scientists also do not know whether miscarriages and stillbirths are the result of infection. Nor do they know at what stage of pregnancy is risk the greatest, or whether another infection that occurred at the same time might affect the risk of birth defects, she said.

The CDC's assessment of the evidence began last October, but included Zika studies published as recently as last weekend, Rasmussen said. The detailed clinical information showed the most severe forms of microcephaly, also known as fetal brain disruption sequence.

Brazil normally has an average of 163 cases of microcephaly each year. But since October, officials have confirmed at least 944 cases of microcephaly or other neurological problems,

according to the WHO.

After a Zika outbreak in French Polynesia, those islands also had an increase in microcephaly cases. A recently published study using data from there estimated the risk for the rare birth condition to be 95 cases of microcephaly for each 10,000 pregnant women infected in the first trimester.

A3. Pandemic theme

Swine flu / H1N1

THE new H1N1 flu has already been transmitted from one passenger to another on a commercial airline, and it is likely that more such incidents will occur if the virus resurges as anticipated this fall. The aviation industry and the Centers for Disease Control and Prevention have tried to reassure passengers that air travel is still safe, but so far they have done too little to try to limit the number of such transmissions.

It is not practical to screen all airline passengers to identify those who harbor infection. A better approach is to educate the public on proper hand-washing and cough etiquette and to give them the hand sanitizer they need to keep clean. Yet on a recent full flight from Boston to Orlando, Fla., I was horrified to see that most of my fellow passengers failed to periodically wash or sanitize their hands.

Several of my fellow doctors have likewise observed a lack of hygiene by airplane passengers, and no effort by airline personnel to educate people on the importance of washing their hands. Keeping our hands clean is critical, because aside from being directly coughed or sneezed upon by an infected passenger, we are most likely to catch a virus by touching a hand or an object like a seat, an overhead bin or plastic seatback tray that is contaminated with invisible droplets full of microorganisms (the bugs can survive there for many hours), and then touching our own mouth, nose or eyes.

Research has shown that people touch their mouths and noses as many as 200 times a day, and that good hand hygiene can reduce infectious disease transmission in public spaces by half. One recent study found soap and water or a hand rub that is at least 60 percent alcohol is highly effective in reducing influenza A virus on human hands.

The lack of communication about the importance of hand cleaning extends to airline Web sites and online travel vendors. Disturbingly, there seem to be no public announcements or printed bulletins in most airports either.

Airlines have said they have contingency plans for responding to infectious outbreaks, but in May, the president of the Association of Flight Attendants told members of a Congressional subcommittee that all flight attendants should be given training in how to handle a person with flu and help in communicating to passengers the importance of keeping clean hands. She also said that flight attendants need to be provided the gloves and facemasks they need to deal with flu-stricken passengers.

Airports and airline personnel should be fully trained in infection control measures, and alcohol-based gel hand sanitizers should be available throughout airports and aboard aircraft. The cruise ship industry has been doing this for years.

Airlines should ensure that passenger cabins are always properly ventilated, including during any flight delays in which passengers are kept aboard the plane. Last year, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, an industry group that develops indoor air quality standards, published the first standard for airplane cabins -which calls, for example, for all air to pass through high-efficiency particulate filters -and they should be universally adopted.

The global threat from new pathogens will not soon disappear. Airlines have the means to simply and effectively reduce the risk of rapidly spreading infectious diseases, and the traveling public should be able to count on their doing all they can.

Ebola

Doctor with Ebola headed to Nebraska

The latest American doctor to be infected with the deadly Ebola virus is being flown from Liberia for treatment at the Nebraska Medical Center in Omaha, the missionary group he works for said Thursday.

Richard Sacra is expected to arrive Friday and will be treated in the hospital's Biocontainment Patient Care Unit, SIM USA said in a statement.

Sacra, the medical director of the organization's hospital in Monrovia, decided to return to Liberia after another missionary doctor and a volunteer from the United States became ill with Ebola, SIM USA President Bruce Johnson said.

The other two Americans infected by Ebola, Kent Brantly and Nancy Writebol, were treated at Emory University Hospital in Atlanta and released from the hospital last month.

Zika

The Ebola epidemic that killed thousands of people in West Africa is no longer an international public health emergency, the World Health Organization announced on Tuesday.

Dr. Margaret Chan, the director general of the W.H.O., said in a news briefing that she was accepting the recommendation of an emergency committee, which concluded that West African countries had the ability to contain the small number of new cases that continued to arise, and that "the likelihood of international spread is low."

Dr. Chan called on nations that had imposed restrictions on interaction with the three countries to "immediately lift any ban on travel and trade."

The Ebola outbreak, ignited in Guinea in December 2013, ultimately sickened more than 28,000 people in Guinea, Liberia and Sierra Leone, killing more than 11,300. But the W.H.O. said in a statement that all three countries had made it successfully through a 42-day observation period and a 90-day surveillance period without any cases linked to the original transmission chain for the virus. The last country to achieve that status was Guinea, which completed the 90-day period two days ago.

"The original Ebola outbreak has come to an end. The original chains of transmission are terminated now," said Dr. Robert Steffen, a communicable disease expert who is vice chairman of the W.H.O. emergency committee.

Still, flare-ups of cases continue, an expected consequence that has occurred with other Ebola outbreaks, W.H.O. officials said. The most recent is a cluster in Guinea of five confirmed and three probable cases, which the W.H.O. said it was treating as a moderate-level crisis. In all, there have been 12 new clusters of cases in the three countries since the original transmission chains were extinguished, but they have been occurring less frequently, the W.H.O. said.

"We know that little clusters will continue to flare up -that will be normal life," Dr. Steffen said. He added that most of the flare-ups had probably been transmitted through the semen of Ebola survivors.

Dr. Bruce Aylward, the W.H.O.'s chief of emergency responses, said that studies following survivors had indicated that in, at most, 2 percent of men, Ebola could persist in semen "for more than a year, out until 15 months." He said scientists had not determined why these men continued to hold traces of virus in their semen and others did not.

Dr. Aylward said that the current Ebola cluster in Guinea was linked to a single transmission chain from one village, and that more than 900 people who had had contact with the patients were being followed "in an effort to bring this to a rapid close."

Asked whether downgrading the emergency status of the Ebola outbreak would allow the W.H.O. to redirect resources to the Zika virus crisis, the officials essentially said no.

"We'd love to say it allows us to step down a little and refocus," said Dr. Aylward, but the agency considers it important to keep hundreds of its employees in the West African countries.

"A high level of vigilance and response capacity must be maintained to ensure the ability of the countries to prevent Ebola infections and to rapidly detect and respond to flare-ups in the future," Dr. Chan said.

Appendix C. Articles used in the experiment

B1. No-CERC condition

New Epidemic, Infecting Scores in Senegal, Threatens to Spread to Nearby Nations

By N. McDonald

Published: 10:36 EST, 14 February 2018

The first outbreak of Acute Tropical Syndrome (ATS) in the West African nation of Senegal has killed at least 59 people and may be spreading into nearby countries, international agencies warned on Monday. Senegal's Health Ministry said most of the cases were in border areas near Guinea and Mali; There were reports of patients with symptoms in several other African countries, but no laboratory-confirmed cases, said Dr. Gabrielle Wolfe, an infectious diseases expert.

"It is hard to say at this point whether the ATS virus is a variant of a previously encountered disease, or whether it is a completely new threat", Wolfe said. Nevertheless, she adds, "the threat is imminent and requires attention from western citizens and agencies".

Even though no cases were reported inside the United States, Dr. Joseph Berger, a leading epidemiologist warns that a spread into American soil is a matter of time: "We've seen it in the past with other similar infectious diseases. Once the virus is spreading rapidly between countries abroad, it is almost inevitable that it will eventually make its way across the ocean and into the States". Moreover, Dr. Berger warns, "the virus is likely to find its way into every state at some point".

In other news, Senegal's new international airport was opening its runways Thursday after a delay of more than 10 years. The airport has had mixed reviews with its location of more than 31 miles from the capital, Dakar. A connecting train service is still years from completion. Addressing concerns about traffic, local bus company Dakar Dem Dik director Moussa Diop has said 40 buses will travel between Dakar and the new airport. Though they marveled at its size and modern finish, "it's quite complicated to get here and expensive," Diop said. Following the launch of the new airport, Senegal's Leopold Sedar Senghor international airport was closing Thursday and has been handed over to Senegal's military. Most airlines, including Royal Air Maroc, TAP and others confirmed they will switch over once the old airport closes.

A Missionary with ATS Headed to Toronto, Contacted the Disease in Senegal

By L. Epstein

Published: 7:22 EST, 15 February 2018

Dolores S. Weber, the first known Canadian to be infected with the deadly ATS virus, is being flown from Senegal for treatment at the Toronto General Hospital, the missionary group she works for indicated Thursday.

Carol Wilson, president of the missionary group CMM, said Dolores was receiving excellent care in Senegal, but is being moved because the Toronto facility has advanced monitoring equipment and offers a wider range of treatment options.

Weber is expected to arrive Friday and will be treated in the hospital's Biocontainment Patient Care Unit, The Canadian Public Health Association said in a statement.

Weber grew up in Ottawa and joined the CMM group when she was 18 years old. She served as a global missionary for the organization since February 1992. She served in several African countries including Benin and Cameroon, before moving to Senegal last year. Wilson described Weber as “a warm and exceptionally dedicated person, who always sacrifices for the well-being of others.” She added that “we are praying for a speedy recovery. Dolores is a strong person, and we are all counting on her beating this horrible disease.”

B2. Pandemic theme condition

New Epidemic, Infecting Scores in Senegal, CDC Studies Early Cases, Monitors Suspected Cases, and Publishes a Travel Advise

By N. McDonald

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US Centers for Disease Control and Prevention (CDC) director, Dr. Anne Schuchat, said on Tuesday that the organization is preparing for a potential outbreak in the States:"The organization will investigate early reports about the nature of the disease by testing samples of suspected ATS cases around the world". Dr. Schuchat added that "at this point, CDC's primary goal is to conduct research to determine the cause of the illness, the source of infection, how it is transmitted and how to break the cycle and prevent further cases". In addition, "the organization is working with partners at U.S ports of entry to identify travelers who show signs of illness, and has published a detailed travel warning and advice to travelers. More information is available in the CDC's recently launched website dedicated to ATS."

A Missionary with ATS Headed to Toronto, CDC Prepares for American Cases

By L. Epstein

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Carol Wilson, president of the missionary group CMM, said Dolores Weber was receiving excellent care in Senegal, but said the Toronto facility had advanced monitoring equipment and a wider range of treatment

Weber is expected to arrive Friday and will be treated in the hospital's Biocontainment Patient Care Unit, The Canadian Public Health Association said in a statement.

The US Centers for Disease Control and Prevention (CDC) is monitoring any developments in Ms. Weber's case and assessing the likelihood of similar cases in the US. CDC officials are coordinating with Senegal's health ministry to learn more about the disease, and the agency is monitoring hospitals across the US for potential cases. CDC spokesperson, Dr. Michael J. Beach, confirmed that, "the agency is working diligently to track the spread of ATS around the world and to gain a better understanding of the disease."

B3. Scientific theme condition

Deadly New Respiratory Epidemic, Spreading through Mosquitoes, Killing Scores in Senegal, Threatens Nearby Nations

By N. McDonald

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US Centers for Disease Control and Prevention (CDC) director, Dr. Anne Schuchat, said on Tuesday that the organization is reviewing the potential public health impact of a possible outbreak in the States: "The organization has investigated early reports from countries dealing with the outbreak, and is tracking potential effects on Americans' health if it were to spread to the US". Dr. Schuchat added that "we recently learned that infection with ATS causes acute respiratory distress, a severe breathing difficulty that may lead to permanent damage and in some cases even death. Early symptoms may also include muscle pain, coughing, and headaches". Earlier this week, CDC scientists reported that the virus's main path of transmission is through mosquitoes, especially the *Anopheles Psorophora* species, which can be found in all U.S States. The organization estimates that the virus can infect people of all ages.

A Missionary with Deadly ATS Headed to Toronto, to be Treated for Breathing Difficulties

By L. Epstein

Published: 7:22 EST, 15 February 2018

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The US Centers for Disease Control and Prevention (CDC) is monitoring any developments in Ms. Weber's case, and assessing the likelihood of similar cases in the US. CDC spokesperson, Dr. Michael J. Beach, said yesterday that, "Ms. Weber was likely infected with ATS through a mosquito bite." According to reports from Senegal's Health Ministry, Ms. Weber's case was brought to the attention of Canadian authorities after her early symptoms of fever and muscle pain developed into a persistent cough that triggered severe respiratory distress. Beach added that "ATS can lead to an inflammatory condition of the lung, either through direct viral pneumonia or secondary bacterial pneumonia."

B4. Social theme condition

New Epidemic, Infecting Scores and Disrupting Day to Day Life in Senegal, Threatens Nearby Nations

By N. McDonald

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"It is hard to say at this point whether the ATS virus is a variant of a previously encountered disease, or whether it is a completely new threat", Wolfe said. Nevertheless, she adds, "the threat is imminent and requires attention from western citizens and agencies".

Even though no cases were reported inside the United States, Dr. Joseph Berger, a leading epidemiologist warns that a spread into American soil is a matter of time: "We've seen it in the past with other similar infectious diseases. Once the virus is spreading rapidly between countries abroad, it is almost inevitable that it will eventually make its way across the ocean and into the States". Moreover, Dr. Berger warns, "the virus is likely to find its way into every state at some point".

US Centers for Disease Control and Prevention (CDC) director, Dr. Anne Schuchat, said on Tuesday that the organization is reviewing the potential social impact of a possible outbreak in the States: "The organization has investigated early reports from countries dealing with the outbreak, and has conducted preliminary assessments of potential effects it might have on Americans' daily lives, routines, and well-being if it were to spread to the US". Dr. Schuchat added that "a large scale outbreak in the States has the potential to wield political and economic impacts that will need to be addressed by the organization. For instance, schools could be closed due to local outbreaks." Schuchat cautions that a rapid spread might require the postponement or even cancellation of large-scale events, such as sporting events or concerts. The organization also estimates potentially adverse impacts on tourism and travel industries that could dramatically affect the stock market.

A Missionary with Deadly ATS Headed to Toronto, as Impeachment Calls Grow Louder in Senegal

By L. Epstein

Published: 7:22 EST, 15 February 2018

Dolores S. Weber, the first known Canadian to be infected with the ATS virus is being flown from Senegal for treatment at the Toronto General Hospital, the missionary group she works for said Thursday.

Carol Wilson, president of the missionary group CMM, said Dolores Weber was receiving excellent care in Senegal, but said the Toronto facility had advanced monitoring equipment and a wider range of treatment

Weber is expected to arrive Friday and will be treated in the hospital's Biocontainment Patient Care Unit, The Canadian Public Health Association said in a statement.

The US Centers for Disease Control and Prevention (CDC) is monitoring any developments in Ms. Weber's case. CDC spokesperson, Dr. Michael J. Beach, said yesterday that "the organization is assessing the likelihood of similar cases in the US." In Senegal, the ATS outbreak has led to political and economic unrest, after members of an opposition party called for the impeachment of President Macky Sall over the government's purportedly insufficient response to the ATS crisis. The outbreak has also had a significant impact on West-African markets, with tourism and travel-related stocks plummeting amidst panic surrounding the virus.

B5. Ideal-CERC condition**Deadly New Mosquito-Borne Epidemic, Killing Scores, Disrupting Normalcy in West Africa. CDC Monitors Cases, Advises Travelers to Avoid Infected Areas and Use Repellents**

By N. McDonald

Published: 10:36 EST, 14 February 2018

The first outbreak of Acute Tropical Syndrome (ATS) in the West African nation of Senegal has killed at least 59 people and may be spreading into nearby countries, international agencies warned on Monday. Senegal's Health Ministry said most of the cases were in border areas near Guinea and Mali; There were reports of patients with symptoms in several other African countries, but no laboratory-confirmed cases, said Dr. Gabrielle Wolfe, an infectious diseases expert.

"It is hard to say at this point whether the ATS virus is a variant of a previously encountered disease, or whether it is a completely new threat", Wolfe said. Nevertheless, she adds, "the threat is imminent and requires attention from western citizens and agencies".

Even though no cases were reported inside the United States, Dr. Joseph Berger, a leading epidemiologist warns that a spread into American soil is a matter of time: "We've seen it in the past with other similar infectious diseases. Once the virus is spreading rapidly between countries abroad, it is almost inevitable that it will eventually make its way across the ocean and into the States". Moreover, Dr. Berger warns, "the virus is likely to find its way into every state at some point".

US Centers for Disease Control and Prevention (CDC) director, Dr. Anne Schuchat, said on Tuesday that the organization is examining potential health and social effects on Americans: "Early reports indicate that the virus is mainly transmitted by mosquitoes found in all U.S states, and causes severe breathing difficulties that may result in permanent damage and in some cases death". According to Schuchat, the organization is monitoring and studying cases of ATS, working with ports of entry to identify travelers who show signs of illness, and has published a detailed travel warning and advice to travelers. Non-travelers are also encouraged to use repellents and consult with their doctors when experiencing symptoms such as muscle pain, coughing, and severe headaches. More information can be found in CDC's website dedicated to ATS." Schuchat added that a local outbreak is expected to affect the tourism and travel industries, with potential adverse impacts on other markets, as sport events, concerts, and other mass gatherings may be cancelled. Schools may also be closed during outbreaks".

A Canadian ATS Patient Treated for Breathing Difficulties, CDC Prepares For Potential Health and Social Impact

By L. Epstein

Published: 7:22 EST, 15 February 2018

Dolores S. Weber, the first known Canadian to be infected with the ATS virus is being flown from Senegal for treatment at the Toronto General Hospital, the missionary group she works for said Thursday.

Carol Wilson, president of the missionary group CMM, said Dolores Weber was receiving excellent care in Senegal, but said the Toronto facility had advanced monitoring equipment and a wider range of treatment

Weber is expected to arrive Friday and will be treated in the hospital's Biocontainment Patient Care Unit, The Canadian Public Health Association said in a statement.

The US Centers for Disease Control and Prevention (CDC) is monitoring any developments in Ms. Weber's case, and assessing the likelihood of similar cases in the US. CDC spokesperson, Dr. Michael J. Beach, said yesterday that "Ms. Weber was likely infected by a mosquito bite, and her symptoms, which started as a fever and body aches, have developed into a persistent cough causing severe respiratory distress". Beach added that "the organization is aware of the severe toll that the outbreak is taking on West Africa, including the political and economic impact, and is working diligently to study the disease, help health workers to identify cases, and prepare emergency sites for potential outbreaks". Meanwhile, CDC advises American citizens to use mosquito repellents and avoid contact with people showing symptoms of fever and cough.

Appendix D. Demographics for mTurk and SSI studies

	Mturk		SSI	
	Freq	%	Freq	%
18-25	34	5.9	65	20.2
26-40	325	56.4	121	37.6
41-55	155	26.9	61	19.0
56 or older	55	9.5	74	23.0
Female	296	51.3	167	52.0
Elementary or grade school	1	< 1	2	< 1
Some high school	10	< 1	15	4.6
High school graduate or GED	70	12.1	100	31.1
Some college	196	34.0	88	27.4
College graduate	237	41.1	98	30.5
Postgraduate / Masters / Doctorate / Law / MD	62	10.7	16	4.9
Republican	106	18.4	101	31.4
Democrat	262	45.4	101	31.4
Independent	175	30.3	86	26.7
Other party	8	< 1	8	2.4
No party preference	25	< 1	25	7.7
White	480	83.3	262	81.6
Black or African American	41	7.1	30	9.3
Asian / Pacific Islanders	47	8.1	17	5.2
Hispanic / Latino / Spanish origin	38	6.5	33	10.2
Less than \$25,000	115	19.9	79	24.6
Between \$25,000 and \$49,999	182	31.5	82	25.5
Between \$50,000 and 74,999	145	25.1	62	19.3
Between \$75,000 and \$99,999	80	13.8	53	16.1
Between \$100,000 and \$149,000	43	7.4	35	10.9
\$150,000 or more	11	< 1	10	3.1

Appendix E. Examples from the sensitivity analysis of Alpha levels for network analysis

Alpha – 0.15 (chosen for analysis)

Theme	Topics
A	Biosafety, Research, Ebola drugs, Mosquitoes, H1N1 vaccine, Florida, Medical treatment, H1N1, Blood donation, Microcephaly, H1N1 outbreak, NY & NJ quarantines, Mexico, Media
B	Hospitals & doctors, Thomas E. Duncan, Disaster response, Dr. Kent Brantly, Screening Passengers, Ebola toll, Hygiene, Liberians
C	Schools, Flu narratives, Sport events, Legal issues, Withdrawing athletes, Rio games, Midterm elections, Tourism, Ebola team, Funding, International cooperation, Markets and stocks

Alpha = 0.35

Theme	Topics
A	Biosafety, Mosquitoes, H1N1 vaccine, Florida, Medical treatment, H1N1, Blood donation, Microcephaly, H1N1 outbreak, Mexico, Hygiene
B	Hospitals & doctors, Thomas E. Duncan, Disaster response, Dr. Kent Brantly, Screening Passengers, Ebola toll, Liberians, Ebola drugs, Schools
C	Flu narratives, Sport events, Legal issues, Withdrawing athletes, Rio games, Midterm elections, Tourism, Ebola team, Funding, International cooperation, Markets and stocks, Research, NY & NJ quarantines, Media

Alpha = 0.10 (as can be seen, as most edges are removed, many topics do not belong in any theme. In other words, the network “collapses”. Many others are in dyads).

Theme	Topics
A	Funding
B	Ebola drugs, H1N1, H1N1 vaccine, H1N1 outbreak, Medical treatment,
C	Research,
D	Florida, Microcephaly
E	Ebola team, Legal issues
F	Schools
G	Rio games, Withdrawing athletes
H	Tourism, Markets & stocks
I	Mosquitoes,
J	Biosafety,
K	International cooperation
L	Ebola toll, Thomas E. Duncan, Liberians, Dr. Kent Brantly, Hospitals & Doctors
M	Media,
N	Hygiene
O	Sport events
P	Screening passengers
Q	Mexico
R	Flu narratives
S	Blood donation
T	Midterm election
U	NY & NJ quarantine
V	Disaster response

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