ABSTRACT


Norovirus is the leading cause of foodborne illness in the United States. Norovirus is a particular problem in closed-settings, including schools due to a low infectious dose, ease of transmission and environmental persistence. Addressing norovirus requires using appropriate sanitizers for cleaning, excluding infected individuals for 24-72 hours after symptoms cease and following proper hand washing procedures. These measures frequently require behavior change and there is a great need for improved educational resources for norovirus control. Additionally, novel education methods like social media and citizen science hold promise for norovirus education but are relatively unexplored. The aim of this thesis was to conduct the necessary research to develop research-based intervention materials targeted towards schools experiencing norovirus.

A systematic literature review of social media use for food safety and infectious disease communication was conducted. Studies were coded for themes about social media use and ranked using a quality index. It was found that trust and personal beliefs are important drivers of social media use, and this information can be used to create effective messages about norovirus control. The variation in reviewed literature revealed that best practices for social media use are not well established and more evidenced based suggestions are needed.

The second study aimed to characterize online discussions of norovirus through a content analysis of outbreak-related online activity. News articles frequently provided control information, which indicates that news outlets may be a target audience for norovirus education. A large number of outbreaks had associated social media activity, indicating its value in norovirus communication. Social media posts often used humor and shared personal
experiences, which could prove effective techniques for social media engagement in health issues. Much of the information being shared in online conversations during norovirus outbreaks is incorrect or misleading, highlighting the need for scientists to engage in these conversations.

For the final study, two major stakeholder groups in schools—administrators and health departments—were surveyed. Respondents were asked about norovirus outbreak procedures, recommendations and communication practices. The importance of health departments in outbreak control was confirmed, but administrators were often unable to provide details of norovirus control policies. This indicates that other school personnel, such as nurses and custodial staff, should be targeted for future communications. Misconceptions about the effectiveness of hand sanitizers and quaternary ammonium compounds against norovirus were common among both groups of respondents. Education measures need to address these issues, but it is also clear that barriers to bleach use within schools need to be addressed. Social media is a potential medium for communicating control information, but barriers to access will need to be solved, including increasing stakeholder comfort.

Taken together, this research provided the foundation for the development of three evidence-based intervention materials which were designed using behavior change theories. It is the goal that these materials serve as effective means for education and outbreak control of norovirus and that the methodologies utilized in this work can be applied to the development of future health education materials.
Creating and Evaluating Norovirus Education and Communication Strategies

by

Katie Nicole Overbey

A thesis submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Master of Science

Food Science

Raleigh, North Carolina

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APPROVED BY:

________________________________________  _______________________________________
Dr. Benjamin Champan                        Dr. Lee-Ann Jaykus
Committee Co-Chair                           Committee Co-Chair

_______________________________________
Dr. Andrew Binder
DEDICATION

To Dad
for instilling in me a fascination with the world

To Mom
for somehow managing to keep me sane
BIOGRAPHY

Katie Overbey was born and raised in Yorktown, VA and is the daughter of Faye Overbey and Gregory Overbey. She attended the Governor’s School for Math, Science and Technology in Hampton, VA, where she developed a love of research. As an undergraduate at UNC Chapel Hill, Katie stumbled into an environmental microbiology course and became fascinated with diseases of environmental etiology. She performed extensive research in the Galápagos Islands on the impacts of human sewage on water quality and became passionate about public health. In May 2014, Katie graduated with honors from UNC Chapel Hill with a bachelor’s degree in environmental science and a minor in physical geography.

As an undergraduate, Katie recognized the value of communication in public health and sought out further training in communication which lead her to North Carolina State University for her master’s degree in Food Science.
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INTRODUCTION

Norovirus (NoV) is the leading cause of acute gastroenteritis in the United States with an estimated 20 million cases occurring each year that result in 56,000-71,000 hospitalizations and 570-800 deaths. It is also the leading cause of foodborne disease, associated with about 5.5 million cases and 150 deaths annually in the United States (Scallan et al., 2011). The economic burden is estimated at upwards of 3 billion dollars each year due to medical costs, productivity loss and mortality (Scharff, 2012). Norovirus, a member of the Caliciviridae family, is a non-enveloped, single-stranded RNA virus that is primarily spread by the fecal-oral transmission route. The virus can affect people of all ages, with usually self-limiting manifestations, though symptoms can be severe and lead to death, mostly in high-risk groups, including the young, elderly and immunocompromised (Glass, Parashar, & Estes, 2009; US Centers for Disease Control, 2015). Symptoms include vomiting and nausea, occasionally accompanied with diarrhea or a mild fever. The illness tends to resolve within 24-48 hours (Adler & Zickl, 1969). The infectious dose of norovirus is estimated to be between 10 and 100 virus particles (Patel, Hall, Vinjé, & Parashar, 2009). Infectious virus can be shed by individuals with symptoms and asymptomatic carriers for multiple days or weeks. The virus is easily spread from person-to-person through direct contact as well as through aerosolized particles in vomit or fecal material (Tung-Thompson, Libera, Koch, De Los Reyes, & Jaykus, 2015). Norovirus particles are extremely environmentally stable and can remain infectious on surfaces for many weeks and in water for up to 3 months (D’Souza et al., 2006; Seitz et al., 2011).
Outbreaks of norovirus are frequently reported in settings where many individuals live or congregate with common touch areas including nursing homes and hospitals, as well as on cruise ships (Green et al., 2002; Harris, Lopman, & O’Brien, 2010). There is also evidence that norovirus plays a large role in school outbreaks of gastroenteritis and it is the primary cause of viral gastrointestinal outbreaks in American schools (Ahmed et al., 2014; Hall et al., 2013; Lee & Greig, 2010; Patel et al., 2009; Scallan et al., 2011). Many cases of norovirus in schools have been documented, and norovirus can pose a particular issue in school settings due to a low infectious dose, asymptomatic shedding, rapid person to person spread, and environmental stability (D’Souza et al., 2006; Patel et al., 2009; Seitz et al., 2011). A particularly important route of norovirus transmission in school settings is the aerosolization of viral particles following a vomiting episode, coupled with insufficient sanitizing methods, which can prolong an outbreak (Gomez, 2008; Marks et al., 2003). Norovirus in schools is not only a contributor to student illnesses; it also leads to a significant increase in missed class time for students and missed work for parents and staff (Holt & Powell, 2014).

The main norovirus control measures highlighted in the literature are exclusion of those who are ill, proper hygiene and proper cleaning of vomit and environmental surfaces (Hall et al., 2011; Wadl et al., 2010). To address transmission of norovirus in schools, and stem the spread of the virus, improved hygiene and cleaning measures are needed, both of which require behavior change (Hall et al., 2011).

Very little research exists on how to best achieve good norovirus management, where behavior change is necessary, despite several studies highlighting a need for increased education to prevent and control norovirus (Kosa, Cates, Hall, Brophy, & Fraser, 2014; Lee &
Greig, 2010; Li, Predmore, Divers, & Lou, 2012; Sandora et al., 2005). Research has indicated that education in schools about hygiene can be valuable in reducing gastroenteritis occurrence, but little exists on what specific education methods work (Lee & Greig, 2010). Additionally, an understanding of what the public knows about norovirus is absent from the literature. One study found important gaps in food worker’s knowledge of norovirus, but no studies examining the general population or school specific audiences exist (Kosa et al., 2014).

The purpose of this work was to develop studies to fill the gaps in research on communicating norovirus risk and control to school populations and use this in conjunction with established communication theories to produce science-based intervention materials. The first of these studies was a systematic literature review examining the use of social media to communicate food safety and infectious disease information (Chapter 1). A broad review on norovirus was not performed as the literature already includes numerous norovirus reviews (Harris et al., 2010; Li et al., 2012; Matthews et al., 2012; Patel et al., 2008, 2009). Social media was chosen as it can play a valuable role in food safety communication and further research on its applicability to norovirus was needed (Chapman, Raymond, & Powell, 2014). The aim of this systematic literature review was to determine current uses, benefits, limitations and recommendations for social media use related to food safety and infectious diseases. This information was used to inform construction of social media-related interventions.

The next study—a content analysis of online activity related to school norovirus outbreaks (Chapter 2)—aimed to understand the public discussion, attitudes and knowledge about norovirus through an examination of online dialogue. To create education measures for schools, it is important to first understand what perceptions and conversations are currently
taking place; who is having these conversations; and, what people know about the virus. This information can be used to better tailor education materials to different demographics and to ensure that the appropriate knowledge gaps are being addressed in the appropriate populations. The content analysis of online activity, including news articles and social media related to school norovirus outbreaks, was used to further understand the role of social media as a medium for norovirus education. Interactions were analyzed to determine how the public may use social media during an outbreak and how practitioners may intervene in these conversations to provide prevention and control information. Additionally, information presented in news articles and by users of social media was analyzed for accuracy and to identify potential knowledge gaps.

A survey of self-reported risk management and communication activities of groups thought to be main stakeholders in school norovirus outbreaks was conducted (Chapter 3). Questions were designed to examine the practices and perceptions of environmental health specialists and school administrators in North Carolina, who were presumed to play important roles during outbreaks. In addition to knowledge of norovirus and control practices of their individual organizations, stakeholders were also asked about communication methods and preferences during norovirus outbreaks. This information was used to understand the current state of norovirus education in schools and to determine which stakeholders to target with intervention materials. Additionally, information on communication methods was used to inform the choice of interventions.

These three research projects were integrated with current norovirus literature and behavior change theory to develop three prototype science-based intervention materials aimed
at school populations experiencing norovirus. Each material and the underlying rationale is explained in the final section of this thesis (Chapter 4) and the materials are provided in the appendices (Appendices C-E). The first intervention materials created were graphics, in the form of flowcharts, which can be shared through social media. These graphics were designed to address the most important norovirus control measures in a short, easy to understand medium. The other two intervention materials were both guides aimed at different key stakeholders during school norovirus outbreaks. The first of these was a norovirus and social media guide for health professionals and the second was a guide for news professionals reporting on norovirus. In addition to providing tangible, research-based intervention materials, this research also provides a foundation for the development of similar materials for a range of food safety topics. The research methods used can be applied in other scenarios to help address current gaps needed to produce effective behavior change campaigns.
REFERENCES


CHAPTER 1

Social Media as a Tool for Communicating About Food Safety and Foodborne Illness:
A Review of Relevant Studies

Introduction

Every year in the United States an estimated 48 million people are sickened by foodborne illness, 125,000 are hospitalized and 3,000 die (Scallan et al., 2011). The estimated cost of these foodborne illnesses in the United States is US$7.7 billion annually (Scharff, 2012). It is well established that addressing the burden of foodborne illness cannot be accomplished by scientific advancements alone—education and communication resulting in behavior change plays a crucial role (Woteki & Kineman, 2003). Behavior change frequently needs to occur at the individual level, as unsafe practices in homes have been shown to significantly contribute to foodborne illness (Lee & Greig, 2010; Redmond & Griffith, 2003, 2004; Smadi & Sargeant, 2013).

One method for engagement with individuals is social media. The number of people using social media sites in the United States continues to grow, with 73% of online American adults using social networks (Duggan & Smith, 2014). Additionally, 72% of internet users say they have used the Internet to find health information (Fox & Duggan, 2013). This represents a potential means for education and changing behavior, as more and more people are expected to turn to the Internet for food safety information (Jacob, Mathiasen, & Powell, 2010). The literature demonstrates that social media can be used to communicate public health messages,
but it is still a relatively unstudied medium, especially in relation to food safety behavior (Bernardo et al., 2013; Chapman, Raymond, & Powell, 2014).

Accurately measuring behavior change as a result of an intervention or campaign is a challenge in food safety. This is due to difficulties in capturing accurate data about food safety practices, which often require self-reporting that can introduce questions of validity or in-home observation that is often not practical. Many food safety education studies do not provide empirical evidence of their effectiveness, and even fewer focus on social media’s role in food safety education (Egan et al., 2007; Mitchell, Fraser, & Bearon, 2007; Sivaramalingam et al., 2015). Previous literature reviews related to this topic are either not food-safety specific (Moorhead et al., 2013), not social media focused (Sivaramalingam et al., 2015) or both (Portnoy, Scott-Sheldon, Johnson, & Carey, 2009; Webb, Joseph, Yardley, & Michie, 2010).

The objective of this literature review was to collate and analyze the body of knowledge of current uses, benefits, limitations and best practices for social media use in food safety education and to evaluate the overall quality of studies using a validated index. Information on non-sexually transmitted infectious diseases was also included, as the communication techniques used could be applicable to foodborne illness.

**Methods**

**Article Selection**

A systematic literature search was conducted as this method allows for rigorous review of research and for the aggregation of results. Articles published in English between 2010 and 2015 were selected, as a recent review of social media for health communication found the
majority of articles were published in 2010 and later (Moorhead et al., 2013). The initial search was conducted on Google Scholar using the search terms: "social media" AND ("food safety" OR "infectious disease") –surveillance. This search yielded 8,780 citations. Additionally, the bibliographies of relevant reviews and meta-analyses (Korda & Itani, 2013; Moorhead et al., 2013; Portnoy et al., 2009; Rutsaert, Moss, & Wall, 2013; Sivaramalingam et al., 2015; Webb et al., 2010) were examined for pertinent studies, yielding four additional articles. Search results were first analyzed by title in order to remove duplicates and any irrelevant studies.

A more thorough analysis of abstracts was then performed to determine final inclusion. Inclusion criteria were: (a) primary focus on communication through social media about food issues and/ or infectious diseases; (b) original, peer-reviewed research studies; and (c) all study designs. The exclusion criteria were: (a) studies not in English; (b) literature reviews, review papers, dissertation theses, reports, conference papers or abstracts, letters to the editor, and feature articles; (c) studies only focused on traditional Internet use (such as email and search engines); (d) studies focused on using social media within healthcare settings; (e) studies focused on general risk communication or on health issues not related to food or non-sexually transmitted infectious diseases; (f) studies focused on data mining, disease tracking/surveillance; and (g) studies with a primary marketing or advertising focus. This process yielded 23 articles for final review.

**Article Analysis**

All articles were first coded for general characteristics. This information included study location, social media platforms involved, basic study design (ie. quantitative, qualitative, or
mixed methods), sample size, and data collection technique (ie. survey, content analysis). The general purpose of the social media activity in each study was also recorded which included three categories: (a) content, where a study examined the themes, purpose or content of a body of social media (ie. Tweets related to a specific subject such as the H1N1 outbreak); (b) intervention, where a study focused on an intervention or campaign delivered through social media with a desired behavior change; and (c) opinions and motivation, which were studies focused on why certain groups used social media or on a group’s opinions of social media.

Articles were coded through an iterative approach and a list of themes was established before final coding. Final coding themes were grouped into four main categories: benefits, drawbacks, usage and suggestions (Table 1.1).

A quality index for each study was developed based on the CONSORT statement (Schulz, Altman, Moher, & Group, 2010), which is a set of recommendations used in medical research for reporting on randomized trials, along with quality indices used in previously published systematic reviews (Moorhead et al., 2013; Viator, Blitstein, Brophy, & Fraser, 2015). This system included eight dimensions, shown in Table 1.2. As there are no standard quality measures for qualitative studies, only quantitative and mixed methods studies were rated by this system. Each study received a score from 0 (low) to 8 (high), receiving one point for meeting each quality criterion.

Results

Table 1.3 details the characteristics of studies included in this review. Of the 23 articles, 15 dealt with food related topics. Thirteen of the food related articles focused on food safety
communications, one on nutrition and another on communication of a broad range of food topics. The other eight articles discussed communications related to influenza. The geographic locations varied, with nine in Europe, seven in the United States, two in Asia, one in both the US and Asia and four that focused on all English language social media content. The majority of articles were mixed methods and involved either surveys or content analyses. A range of social media types was represented with the most studies focusing on multiple platforms or all social media. Ten articles sampled online content (ie. Tweets, blogs) while 11 sampled participants via a survey or interview. For samples of online content, size ranged from 224 artifacts to over 1,000,000, while samples of participants ranged from 12-1,400 people. Four research studies utilized qualitative methods, five used quantitative methods and the other 14 applied a mixed methods approach. Analyzing online content to determine online users’ practices and perceptions was the most common purpose. Only three studies looked at specific interventions and of those, only two performed a controlled study of intervention impacts with an experimental design where one group received the intervention and the other did not (James et al., 2013; Mayer & Harrison, 2012).

**Quality of studies**

Nineteen articles were rated by the quality criterion, four were excluded as they were exclusively qualitative. Each article was rated on an eight point scale with an average rating of 6.00, a standard deviation of 1.76 and a mode of 7.00. The individual scores for each article are not provided as the intent was to appraise the overall body of literature and not any specific study. The least frequently met criterion were sample size (5% met criterion), data analysis
(74%), measurement characteristics (79%), precision (79%) and generalizability and limitations (79%). The reason for the low percentage of studies meeting the sample size criterion is that though all provided a description of the sample, very few provided explicit justification that the sample size was appropriate.

**Benefits**

A majority (91%) of the 23 analyzed articles included some information about the benefits of social media for food or infectious disease related communication (Table 1.4). Six articles also discussed how social media can impact public knowledge and behaviors. Three of these provided data on the impact of social media or a social media based intervention on: (1) increased self-reported food safety behaviors (James et al., 2013); (2) increased food safety knowledge and attitudes (Mayer & Harrison, 2012); and (3) increased food safety preventive actions (Mou & Lin, 2014). The others cited social media’s ability to shape public opinion (Chew & Eysenbach, 2010), its role in influencing health behaviors (Tirkkonen & Vilma, 2011), and its utility in providing information to help the public understand health concerns (Vos & Buckner, 2015).

In two studies controlled trials were conducted to determine impacts of food safety interventions delivered through social media. One tested a campaign using both social and traditional media aimed at encouraging families with young children to properly handle and dispose of leftovers (James et al., 2013). This study found that in areas where the intervention was implemented, there was higher knowledge of proper handling and higher self-reported proper handling. The second study examined the impacts of a lecture based course in
conjunction with a Facebook based intervention on college students’ knowledge, attitudes and self-reported practices (Mayer & Harrison, 2012). It was found that participation in the Facebook intervention alone led to significant improvements in food safety knowledge, attitudes and perceptions. Knowledge improvements were even greater when the Facebook intervention was administered in conjunction with the lecture and a longer time spent on the associated Facebook page led to higher improvements in attitudes and practices.

Challenges

A smaller proportion (52%, n = 23) of articles mentioned challenges in using social media, compared to benefits. These were almost evenly split between discussions of the drawbacks to using social media (n = 7) and the barriers that prevent the use of social media (n = 8). Drawbacks and barriers found in these studies are summarized in Table 1.5.

Usage

All articles except one (Albrecht et al., 2012) included information about how social media is used or what factors impact its use by the public. Thirteen studies analyzed the content of social media posts. Five of these determined the most common content types on social media to be: informative resources (Chew & Eysenbach, 2010); news updates, including spread and government actions (Ding & Zhang, 2010; Shan et al., 2014; Vos & Buckner, 2015); and posts of Wikipedia information (Hale et al., 2014). One paper specifically pointed out the dearth of efficacy information found on Twitter (Vos & Buckner, 2015). Personal experiences, opinions and reactions were also found to be relatively common in analyzed social
media (Chew & Eysenbach, 2010; Shan et al., 2014), along with links (Chew & Eysenbach, 2010; Shan et al., 2014; Vos & Buckner, 2015). A conflict was observed between findings on misinformation, though a few articles maintained that misinformation is prevalent on social media (Freberg, 2012; Vos & Buckner, 2015), Chew and Eysenbach (2010) found that only about 4.5% of Tweets actually contained misinformation.

Eleven articles discussed utilizing the engagement capacity of social media, with seven pointing out highlighting engagement as a unique or positive aspect of social media. One theme that came up frequently (n = 8) was the idea of individual influencers- people in the public who possess influence as risk communicators on social media. While most studies focused on individuals as content creators, two indicated the potential for these individuals to widely disseminate content created by health authorities (Corley et al., 2010; Rutsaert, Pieniak, et al., 2013).

Studies also provided explanations for why users may be more engaged with food safety or infectious disease information on social media. Two articles suggested that the public may be growing more interested in food issues in general (Boehm et al., 2010; Prades et al., 2014). Six articles pointed to controversial issues, like GMOs (Boehm et al., 2010), or high profile stories, like a celebrity becoming ill (Chew & Eysenbach, 2010; Corley et al., 2010), as a contributing factor in increased sharing and engagement. Additionally, some studies indicated that more social media activity was likely to occur during crisis/outbreak situations (Panagiotopoulos et al., 2013), possibly due to media preference for those stories (Prades et al., 2014)
Twenty one of the 23 articles discussed variables that impacted dissemination and reception of social media content. The most common variable was content source, with many articles noting that trust in the producer of social media content was paramount in users’ minds (n = 8). A few articles indicated that consumers were not likely to trust information originating from platforms like Facebook or Twitter, but many users placed a high amount of trust in wiki-based sites (Rutsaert, Pieniak, et al., 2013; VanVelsen, VanGermet-Pijnen, Beaujean, Wentze, & VanSteenbergen, 2012) and these sites were a common source of information for acute conditions (ie. flu symptoms, diarrhea) on Facebook pages (Hale et al., 2014). One study also found that there was no difference in public reception between confirmed and unconfirmed messages (Freberg, 2012).

Another frequently mentioned concept was that of consumer interest and emotions. Many studies indicated that consumer interest in food safety was an important contributing factor in how likely they were to use social media as an information source (n = 7). Consumers’ perceived risk about foodborne illness was cited as an important predicting factor in use of social media for food safety information (James et al., 2013; Mou & Lin, 2014; Wu, 2015). In one study, the most common reason for students not seeking out food safety information on social media was a belief that they already possessed the knowledge, followed by a lack of interest and a belief that they were not susceptible to foodborne illness (Mayer & Harrison, 2012).

**Recommendations**
Seventy percent of articles (n = 16) offered recommendations for practitioners using social media to communicate about food safety or infectious disease (Table 1.6). One inconsistency was in the suggestion of using links; one study suggested including links in social media content (Leak et al., 2014), while another provided evidence that this may actually prevent the widespread dissemination of content (Vos & Buckner, 2015).

Though all studies provided suggestions for future directions, nine explicitly stated that there is a need for more research on the applicability of social media to food safety and infectious disease communication. These research needs included better tools to measure behavior change in social media interventions (James et al., 2013); an understanding of why certain strategies motivate behavior change (Freberg et al., 2013); how to distinguish between the general public and experts in an online environment (Shan et al., 2014); and the development of pragmatic guidelines for best practices in encouraging behavior change through social media (Hale et al., 2014; Rutsaert et al., 2014; Vos & Buckner, 2015).

**Discussion**

There is an ever growing body of literature examining the use of social media in health applications, and this medium is just beginning to be explored for application in food safety communications. The literature on this topic is varied and includes a range of studies looking at both content of social media and public reactions to and use of social media. This review covers the current knowledge about social media as it relates to food safety communications and highlights strengths and weaknesses in this body of literature. The aim is to aid researchers
both in their use of social media for food safety purposes and in their design of new studies on this topic.

The study types examined in this review were diverse, but fell into two general groups—analyzing already published social media content (n = 13) and analyzing public perceptions or impacts of social media (n = 10). These types of articles serve two different functions. Content analysis provides insight into most shared messages, public knowledge and conversations about food safety issues online, while survey and interview based research gives insight into why certain messages work and can provide a clearer picture of what consumers want to see on social media, compared to content analysis. An important note is that only two studies provided any type of control group in their analysis of social media impacts (James et al., 2013; Mayer & Harrison, 2012). The absence of controlled studies makes eliminating confounding variables and providing a strong conclusion about social media’s efficacy difficult and has been pointed out in other reviews (Viator et al., 2015). One challenge in executing social media communication studies is the difficulty in measuring behavior change through a social media intervention (James et al., 2013; Panagiotopoulos et al., 2013).

The observed scores on the quality index indicate a few areas for improvement in future studies. The first is sample size determination and justification, which was not provided with the exception of one of the articles. All studies provided a sample size but did not provide explicit evidence that the sample size was sufficient. It is recommended that sample size estimation or power calculations are performed to improve the validity of statistical conclusions (Lenth, 2001). Second, more robust statistical analyses and measurements of precision are needed. If behaviors, knowledge or opinions are being measured, validity and
reliability measures need to be provided. Adding evaluation measures can increase confidence in results of studies and also allow for ease of replication and comparison. Third, the limitations and generalizability of a study need to be clearly stated. It is important to acknowledge outside factors that could limit applicability of conclusions and specify in which situations recommendations apply.

Four of the analyzed articles were purely qualitative and not subjected to the quality index. These articles do provide value in their ability to capture complexity and provide a deeper understanding of beliefs and motivations (Johnson & Waterfield, 2004). However, there are concerns about the rigor of qualitative methods and other research has proposed various frameworks to address this, including the Qualitative Legitimation Model and the use of thematic networks (Attride-Stirling, 2011; Onwuegbuzie & Leech, 2007). The application of these methods to qualitative studies is advisable and in the future it may be possible to use the methods to develop a quality index for purely qualitative research.

Based on the studies analyzed, it is clear that social media provides many benefits and opportunities for food safety communications. The most important of these benefits appears to be the ability to respond quickly and to reach a wide variety of people with tailored messages. It appears, though, that this second benefit is a double-edged sword, as some studies point out that it can be difficult to reach all demographic groups online (Freberg, 2012). The most common motivating factors for a user seeking food safety information on social media were trust and individual interest and beliefs. Trust in the source and in the online community if posting in a group or forum was repeatedly emphasized as paramount to user’s positive perceptions of social media messages and inclinations to follow those messages. Additionally,
numerous studies mentioned the importance of traditional media in shaping social media content and its function as a complement to social media. Studies found that a majority of consumers still choose traditional media over social media as a news source and that a lot of content on social media originated from traditional news sites.

The concept that personal interests and beliefs drive responses to food safety content on social media is interesting and warrants further exploration. Some studies demonstrated that those who: (a) believe they are not susceptible to foodborne illness (James et al., 2013); (b) believe they already possess correct knowledge (Mayer & Harrison, 2012); or (c) just have no interest in, or knowledge of, food safety information (Mou & Lin, 2014) are less likely to seek out and use social media based food safety information. However, these studies did not provide further research on how these initial beliefs are formed and how to potentially change them and encourage utilization of food safety resources. Emotion’s role in social media behaviors also requires further research, as studies point out that emotional responses can play a dramatic role in whether or not an individual takes preventive actions (Mou & Lin, 2014). However, others point to emotional responses as potentially dangerous in a social media setting as they could escalate a crisis (Rutsaert et al., 2014).

The idea of individual influencers also merits further investigation, as numerous studies referenced the concept but did not provide much information. The concept of a few individuals who have power over a large group of people online is still relatively unexplored but one that could have devastating consequences if not addressed. If these individuals are providing incorrect information, it could pose a serious threat to public health. More work is needed on assessing individual influence over social media and creating strategies to work with these
individuals to provide accurate information. Individual influencers have a combination of knowledge, ability, and motivation to lead others, along with social capital in the form of a wide reach, and further research on how these factors influence public opinion could allow for the development of more persuasive materials (Langner, Hennigs, & Wiedmann, 2013). If direct cooperation with an individual is not possible, an organization may be able to utilize the techniques of individual influencers, which could include displaying competence and value to users (Anderson & Kilduff, 2009).

More research on the role of social media in food safety communication is needed. Very few articles were located on this topic, and articles on infectious diseases ultimately were included to provide a more robust sample size. Though these infectious disease studies offer helpful insight into communications similar to those related to foodborne illness, it would be ideal to have a wider body of food-specific knowledge to draw conclusions from.

**Conclusions**

Social media is a relatively new frontier for food safety education, yet could be extremely valuable in closing the gap in public knowledge. Many of the studies in this review focused on different topics, utilized different methods and provided a range of conclusions. In order to build a credible body of evidence on the role of social media in food safety communication and to establish best practices, more standardization of studies may be necessary. This could potentially be done through the creation of a framework similar to the CONSORT statement that provides standards for researchers utilizing mixed or qualitative methods. Trust and personal beliefs appear to be crucial in determining public use of social
media, but more research is needed on using this information to create effective messages about food safety risks and preventive actions. It is important not to undervalue traditional media’s role in social media communication and to ensure that social media campaigns are executed in conjunction with traditional media campaigns. Best practices for social media use are still not well established and there is a need for more evidenced-based suggestions and controlled studies of impacts.
### Main Coding Themes

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td>Discusses the benefits of using social media including any measured positive impacts</td>
<td>One benefit is the ability to conveniently update content (Albrecht, Larvick, Litch, &amp; Weishaar, 2012) Data suggests that the campaign impacted food safety behaviors (James, Albrecht, Litchfield, &amp; Weishaar, 2013)</td>
</tr>
<tr>
<td>Drawbacks</td>
<td>Discusses drawbacks of using social media including challenges in providing content, negative outcomes, and barriers to access and use by the public</td>
<td>A negative image of social media is seen as a weak spot (Rutsaert et al., 2014) The most frequently identified barrier to accessing food safety information through social media was a lack of time (Mayer &amp; Harrison, 2012)</td>
</tr>
<tr>
<td>Usage</td>
<td>Covers a topic related to the current usage of social media, including most common content, nature of engagement, and variables that impact how the public uses social media</td>
<td>90.2% of tweets provided references to information they were providing (Chew &amp; Eysenbach, 2010) The purpose of using social media is to establish a virtual community (Freberg, Palenchar, &amp; Veil, 2013) Perceived severity and intense news coverage are likely factors that dictate tweet posting activity (Chew &amp; Eysenbach, 2010)</td>
</tr>
<tr>
<td>Suggestions</td>
<td>Provides suggestions for the best way to utilize social media or for future research on social media</td>
<td>Campaigns should utilize an appropriate mix of traditional media and social media (James et al., 2013) Social media is in its infancy and more research is needed to evaluate its educational use (James et al., 2013)</td>
</tr>
</tbody>
</table>
Table 1.2

Criteria Used to Score Quality of Articles Including Quantitative Analysis, Adapted from the CONSORT Statement*  

<table>
<thead>
<tr>
<th>Quality Criterion</th>
<th>Criterion is met if:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Authors have stated specific objectives and aims and provide a rationale for performing the study.</td>
</tr>
<tr>
<td>Sample selection</td>
<td>Authors describe the general population, the included sample, and the method of sample collection.</td>
</tr>
<tr>
<td>Sample size</td>
<td>Explanation of sample size is included, along with justification for why sample size is appropriate.</td>
</tr>
<tr>
<td>Study design</td>
<td>Study measures quantitative values appropriate for addressing stated aim; if study is testing an intervention, study design includes a comparison and control group and a pre- and post-intervention analysis.</td>
</tr>
<tr>
<td>Measurement</td>
<td>For measures of knowledge, attitude, or behavior, authors report reliability and/or validity of measures. For observations and counts, the authors provide enough explanation for replication.</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Statistical and data analysis methods are included and described with enough detail to allow replication.</td>
</tr>
<tr>
<td>Precision</td>
<td>Reported outcomes include information about uncertainty (e.g., P values); if descriptive statistics and percentages are used, a sample size is indicated.</td>
</tr>
<tr>
<td>Generalizability and limitations</td>
<td>Authors acknowledge the extent to which the study is generalizable and address limitations of the data.</td>
</tr>
</tbody>
</table>

*Each article received a score of 0 (not met) or 1 (met) for each criterion
### Table 1.3

**Characteristics and Key Findings of Included Studies**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Topica, Purpose</th>
<th>Location</th>
<th>Social Media Type</th>
<th>Sampleb</th>
<th>Data Collection</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Albrecht et al., 2012)</td>
<td>FS; Intervention</td>
<td>US</td>
<td>Phone App</td>
<td>N/A</td>
<td>Case study</td>
<td>The use of mobile smartphone technology has the opportunity to offer consumers immediate access to food safety information.</td>
</tr>
<tr>
<td>(Boehm et al., 2010)</td>
<td>F; Content</td>
<td>Germany</td>
<td>Blogs, forums</td>
<td>Online content (n = 50,931)</td>
<td>Content analysis</td>
<td>Controversial issues are the most talked about food issues online and are often framed in a two-sided way.</td>
</tr>
<tr>
<td>(Chew and Eysenbach, 2010)</td>
<td>ID; Content</td>
<td>English language content</td>
<td>Twitter</td>
<td>Online content (n = 5395)</td>
<td>Content analysis</td>
<td>H1N1 tweets were primarily used to disseminate information, but also included opinions and experiences. Tweets can be used for real-time information gathering to allow timely response to public concerns.</td>
</tr>
<tr>
<td>(Corley et al., 2010)</td>
<td>ID; Content</td>
<td>English language content</td>
<td>Blogs</td>
<td>Online content (n = 158,497,700)</td>
<td>Text mining</td>
<td>Text and structural data mining provides a technique to identify online “flu” topic health information communities for targeting health campaigns.</td>
</tr>
<tr>
<td>(Ding and Zhang, 2010)</td>
<td>ID; Content</td>
<td>US and China</td>
<td>All</td>
<td>Online content (n =540)</td>
<td>Content analysis</td>
<td>During H1N1 pandemic, governments used social media in one-way or limited two-way transmission, while the public circumvented institutional response through participatory communications.</td>
</tr>
<tr>
<td>Authors</td>
<td>Topic^a; Purpose</td>
<td>Location</td>
<td>Social Media Type</td>
<td>Sample^b</td>
<td>Data Collection</td>
<td>Key Findings</td>
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<tr>
<td>(Freberg, 2012)</td>
<td>FS; Motivation/Opinion</td>
<td>US</td>
<td>All</td>
<td>Public (n = 400)</td>
<td>Survey</td>
<td>Stronger intent to comply with organizational food recall messages compared to user-generated, but no effect observed with message reliability; strong age cohort effects were seen in response to message source.</td>
</tr>
<tr>
<td>(Freberg et al., 2013)</td>
<td>ID; Content English</td>
<td>US</td>
<td>Bookmark Online</td>
<td>Online (n = 953)</td>
<td>Content analysis</td>
<td>From social bookmarks related to H1N1, the CDC was the most popular reference, individuals were strongly present, blogs were the most popular type of documents, and Twitter was the most popular source being referenced.</td>
</tr>
<tr>
<td>(Hale et al., 2014)</td>
<td>ID; Content</td>
<td>US</td>
<td>Facebook</td>
<td>Online (n = 600)</td>
<td>Content analysis</td>
<td>Health related Facebook content is frequently irrelevant and diseases with stigmas may inhibit how users interact on social media.</td>
</tr>
<tr>
<td>(James et al., 2013)</td>
<td>FS; Intervention</td>
<td>US</td>
<td>Facebook, Twitter</td>
<td>Intervention Users (n = 600)</td>
<td>Survey</td>
<td>The use of interventions delivered through both traditional and social media increased awareness and intention to change health behaviors related to handling of leftovers.</td>
</tr>
<tr>
<td>Authors</td>
<td>Topic(^a); Purpose</td>
<td>Location</td>
<td>Social Media Type</td>
<td>Sample(^b)</td>
<td>Data Collection</td>
<td>Key Findings</td>
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<tr>
<td>(Kuttschreuter et al., 2014)</td>
<td>FS; Motivation/Opinion</td>
<td>Europe</td>
<td>All</td>
<td>Public (n = 1264)</td>
<td>Survey</td>
<td>Identified four consumer types based on inclination to seek information about food-related risks; individuals most inclined to use social media considered it more important to be well informed, were more motivated to find information, and had high perceived risk of a food incident.</td>
</tr>
<tr>
<td>(Leak et al., 2014)</td>
<td>F; Motivation/Opinion</td>
<td>US</td>
<td>All</td>
<td>Public (n = 26)</td>
<td>Focus Group</td>
<td>Identified aspects important to a nutrition education social media page were: page content, page maintenance, networking opportunities with others; trust was central as participants wanted reliable information from known, credible sources.</td>
</tr>
<tr>
<td>(Mayer and Harrison, 2012)</td>
<td>FS; Intervention</td>
<td>US</td>
<td>Facebook</td>
<td>Intervention Users (n = 710)</td>
<td>Survey</td>
<td>Participation in the “Safe Eats” Facebook intervention leads to improvements in food safety attitudes, practices, and knowledge; the combination of lecture and Facebook resulted in higher knowledge scores than Facebook alone and participants who spent more time on the Facebook page had greater improvements in food safety attitudes and practices.</td>
</tr>
</tbody>
</table>
Table 1.3 (Continued)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Topic; Purpose</th>
<th>Location</th>
<th>Social Media Type</th>
<th>Sample</th>
<th>Data Collection</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Mou and Lin, 2014)</td>
<td>FS; Motivation/Opinion</td>
<td>China</td>
<td>Microblog (Weibo)</td>
<td>Public (n = 1400)</td>
<td>Survey</td>
<td>Emotional response towards food safety incidents was a stronger predictor of risk perception and preventative action, compared to awareness of food safety incidents and knowledge.</td>
</tr>
<tr>
<td>(Panagiotopoulos et al., 2013)</td>
<td>FS; Motivation/Opinion</td>
<td>UK</td>
<td>All</td>
<td>N/A</td>
<td>Case study</td>
<td>Governments using social media should manage the public’s expectations for responsiveness, be aware of their audience, use proactive monitoring and utilize social media for promotion of behavior change.</td>
</tr>
<tr>
<td>(Prades et al., 2014)</td>
<td>FS; Motivation/Opinion</td>
<td>Spain</td>
<td>Blogs</td>
<td>Public (n = 12)</td>
<td>Interview</td>
<td>Social media is reshaping online roles related to food content and both professionals and the public have roles in online food communication; in social media food-related content, there is a need for more official sources, information overload is a big drawback and creativity is paramount.</td>
</tr>
<tr>
<td>(Rutsaert et al., 2014)</td>
<td>FS; Motivation/Opinion</td>
<td>Belgium</td>
<td>All</td>
<td>Public (n = 497)</td>
<td>Survey</td>
<td>Social media has a role in food risk/benefit communication; identified strengths include speed, accessibility and interaction, while weaknesses include lack of filter, low trust, information overload and preference for traditional media.</td>
</tr>
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</table>
Table 1.3 (Continued)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Topic^a; Purpose</th>
<th>Location</th>
<th>Social Media Type</th>
<th>Sample^b</th>
<th>Data Collection</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Rutsaert et al., 2013)</td>
<td>FS; Motivation/Opinion</td>
<td>Europe</td>
<td>All</td>
<td>Public (n = 71)</td>
<td>Interview</td>
<td>Groups with higher interest in social media as an information source had higher familiarity and appreciation for the opportunities of social media; Wikipedia was perceived by all groups as the most useful and credible online source; Speed and accessibility were the main motives for using social media while lack of trustworthiness was the main barrier.</td>
</tr>
<tr>
<td>(Shan et al., 2014)</td>
<td>FS; Content</td>
<td>Ireland</td>
<td>Blogs, Forums, Twitter</td>
<td>Online content (n = 316)</td>
<td>Content analysis</td>
<td>Social media related to the Irish dioxin crisis responded and diminished faster than traditional media and used news messages as the primary sources; no significant difference in negative tone was found between traditional and social media.</td>
</tr>
<tr>
<td>(Signorini et al., 2011)</td>
<td>ID; Content</td>
<td>US</td>
<td>Twitter</td>
<td>Online content (n = 1,000,000)</td>
<td>Text mining</td>
<td>Twitter can be used as a measure of public interest or concern about health-related events in order to target messages.</td>
</tr>
<tr>
<td>Authors</td>
<td>Topica; Purpose</td>
<td>Location</td>
<td>Social Media Type</td>
<td>Sampleb</td>
<td>Data Collection</td>
<td>Key Findings</td>
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</tr>
<tr>
<td>(Tirkkonen and Vilma, 2011)</td>
<td>ID; Content</td>
<td>Finland</td>
<td>Forum</td>
<td>Online content (n = 2264)</td>
<td>Content analysis</td>
<td>Trust of authorities may not necessarily extend to the online environment, particularly if interventions are carried out too late and with too little resources; more proactive authority communication is needed to establish a dialogue with citizens before a crisis.</td>
</tr>
<tr>
<td>(VanVelsen et al., 2012)</td>
<td>ID; Content</td>
<td>Germany</td>
<td>All</td>
<td>Public (n = 18)</td>
<td>Content analysis</td>
<td>During an infectious disease outbreak, the sample believed that social media was not a suitable or reliable source for communicating information, while Wikis did fill several information needs; source credibility was cited as an important aspect of useful information.</td>
</tr>
<tr>
<td>(Vos and Buckner, 2015)</td>
<td>ID; Content</td>
<td>English language content</td>
<td>Twitter</td>
<td>Online content (n = 25,598)</td>
<td>Content analysis</td>
<td>A large proportion of Twitter messages related to H7N9 (bird flu) contained sense making information, but few contained efficacy information that would help individuals respond.</td>
</tr>
<tr>
<td>(Wu, 2015)</td>
<td>FS; Motivation/Opinion</td>
<td>Taiwan</td>
<td>Facebook</td>
<td>Public (n = 652)</td>
<td>Survey</td>
<td>High risk perception, social trust, support and positive emotions are key determinants of Facebook use for finding food-safety information.</td>
</tr>
</tbody>
</table>

---

a FS: Food safety, F: General food related, ID: Infectious disease
b Studies without sample size (N/A) were single case studies
Table 1.4

*Benefits Associated with Social Media Use for Risk Reduction Identified in the Literature*

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach</td>
<td>Social media provides the ability to reach a diversity of people</td>
<td>(Chew &amp; Eysenbach, 2010; Corley, Cook, Mikler, &amp; Singh, 2010; Ding &amp; Zhang, 2010; Freberg et al., 2013; James et al., 2013; Kuttschreuter et al., 2014; Mayer &amp; Harrison, 2012; Prades, Farré, &amp; Gonzalo, 2014; Rutsaert et al., 2014; Rutsaert, Pieniak, Regan, McConnon, &amp; Verbeke, 2013)</td>
</tr>
<tr>
<td>Information gathering</td>
<td>It is possible to use social media to gather information and to target specific populations</td>
<td>(Boehm, Kayser, &amp; Spiller, 2010; Corley et al., 2010; Freberg et al., 2013; Freberg, 2012; James et al., 2013; Mayer &amp; Harrison, 2012; Panagiotopoulos, Barnett, &amp; Brooks, 2013; Prades et al., 2014; Rutsaert et al., 2014; Signorini, Segre, &amp; Polgreen, 2011)</td>
</tr>
<tr>
<td>Immediate</td>
<td>Social media provides the ability to react immediately to situations and provide timely information</td>
<td>(Albrecht et al., 2012; Chew &amp; Eysenbach, 2010; Ding &amp; Zhang, 2010; James et al., 2013; Kuttschreuter et al., 2014; Leak et al., 2014; Rutsaert et al., 2014; Rutsaert, Pieniak, et al., 2013; Shan, Regan, De Brun, &amp; Barnett, 2014)</td>
</tr>
<tr>
<td>Interaction</td>
<td>Social media provides opportunities to engage with the audience</td>
<td>(Boehm et al., 2010; Rutsaert et al., 2014)</td>
</tr>
<tr>
<td>Public opinions</td>
<td>Social media can allow users to access unbiased public opinions that can help improve communication efforts</td>
<td>(Corley et al., 2010; Rutsaert et al., 2014)</td>
</tr>
<tr>
<td>Cost</td>
<td>Social media use has a low cost and resource input</td>
<td>(Corley et al., 2010)</td>
</tr>
</tbody>
</table>
Table 1.5

*Challenges Associated with Using Social Media for Risk Reduction Identified in Literature*

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drawbacks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complicated</td>
<td>Numerous platforms can be difficult to manage and the ease of information access allows more complex questions to be asked</td>
<td>(Boehm et al., 2010; Freberg, 2012; Panagiotopoulos et al., 2013)</td>
</tr>
<tr>
<td>Hard to measure</td>
<td>It is difficult to measure if and how social media is impacting behavior</td>
<td>(James et al., 2013; Panagiotopoulos et al., 2013)</td>
</tr>
<tr>
<td>Resources</td>
<td>It takes a lot of time to manage a social media account and an investment is needed to ensure effective presence</td>
<td>(Rutsaert et al., 2014; Tirkkonen &amp; Vilma, 2011)</td>
</tr>
<tr>
<td>Control</td>
<td>It can be difficult to control the messages on social media, and there is a concern that hysteria could ensue</td>
<td>(Rutsaert et al., 2014)</td>
</tr>
<tr>
<td><strong>Barriers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Different age groups use social media and some are generally more comfortable with the medium</td>
<td>(Freberg, 2012; Kuttschreuter et al., 2014; Rutsaert et al., 2014)</td>
</tr>
<tr>
<td>Anonymity and stigma</td>
<td>Some users may be concerned about privacy or about discussing health concerns that carry a stigma (ie. diarrhea associated with food-borne illness)</td>
<td>(Hale, Pathipati, Zan, &amp; Jethwani, 2014; Leak et al., 2014; Tirkkonen &amp; Vilma, 2011)</td>
</tr>
<tr>
<td>Information overload</td>
<td>Users may be overwhelmed by the amount of information on social media and either reject the whole medium or not know how to identify credible information</td>
<td>(Hale et al., 2014; Prades et al., 2014; Rutsaert et al., 2014)</td>
</tr>
</tbody>
</table>
Table 1.6

Recommendations for Using Social Media for Risk Communication Identified in the Literature

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complement</td>
<td>Recommend that social media be treated as a complement to traditional media sources</td>
<td>(Boehm et al., 2010; Chew &amp; Eysenbach, 2010; Freberg et al., 2013; James et al., 2013; Kuttschreuter et al., 2014; Mou &amp; Lin, 2014; Panagiotopoulos et al., 2013; Prades et al., 2014; Shan et al., 2014; Signorini et al., 2011; VanVelsen et al., 2012)</td>
</tr>
<tr>
<td>Proactive</td>
<td>Emphasize the importance of proactively monitoring social media and to building relationships before crises</td>
<td>(Boehm et al., 2010; Kuttschreuter et al., 2014; Panagiotopoulos et al., 2013; Tirkkonen &amp; Vilma, 2011; Vos &amp; Buckner, 2015)</td>
</tr>
<tr>
<td>Demographic specific</td>
<td>Suggest that social media is more appropriate for certain demographics and should be tailored to different groups</td>
<td>(Freberg, 2012; Hale et al., 2014; Kuttschreuter et al., 2014; Panagiotopoulos et al., 2013; Rutsaert et al., 2014)</td>
</tr>
<tr>
<td>Links</td>
<td>Provide advice on the use of links in social media content</td>
<td>(Leak et al., 2014; Vos &amp; Buckner, 2015)</td>
</tr>
<tr>
<td>Consistency</td>
<td>Emphasize the need for consistent messages between different groups</td>
<td>(VanVelsen et al., 2012)</td>
</tr>
<tr>
<td>Conclusions</td>
<td>Consumer want communications about the conclusions of outbreaks or crises situations</td>
<td>(VanVelsen et al., 2012)</td>
</tr>
<tr>
<td>Photos</td>
<td>Consumers prefer images and content with visual appeal</td>
<td>(Leak et al., 2014)</td>
</tr>
</tbody>
</table>
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CHAPTER 2

Using Online Activity to Understand Knowledge Gaps in School-Linked Norovirus Outbreaks

Introduction

Norovirus can pose a particular issue in schools due to the closed setting, high number of common hand touch areas, and potentially low hygiene practices of children. These factors compound the problems with norovirus, which has a low infectious dose, rapid person-to-person spread and significant environmental stability (Patel, Hall, Vinjé, & Parashar, 2009). Norovirus in schools is not only a contributor to student illnesses; it can also lead to a significant increase in missed work for staff (Holt & Powell, 2014). A particularly important route of norovirus transmission in school settings is the combination of the aerosolization of viral particles following a vomiting episode, coupled with incorrect sanitizing methods, which can prolong an outbreak (Gomez, 2008; Marks et al., 2003). Combating the spread of norovirus often requires risk management behaviors, including increased hygiene and cleaning/sanitizing measures (Hall et al., 2011; Kosa, Cates, Hall, Brophy, & Fraser, 2014; Lee & Greig, 2010; Li, Predmore, Divers, & Lou, 2012; Sandora et al., 2005).

Online posts, discussions and conversations can provide an indication of public perception, knowledge and misconceptions which are important to understand in order to create effective education interventions. Additionally, investigating characteristics of school norovirus outbreaks can aid in developing tailored education messages. An estimated 72% of people receive their news from online sources, with 73% of internet users on social media, and
online articles and forums are an important source of conversations about norovirus (Maeve Duggan & Smith, 2014; Lenhart, Purcell, Smith, & Zickuhr, 2010). Previous studies have highlighted the usefulness of online surveillance and social media for monitoring and tracking diseases, but indicate that this medium is rarely used (Brownstein, Freifeld, & Madoff, 2009; Corley, Cook, Mikler, & Singh, 2010). Social media could be particularly beneficial in communicating public health messages, but is still a relatively untapped resource (Bernardo et al., 2013; Chapman, Raymond, & Powell, 2014).

The goal of this research was to provide content analysis of news articles and social media postings related to norovirus, to characterize school outbreaks and better understand public knowledge about this virus. This information will be used to identify knowledge gaps and inform the creation of new intervention methods better tailored to populations affected in school outbreaks of norovirus.

**Methods**

**Search methodology**

A systematic search methodology was used to identify online news article artifacts and social media activity related to norovirus outbreaks in schools. An initial search was performed using the Google search engine (www.google.com) and the following query: “norovirus outbreak” AND (“school” OR “elementary” OR “middle” OR “high”). Searches were performed weekly in June and July, 2014 and biweekly the search terms were entered into Facebook and Twitter’s search fields to locate social media activity during the same time period. When a new outbreak was identified, the name of the identified school, combined with
the term “norovirus outbreak” was used for subsequent Google, Facebook and Twitter searches.

Only results from the first ten pages of Google search returns were included in this study to capture the most recent outbreaks, outbreaks with an active online presence and articles most likely to be viewed (Chitika Insights, 2013). Inclusion criteria were: (1) published in English; (2) news article or social media post; and (3) information covered was related to an outbreak of gastroenteritis in a school. Company advertisements and health department reports were excluded and the remaining artifacts were categorized as either social media or news articles. Social media included content from Twitter, Facebook, blogs, and other social media forums, including Reddit.com. If articles had identical text, only one version of the article was analyzed. In total, 63 outbreaks were identified, with 311 corresponding news articles and 114 social media webpages.

**News Article Coding**

Codes were established through an iterative approach. A 10% subset of articles was initially coded by two coders to establish coding themes and reliability, before applying a final coding system to all artifacts. News articles were coded for identifying information about the outbreak as well as norovirus information provided in the article (Table 2.1). If any outside links were provided or other sources were referenced, the source was recorded. Information gaps were also identified, as well as misconceptions and incorrect information.
Social Media Coding

For the purposes of observing an overall trend in Tweets, all Twitter posts related to an outbreak were considered one artifact and coded together. The aim of this was to understand what the common content on Twitter was, instead of analyzing any individual Tweet. All social media posts were coded with the identifying information in addition to recording the number of likes, shares, and comments. Both original posts and associated comments were analyzed for six themes (Table 2.2).

Statistical Methods and Inter-Rater Reliability

All coded variables were tested for reliability using Krippendorf’s alpha (Hayes & Krippendorff, 2007). Calculations were performed using the online web service, ReCal2 (http://dfreelon.org/utils/recalfront/recal2/) (Freelon, 2010). Ten percent of artifacts were coded by both coders to determine reliability during codebook development. The final version of the codebook was established when a sufficient alpha (> 0.7) was achieved for each variable. For a few variables, Krippendorf’s alpha was undefined due to invariant values, but these variables were still included as the percent agreement was 100%. A non-parametric Analysis of Variance (ANOVA) was used to compare differences in coded variables based on post characteristics.
Results

In total, 63 outbreaks occurring between February 2006 and October 2014 were identified via Internet searches. From these outbreaks, 311 unique news stories and 114 unique social media postings were analyzed. On average, there were five news articles associated with each outbreak, though eleven outbreaks only had one news article associated with them. Most of the analyzed outbreaks (95%, N = 63) occurred between 2011 and 2014. The majority of outbreaks (38) occurred in the cooler months (October-March), with 22 in the winter months (December-February), and an observed peak in May of 11 outbreaks. Fifty-six outbreaks were found in 27 US States (Figure 2.1), along with five in Canada and two in England. Elementary schools accounted for the majority of outbreaks, followed by high schools and universities (Table 2.3). Fifty-nine outbreaks had associated news articles which reported the number of ill individuals. Of these, 63% had 100 or more reported sick individuals, with 14% reporting 300 or more (N = 53).

If at least one news article mentioned that an outbreak was confirmed by laboratory results, the whole outbreak was considered confirmed. Of the outbreaks analyzed, 54% were considered confirmed norovirus outbreaks and 43% were suspected. Two of the outbreaks did not have any news articles that specifically mentioned norovirus, but described a school outbreak of general gastrointestinal illness. Only 20 outbreaks had associated news articles that discussed potential causes. Of these, most mentioned either a possible cause (60%, N = 20) or stated explicitly that something (for example, the cafeteria food) was not the cause (25%, N = 20). Potential causes included contaminated school food, water fountains, outside food, outside
events, or a child getting sick in the school. The three outbreaks where a cause was given all cited outside food or social events as the source.

School actions to address outbreaks were discussed in 93% of articles, representing 60 analyzed outbreaks. Most of these articles (77%, N = 288) indicated that the school increased cleaning/ sanitizing procedures on the school grounds. According to news reports, five of the schools provided hand sanitizer to staff and students as a preventive measure. Twitter activity was used to provide an estimate of outbreak duration for the 49 outbreaks with a presence on Twitter. The median duration was 6 days with a geometric mean of 4.8 days (95% CI, 2.6 to 7.0).

Content of News Articles

A majority of the news articles analyzed (87%, N = 311) provided some information about norovirus and its associated illness (Table 2.4). The most commonly addressed topics were: the symptoms of norovirus; the high infectivity of the virus; and, its transmission routes, especially person-to-person transmission. Only eleven articles explicitly mentioned that norovirus persists for a long period in the environment.

In addition to discussing the virus itself, two-thirds of the articles (66%, N =311) provided some form of advice for the reader on how to prevent norovirus and its spread in the community. Seventy-six percent of articles providing advice mentioned proper hand washing and 67% advised excluding those who are sick from school and work, while 13% explicitly specified to avoid food handling while ill. A quarter of articles suggested cleaning or sanitizing surfaces to prevent the spread of virus and two percent suggested limiting food sharing (N =
206). Of the 81 articles providing external links or quotes, 46% referenced the CDC and twenty-nine (36%) referenced local health departments. Of the 21 articles where norovirus misconceptions were noted, most either called norovirus a bacterium (33%) or equated it with the flu (33%). A few articles included the belief that norovirus primarily impacts cruise ships, that quaternary ammonium compound products are effective in preventing the spread of the virus and that covering coughs and sneezes are important in norovirus control.

Social Media

Social media activity was found for 53 outbreaks, with the majority on Twitter (92% of outbreaks) and Facebook (62% of outbreaks). Additionally, fifteen outbreaks were referred to in blog posts and two in forum sites; none of which were directly associated with the school. Most Facebook posts (66%, N = 44) originated from news outlets and contained a news story link (64%, N = 44). A quarter of Facebook posts included a coded theme, with the most common being advice (n = 8). There appeared to be no significant relationship between post characteristics (time, poster, mention of norovirus and post content) and Facebook interactions as measured by likes, shares and comments (ANOVA, p > 0.01).

A total of 2,149 tweets were identified, and most outbreaks (63%, N = 51) had less than 20 tweets in the overall Twitter activity, with only four having over 100. Fifty-five percent of all tweets included a news link and 27% were posted by a news station or individual associated with a news station (N = 2149). A larger percent of Facebook comments were coded for a theme compared to tweets, with sharing of personal experiences being the most common theme on Facebook and second most common on Twitter (Figure 2.2). Humor was the most coded
theme in tweets, while humor and questions were least common in Facebook comments. Commenters that offered advice generally wrote about hand washing and staying home from school. Those that showed concern occasionally mentioned the virus’ association with cruise ships, while no other location was mentioned by commenters or Twitter posters.

Two outbreaks had outbreak specific hashtags on Twitter and these two outbreaks accounted for 34% of all Twitter posts analyzed (N = 2149). The hashtags were #DSSPlague2014 and #rssplague. The activity for these outbreaks had less news account participation and tweets of news links compared to activity without an outbreak-specific hashtag (Table 2.5).

One “parody account” was also analyzed. This account was an individual posing as the virus and tweeting as if they were the norovirus at the school experiencing the outbreak. The account had 40 posts, 38 of which were posted within one month of the outbreak. There were 246 followers, but the account was not following any other users. The account heavily relied on humor and also school-specific information, including references to student elections. Most of the humor was general, but a small subset used humor to also provide information about the virus (Table 2.6).

**Discussion**

This study is the first to analyze online activity in relation to norovirus outbreaks in schools and to use this information to understand the knowledge level of the public about norovirus. This study demonstrates that the Internet is an important source for information about norovirus outbreaks and can be a tool to disseminate information and engage the public
in conversations about disease prevention. It has previously been demonstrated that online searches and blog activity correlate with actual disease trends for both influenza and norovirus, and it is possible that news articles and other social media activity could serve as another source for this information (Corley et al., 2010; Desai et al., 2012; Polgreen, Chen, Pennock, & Nelson, 2008).

Seasonal patterns observed in outbreaks, with the majority in the cool months and a winter peak, has been demonstrated previously (Ahmed, Lopman, & Levy, 2013). The peak of articles in May is not consistent with previous data, but can likely be explained by bias introduced from searches being performed in June and July. The majority of outbreaks occurring in elementary schools aligns with data showing the highest incidence of norovirus among children aged 0-11 (de Wit et al., 2001).

The number of infected individuals in each outbreak was determined from numbers provided in news coverage. These numbers ranged from 10 to 600 individuals with an average of 141, which is much higher than other reports of school outbreaks of norovirus (Lopman, Adak, Reacher, & Brown, 2003). A possible explanation is that news reports could be skewed towards outbreaks with larger numbers of affected individuals because of media preference to cover higher impact outbreaks. Duration of outbreaks as determined from Twitter activity was slightly shorter (median 6 days) than average durations reported in the literature [6.5 days (Harris, Lopman, & O’Brien, 2010) and 8 days (Lopman et al., 2003)], possibly because Twitter activity missed the first few days of the outbreak.

It is concerning that five of the 63 schools were reported as providing hand sanitizer to students, as it is well-established that commercially available alcohol-based hand sanitizer is
not effective in completely inactivating norovirus, and it has been suggested that hand sanitizers can actually increase outbreak duration (Liu, Yuen, Hsiao, Jaykus, & Moe, 2010; Vogel, 2011).

**Advice from News Articles**

The majority of news articles included correct information about norovirus and covered the main control measures, but often missed crucial details. Most articles correctly described norovirus symptoms, but only about half discussed transmission and infectivity. The omission of this information is concerning as previous data has found that the public needs more specific information about infectious agents and their spread to make accurate risk decisions (Roche & Muskavitch, 2003). Additionally, few articles mentioned environmental persistence of norovirus, even though it has been suggested that environmental persistence plays a very important role in outbreaks (Lopman et al., 2012).

One third of articles provided no advice for readers on how to prevent norovirus infection. Of the articles offering advice, the main messages were hand washing and exclusion of ill individuals, which is supported by literature suggesting these as some of the most important control measures (Chadwick et al., 2000; Hall et al., 2011). In comparison, environmental cleaning was mentioned much less frequently, though it is an important control measure, with a potential to impact outcomes during an outbreak (Hall et al., 2011; Lopman et al., 2012). The absence of this important information, along with the presence of common misconceptions is consistent with literature that has indicated that news reporters are not always familiar with the health issues they are reporting on (Andrea, 2004). There appears to
be a need for reference material to ensure that news reporters are providing correct information for readers to prevent the spread of the virus. Additionally, 36% of articles that provided outside information cited local health departments, highlighting the importance of validating these materials and supporting local health departments in providing accurate information.

**Social Media**

This research demonstrates the use of social media for information dissemination during public health crises and highlights its potential value in distributing information about noroviruses. The majority of posts on Facebook and Twitter were news links, which is consistent with trends during other health emergency situations (Chew & Eysenbach, 2010). Describing personal experiences with the virus was very common on both Facebook and Twitter, which is not surprising as many studies have found that people use social media to share their life experiences (Chew & Eysenbach, 2010; Joinson, 2008; Zhao & Rosson, 2009). Personal experience sharing could be harnessed in the future as a way to identify an audience for intervention materials and to open a dialogue with users to provide norovirus prevention information. Humor was also identified as a common theme, particularly on Twitter, and integrating humor into communications about norovirus could serve to further engage and attract users to prevention information.

There appeared to be confusion among commenters online about the virus, especially about whether vaccines were available and if it was transmissible through the air. There is very little information in the literature about public knowledge of norovirus, and a relevant study in the US focusing on food handler knowledge found that the biggest gaps were on employee
exclusion and proper sanitation compounds (Kosa et al., 2014). This highlights a need to perform more research about what different populations know about norovirus so that misconceptions can be identified and addressed in education materials.

Two other special types of interactions were seen on Twitter—outbreak-specific hashtags and parody accounts. Outbreak-specific hashtags were found in two outbreaks and accounted for a large portion of Twitter activity that was not dominated by news conversations. This phenomenon has been previously described by Huang et al. as “micro-memes” and represents a relatively new use of hashtags (Huang, Thornton, & Efthimiadis, 2010). Previous research indicates that hashtags serve to unite a community and this could explain the high volume of interactions with these hashtags (Yang, Sun, Zhang, & Mei, 2012). One parody account was identified and consisted of an individual posing as the outbreak specific norovirus. The use of fake accounts, where a user poses as someone they are not, has been heavily documented in political and corporate spheres as an effective means to foster online engagement (J. Wilson, 2011). The fake account could serve as a new tool to engage with online users around norovirus outbreaks and other public health concerns. Additionally, humor used in a fake account can serve a dual purpose of driving more users to the site and providing information.

Limitations

The skew towards recent outbreaks observed in this study can be explained by the nature of online searches, which are most useful for recent activity. Additionally, there have been concerns over the sensitivity and specificity of disease surveillance information obtained
from the Internet (K. Wilson & Brownstein, 2009). Despite these limitations, the observed outbreak trends were consistent with published literature, and the nature of interactions on social media still provides valuable insights into public knowledge of norovirus.

Much more activity was found on Twitter than Facebook, which is unusual as studies have reported a much higher number of adult internet users on Facebook than on Twitter (M. Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). It is possible that this trend was a result of Facebook posts becoming inaccessible during the research period or an inability to find posts by private Facebook users. This limitation is important to take into consideration if social media is used to analyze outbreaks.

An additional limitation in using social media to analyze and address outbreaks is the impact of external factors on social media engagement for an outbreak. Three of the four outbreaks with over 100 tweets had underlying circumstances that could have contributed to the high volume of activity. One school was experiencing a teachers strike, another recently had an unrelated hashtag go viral, and the third was a university where an “annual kissing party” had just occurred. When developing intervention methods for any given outbreak, it is important to take external factors into account and tailor messages to that specific outbreak.

Conclusion

In general, public knowledge about norovirus is very poorly understood, while public education is considered critical in reducing the spread of norovirus. This study is the first to analyze online activity in relation to norovirus outbreaks in schools. It was found that news articles can be a potential resource for outbreak identification and can provide an opportunity
to disseminate prevention information. The scientific and public health communities need to connect with news reporters during a norovirus outbreak to create content that will give the public accurate information on norovirus and its prevention. Social media was widely used in the sharing of norovirus outbreak information, but information about preventing the virus was mostly absent. Social media could be an important method for reaching a wide audience during a school norovirus outbreak through the use of tweeting general information, the creation of outbreak hashtags to attract users and the use of parody accounts to engage users. This research provides a new set of potential tools for the dissemination of norovirus information and highlights a need for a better understanding of public norovirus knowledge to inform intervention materials.
Table 2.1

*Coding Themes for News Articles*

<table>
<thead>
<tr>
<th>Cause of Outbreak</th>
<th>Actions Taken by School</th>
<th>General Norovirus Information</th>
<th>Advice for Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible cause</td>
<td>Sanitizing or cleaning the school</td>
<td>Symptoms</td>
<td>Keep sick kids home</td>
</tr>
<tr>
<td>Definite cause</td>
<td>Close school</td>
<td>Transmission</td>
<td>Hand washing</td>
</tr>
<tr>
<td>Not caused by</td>
<td>Provide hand sanitizer to staff and students</td>
<td>Infectivity&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Disinfect surfaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Persistence&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Use hand sanitizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Virus action</td>
<td>Do not use hand sanitizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not influenza</td>
<td>Good food preparation practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No vaccine or drug</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Article stated that virus is highly contagious, easily spread, or another similar message

<sup>b</sup> Article mentioned how long lived the virus is in the environment or called it hardy
Table 2.2

_Coding Themes for Social Media Activity_

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Example Tweets and Comments</th>
</tr>
</thead>
</table>
| Blame          | Places blame on a group or individual for the outbreak or spread of the virus | *Maybe if schools got disinfected more often this wouldn't happen!*  
                |                                                                             | *Sounds like the lunch lady forgot to wash her hands.*                                   |
| Questions      | Asks a question about norovirus or the outbreak                              | *I'm guessing the flu shot didn't cover this strand?*  
                |                                                                             | *What is it??*                                                                          |
| Advice         | Offers advice on how to deal with norovirus or how to address the outbreak  | *Quit using hand sanitizer. Wash your hands with soap and water!!*  
                |                                                                             | *Pretty sure it's airborne, washing your hands won't save us.*                          |
| Concerns       | Expresses worry about the outbreak, catching the virus or how they do not want to get it | *Oh goodness! Stay away!!*  
                |                                                                             | *Yuck. From cruise ships to our schools.*                                                  |
| Personal experience | Discusses their personal experience with the virus or the outbreak            | *Two of my kids had it too, last week.*  
                |                                                                             | *Just laying [sick?] next to my toilet dying...*                                         |
| Humor          | Post uses humor or contains humorous picture                                 | *I always knew the cause of my death would be school.*  
                |                                                                             | *You know it's a bad Friday when you're dodging projectile vomit more than once.*         |
Table 2.3

*Schools Where Norovirus Outbreaks Were Identified*

<table>
<thead>
<tr>
<th>School Type</th>
<th>Identified Outbreaks (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 63</td>
</tr>
<tr>
<td>Elementary school</td>
<td>23 (37%)</td>
</tr>
<tr>
<td>Combined elementary/ middle</td>
<td>3 (5%)</td>
</tr>
<tr>
<td>school</td>
<td></td>
</tr>
<tr>
<td>Middle school</td>
<td>7 (11%)</td>
</tr>
<tr>
<td>Combined middle/ high school</td>
<td>2 (3%)</td>
</tr>
<tr>
<td>High School</td>
<td>14 (22%)</td>
</tr>
<tr>
<td>University</td>
<td>10 (16%)</td>
</tr>
<tr>
<td>Whole school district</td>
<td>4 (6%)</td>
</tr>
</tbody>
</table>
Table 2.4

*General Norovirus Information Provided in News Articles*

<table>
<thead>
<tr>
<th>Norovirus Information</th>
<th>Number of Articles (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus symptoms (i.e. nausea, vomiting, diarrhea)</td>
<td>253 (81)</td>
</tr>
<tr>
<td>Transmission of norovirus</td>
<td></td>
</tr>
<tr>
<td>Through air</td>
<td>4 (1)</td>
</tr>
<tr>
<td>Through water</td>
<td>62 (20)</td>
</tr>
<tr>
<td>Through food</td>
<td>83 (27)</td>
</tr>
<tr>
<td>From touching contaminated surfaces</td>
<td>96 (31)</td>
</tr>
<tr>
<td>From person to person</td>
<td>118 (38)</td>
</tr>
<tr>
<td>Infectivity of virus, including how easily it spreads</td>
<td>158 (51)</td>
</tr>
<tr>
<td>Mentions that no vaccine or drug is available for norovirus</td>
<td>34 (11)</td>
</tr>
<tr>
<td>Discussion of actual virus action in the body</td>
<td>19 (6)</td>
</tr>
<tr>
<td>Persistence of the virus in the environment</td>
<td>11 (4)</td>
</tr>
</tbody>
</table>
Table 2.5

*Presence of Links and News Tweets in Twitter Activity with Outbreak Specific Hashtags (N = 2149)*

<table>
<thead>
<tr>
<th>Presence of Outbreak Specific Hashtag</th>
<th>Number of tweets containing news links (%)</th>
<th>Number of tweets by news groups (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With (N = 602)</td>
<td>13 (1)</td>
<td>14 (1)</td>
</tr>
<tr>
<td>Without (N = 1547)</td>
<td>1173 (55)</td>
<td>572 (27)</td>
</tr>
</tbody>
</table>

Table 2.6

*Nature of Humorous Quotes in Parody Account*

<table>
<thead>
<tr>
<th>Type of humor</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puns</td>
<td>230 followers? <em>Looks like I’ve gone viral</em></td>
</tr>
<tr>
<td>Sarcasm</td>
<td><em>Oh, you didn’t want to spend all night kneeling over your toilet?</em></td>
</tr>
<tr>
<td>School specific jokes</td>
<td><em>Take solace in the fact that [rival school’s] victory party is going to turn into a vomit party in about two hours.</em></td>
</tr>
<tr>
<td>Jokes about virus prevalence</td>
<td><em>Going out tonight? See you there! Can’t wait to get my freak on in your GI tract</em></td>
</tr>
<tr>
<td>Providing information about the virus</td>
<td><em>If you’ve shaken hands with someone today, they probably gave you a little present (the little present = trace fecal matter I was in).</em></td>
</tr>
<tr>
<td></td>
<td><em>Good news for those of you leaving for President’s Day weekend: I live on surfaces for up to twelve days. See you when you get back!</em></td>
</tr>
</tbody>
</table>
Figure 2.1

*Identified Outbreaks of Norovirus in US Schools*
Figure 2.2

*Themes Found in Norovirus Related Facebook and Twitter Posts*
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CHAPTER 3
School Norovirus Outbreaks: Policies, Procedures and Perceptions of
Administrators and Health Departments

Introduction

School administrators often turn to public health departments for their expertise during gastroenteritis outbreaks, making public health officials and school administrators important players in managing outbreaks (Ha, Rios, & Pannaraj, 2013; Hoebe, Vennema, de Roda Husman, & van Duynhoven, 2004). However, very little is known about the knowledge and practices of these important stakeholders in school norovirus outbreaks. Understanding what school stakeholders know about norovirus control; their self-reported response to a norovirus outbreak; and, their communication methods is necessary for improving response and limiting the scope of illnesses.

Preliminary research indicates that there are gaps in public knowledge of norovirus, but these studies have been limited to food handlers and infection control (Kosa, Cates, Hall, Brophy, & Fraser, 2014; Kosa, Cates, Hall, Brophy, & Frasier, 2014; Verhoef, Jaramillo Gutierrez, Koopmans, & Boxman, 2013). More information is needed on what stakeholders know about norovirus and what school guidelines are for addressing norovirus. A review of school infection control measures reported in the literature identified potentially effective measures, but no review of actual school policies has been undertaken (Lee & Greig, 2010). Additionally, understanding how two primary risk management groups—school administrators and local health authorities—communicate with each other and with students
and parents is valuable in creating new intervention materials to limit the risk of norovirus outbreaks.

The objective of this study was to investigate knowledge, policies and communication methods of local health officials and school administrators about prevention and infection management of norovirus. The results serve as a needs assessment and will be used to identify knowledge gaps and inform the creation of new intervention methods, including education programs and school guidelines, better tailored to populations affected in school outbreaks of norovirus.

Methods

School Administrator Survey

School norovirus policies and procedures were evaluated using a 38 question online survey (Appendix A) distributed to school administrators in North Carolina. Responses were collected via a convenience sample and the survey was sent to a total of 1,971 individuals. There are 2,279 schools in North Carolina, but the list of contact information obtained from the NC Department of Public Instruction included a portion of email addresses that were no longer valid. Additionally, many schools do not allow their staff to participate in research. The survey was pretested with a small group of administrators to address wording, scope and focus. The response rate was 4.6%, with 92 individuals responding to the questionnaire. Participants were asked a combination of open-ended, dichotomous and multiple-choice questions regarding school policies during a norovirus outbreak, including cleaning measures, exclusion
policies and communication with parents and students. These subjects were selected as previous studies of norovirus outbreaks have indicated these areas to be an important part of infection control (Heijne et al., 2009; Lee & Greig, 2010; Wadl et al., 2010).

The majority of survey questions were open-ended, allowing participants to report their school’s policies. This was done to capture variation in responses and to eliminate the possibility of respondents merely guessing about correct control measures or selecting those measures that sounded appropriate, but did not reflect their actual procedures. Content analysis was performed on open-ended questions to determine major themes and important aspects of policies.

**Environmental Health Specialists Survey**

Norovirus-related communications by environmental health specialists in the state of North Carolina and their level of engagement with schools were evaluated using a 26-question online survey (Appendix B). Participants were selected via a convenience sample and the survey was sent to a total of 1,835 individuals. The total population represents all environmental health specialists in North Carolina, not just those who would be responsible for addressing norovirus. The response rate was 7%, with 127 individuals responding to the online questionnaire.

Participants were asked a combination of open-ended, Likert scale, and importance-ranking tasks. Questions focused on interactions with schools; knowledge of norovirus prevention; recommended norovirus control measures; education methods currently used in schools for both staff and students; and preferences for new education programs. The questions
about norovirus prevention were based on previous literature highlighting important norovirus control measures and areas of knowledge gaps about norovirus control (Hall et al., 2011; Kosa, Cates, Hall, Brophy, & Frasier, 2014). Likert-scale and importance-rank questions were analyzed by determining average values for each item, while open-ended responses were qualitatively coded to identify major themes.

**Statistical Methods**

For Likert-scale questions, a Kruskal-wallis one-way analysis of variance was performed, and p-values were adjusted using Bonferroni corrections to control for type I error. These tests were performed in JMP®, version 11 (SAS Institute Inc., Cary, NC, 1989-2007).

To examine the relationship between multiple answers from participants, conditional probabilities were calculated. Responses of each participant to two questions were recorded and the conditional probabilities of each of the four possible response scenarios were calculated. A chi-squared test was used to determine if there was a significant difference between conditional probabilities for each group. Chi-squared tests were performed on quantpsy.org (Preacher, 2001).

**Results**

**School Administrator Survey**

A total of 92 participants responded to the survey of school administrators. Of the respondents, 26% had experienced a norovirus outbreak in their school. These respondents
most often cited increased cleaning and sanitizing as part of their outbreak response (74%), followed by increased hand washing (37%) and notifying parents (37%) \( (N = 19) \). Only three of these 19 participants mentioned using bleach during an outbreak, and one mentioned using quaternary ammonium compounds.

**School Administrator Resources & Communication**

Sixty-five percent of school administrators said their school had received guidelines about norovirus prevention or control \( (N = 84) \) and the majority of these came from a county health department \( (60\%, N = 54) \). A third of participants said their school provided resources to parents when children were sick, while 54% provided general resources about gastrointestinal (GI) illness \( (N = 70) \). A majority of those who said their schools distributed general information about GI illness said letters, newsletters, and other written material were most effective \( (95\%, N = 38) \).

Two-thirds of participants indicated that there is a need for more or better resources about GI illness \( (N = 70) \). The most preferred format for this information was written handouts and flyers (Figure 3.1). Participants were also asked if their school had specifically used social media to communicate health information. As for social media use, 24% reported employing the engagement tool, while 33% had not. Conversely, 43% of respondents said their school had not used social media to communicate health information and that they would not be interested in doing so in the future \( (N = 70) \).
School Policies

Only a third of respondents said their school had written policies specifically for handling a norovirus outbreak (N = 82). Twenty-six respondents provided open-ended descriptions of these plans, which were coded and analyzed for themes (Table 3.1). These responses fell into five main categories: (1) increased cleaning and/or sanitizing, (2) increased emphasis on hygiene, (3) isolation and exclusion of those who are ill, (4) notification of local authorities and communication with individuals affected by the outbreak, and (5) providing educational materials about norovirus. Twenty-seven percent of respondents indicated that these norovirus control measures would be organized by the school nurse (N = 26).

When asked about a policy specifically for determining when to exclude sick students, 59% of respondents said they had a written policy (N = 56), but 56% of those did not know the policy or could not provide details about it (N = 33). Of the thirteen participants who could provide details about their policies on exclusion of ill students, only six mentioned exclusion for 24-hours after symptoms subsided. A majority of participants said they also had guidelines for excluding ill staff members, most of which were general guidelines for staff to stay home when experiencing symptoms (Figure 3.2).

Eighty-six percent of participants said their school did have written policies for cleaning and sanitizing after a vomit incident (N = 71). Only one of these respondents specifically mentioned bleach, and a quarter did not know or could not provide the specifics of the policy (N = 60). Almost half of the 60 respondents who provided details of their cleaning and sanitizing protocol indicated that the janitorial staff (40%) or an outside company (7%)
knew the protocols. Additionally, 66% of the respondents expressed interest in receiving written policies for the janitorial staff (N = 70).

Nineteen respondents said they knew which compounds were used to disinfect after vomiting incidents, but thirteen did not actually provide a specific compound or details when prompted. Of the six respondents who provided specifics about their disinfection compounds, three mentioned contact time, one said their school uses an anolyte solution, which is produced using electrolyzed water, two indicated their school used quaternary ammonium compounds and two specifically included bleach.

**Environmental Health Specialists Survey**

A total of 127 environmental health specialists responded to the survey. Of the respondents, 21% had investigated an outbreak of norovirus at a school and 31% had been contacted by a school asking for norovirus advice (N = 127). Sixty-seven percent of participants (N = 127) said they had received guidelines from an outside source about norovirus, a majority of which originated from state agencies (85%, N = 85).

**Health Department Resources and Education**

One third of participants said their health department provided general gastrointestinal illness information for distribution to parents or students (N = 96), with flyers and handouts being the most common form of communication (54%, N = 28). Participants were also asked to rank six types of informational resources based on how effective they believed they were for education about GI illness (Figure 3.3). Significant differences were observed between the
rankings of effectiveness for each resource (Figure 3.4). Class presentations and videos were ranked as significantly more effective than the other four educational materials, while the use of pamphlets was ranked as the significantly least effective.

Fifteen percent of respondents said their health department provided training to school staff about norovirus and other foodborne illnesses, while 10% provide training to students (N = 116). Of the 17 participants who indicated that their department provides staff training, the majority (53%) said evaluation was performed by observation, with no further detail given by respondents, while only one respondent specified the use of pre- and post-tests. Respondents were also asked to describe any misconceptions they had observed related to norovirus prevention and control; themes identified in these responses are shown in Table 3.2.

Health Department Communication Methods

About a third (36%) of respondents indicated that their health department would contact local schools if an increase in local norovirus illness was observed in the community, while 40% were unsure if their department did this (N = 97). Of the 35 respondents who said their health department would contact schools, the school nurse was the most commonly identified point of contact (47%), followed by the school principal (37%). The probability that respondents who had investigated a norovirus outbreak selected the school nurse as the primary point of contact was 0.76, which was significantly higher (p < 0.001) than that for respondents who had not been involved in an outbreak (0.51).

Forty percent of respondents indicated that their health department had used social media as a health communication tool in the past, while 24% were unsure (N = 94). The most
commonly used platforms were Facebook (69%), followed by Twitter (21%) and YouTube (14%) (N = 29). An “other” category for social media platforms was provided and responses included television, email, websites and newspapers. Respondents were asked to select reasons that their health department may not want to use social media, with the most common barrier being lack of comfort with the medium (Figure 3.5).

**Environmental Health Specialists’ Recommendations for Norovirus Control**

Participants were provided a list of seven common control measures and asked to rank them in order of priority (Figure 3.6). Significant differences were observed between rankings (Figure 3.7). Teaching proper hand washing, encouraging hand washing and sending home sick individuals were all ranked significantly higher priorities than the other four control measures. Increasing routine cleaning was only ranked significantly higher than changing dining procedures, which was the lowest priority control measure.

Participants were also provided a list of fourteen potential control measures, which included both correct and incorrect information, and were asked to select all measures they would recommend to control norovirus (Table 3.3). The measures selected by greater than 90% of participants (N = 102) were: excluding sick food handlers, disinfecting with bleach solution, enforcing proper hand washing and excluding sick staff and students. Some incorrect responses were also selected, the most common being encouraging use of commercially available alcohol based hand sanitizers and using quaternary ammonium compounds for disinfection with over 20% of respondents reporting they would recommend these measures.
Responses to other survey questions were examined to determine if there were any significant differences between participants who did and did not select incorrect control measures. It was found that respondents involved with investigating an outbreak were significantly less likely to select the two most common incorrect control measures (Table 3.4). No significant difference was observed in recommending phenolic compounds between the two groups.

**Discussion**

Environmental health specialists appear to play an important role in norovirus outbreaks in schools, with many indicating their department had either assisted in investigating an outbreak or provided advice about norovirus and GI illness in the past. This finding is consistent with previous reports of disease outbreaks in schools that highlight the significant role of the local health department (Gomez, 2008; Lessler, Reich, & Cummings, 2009). However, few respondents reported that their departments provided direct training, and of those that did, it is unclear if impacts are being evaluated. More health training in schools on gastrointestinal illness and food safety are needed, in addition to evaluations of training effectiveness. Previous research has also pointed out the need for better evaluation of health and safety training programs (Colligan & Cohen, 2004; Ford & Fisher, 1994; Vojtecky & Berkanovic, 1984). Additionally, it appears that environmental health specialists who have experience investigating norovirus outbreaks were less likely to suggest incorrect control measures. This indicates that norovirus knowledge within a health department may be contained to a group of specialized individuals who are most likely to deal with an outbreak.
Though this specialized information can be valuable, it is important that health departments and schools seek out these knowledgeable individuals in the case of an outbreak. Furthermore, hands on training and experience should be an important part of educating environmental health specialists and could also be valuable in training other groups, including custodial staff and other school staff.

School administrators were assumed to be an important source of information about school policies regarding norovirus, but frequently respondents were unable to give details of their school’s control plans. However, school administrators often cited school nurses and custodial staff as important in infection control. This was consistent with a large portion of environmental health specialists indicating that they would contact the school nurse in the case of an outbreak, especially if they had previous experience investigating a norovirus outbreak. Literature has also pointed to school nurses as crucial partners in outbreak investigation, prevention and control (Gomez, 2008; Robinson, 2009). Research on the roles of custodial staff in outbreak control is less direct, though many guidelines refer to a need for increased cleaning, which would be performed by custodial staff (Lee & Greig, 2010; Robinson, 2009). Respondents to the environmental health specialists’ survey reinforced the importance of custodial staff receiving thorough training on norovirus control measures and the need for cooperation between custodial staff, school administrators, nurses, teachers and other staff. Past literature has also stressed the positive results of programs that have school-wide support and the need for increased staff training to prevent foodborne outbreaks (Daniels et al., 2002; Horner, Sugai, & Anderson, 2010). In addition, some school individuals who were initially contacted stated that they could not participate in research studies, further limiting responses.
In order to obtain more robust research on school practices during norovirus incidents, this barrier will need to be addressed.

The most commonly identified control measures in both groups were exclusion of those who are ill, proper cleaning and increased hand washing. These are consistent with current literature on effective control measures for norovirus (Hall et al., 2011). Responses by environmental health specialists frequently emphasized important control measure details that were absent in administrator responses. This could potentially be due to the frequent use of open-ended questions in the school administrator survey compared to the environmental health survey, as respondents may have been more likely to leave out details in open-ended questions. This is consistent with research that found open-ended responses to be less detailed and complete than closed-ended questions (Reja, Manfreda, Hlebec, & Vehovar, 2003). However, open-ended questions provide a wider range of answers and can still give valuable insights into the policies and knowledge of school administrators. Additionally, many respondents in the principal survey indicated they did not know the answer to open-ended questions about their norovirus policies. This suggests that other groups within a school setting, such as janitors and nurses, have greater knowledge of control measures, which could explain the lack of detail in administrator responses.

Environmental health specialists frequently discussed the importance of bleach in norovirus control, while few administrators explicitly mentioned bleach in their responses. Environmental health specialists also included the use of quaternary ammonium compounds, instead of bleach, as a common knowledge gap they had observed in school populations. Previous research studies have found knowledge of appropriate sanitizers to be lacking among
various groups, including custodial staff (Gomez, 2008; Kosa, Cates, Hall, Brophy, & Fraser, 2014; Kosa, Cates, Hall, Brophy, & Frasier, 2014). An additional challenge brought up by environmental health specialists was that bleach was banned in many schools, making adequate disinfection during norovirus events extremely difficult.

Though many school administrators indicated that they had exclusion policies in place for staff and students, only about half included the need for infected individuals to remain at home until 24-72 hours symptom free (Atmar et al., 2008). This was consistent with many environmental health specialists pointing to exclusion duration as a common gap in knowledge. This raises the concern that infectious workers or students could be coming in during an outbreak and further perpetuating the spread of norovirus. Other research has also emphasized the need to educate workers about the appropriate exclusion duration for norovirus to prevent further transmission (Lee & Greig, 2010; Verhoef et al., 2008). Another concern with school exclusion policies is that many school administrators did not indicate that these, and other norovirus control policies, were written. Protocols and policies that are not explicitly written could be difficult for schools to implement and could lead to inconsistent and ineffective responses to norovirus.

Proper hand washing is considered a significant knowledge gap by environmental health specialists and an important priority by school administrators. School administrators frequently acknowledged the value of hand washing, but environmental health specialists emphasized that more needs to be done to enforce correct hand washing in schools. This concern is supported by evidence that found low compliance with correct hand hygiene measures, despite high self-reporting of correct behaviors (Surgeoner, Chapman, & Powell,
Though considered a common misconception by some environmental health specialists, the use of alcohol-based hand sanitizer for norovirus was recommended by a larger proportion of environmental health specialists than school administrators. This again could be due to the broad range of environmental health specialists involved in the survey and further emphasizes the need to ensure those familiar with norovirus control are brought to help in containing an outbreak. However, some environmental health specialists with norovirus experience still recommended incorrect control measures, highlighting the need for education within health departments, as well as in schools. A need for education among health departments is further supported by the low priority of routine cleaning in controlling norovirus outbreaks among environmental health specialists. Routine cleaning is extremely important during norovirus outbreaks as transmission from environmental surfaces can play a very large role in prolonging an outbreak (D’Souza et al., 2006; Lopman et al., 2012).

Both health departments and school administrators indicated that written material, including handouts and posters, were the most common ways they communicated with parents and students about GI illness. However, environmental health specialists ranked written materials as some of the least effective educational materials, favoring class presentations and videos. Other research has also suggested the need to move away from generic educational materials in food safety education and to develop new strategies (Chapman, MacLaurin, & Powell, 2011; US Centers for Disease Control and Prevention, 2009). Social media provides a potential opportunity for improving education within school populations experiencing norovirus. Previous studies have indicated the important role social media can play in food safety communication and a large proportion of respondents indicated a willingness to use
social media as a communication tool (Chapman, Raymond, & Powell, 2014; Mayer & Harrison, 2012; Rutsaert et al., 2014). Barriers to social media use among schools and health departments do exist though, including general comfort with using the medium and access to social media sites, particularly on work computers at health departments. It appears that education about what social media is and why it is important in health communication is needed. When asked about social media platforms, respondents from health departments listed methods that were not actually social media, including television, newspapers and email. Though these communication channels are very useful during norovirus outbreaks, they lack the two-way exchange of information that characterizes social media and makes it so valuable.

### Conclusions

This is the first study to examine norovirus knowledge and control behaviors of school personnel and environmental health specialists. The lessons learned from this research can be used to develop further studies examining norovirus control measures in schools and to inform the development of new intervention materials. It is clear that close partnerships between schools and local health departments are important in norovirus control in schools. Further research is needed to determine which school staff should be targeted during an outbreak, though preliminary results indicate the importance of school nurses and custodial staff. Additionally, it is clear that cooperation among all school staff and the presence of administrators who value proper norovirus control could play a large role in addressing outbreaks. Data on specific control measures in schools is needed and will likely need to be
obtained directly from school protocols instead of through surveys of school personnel, which may be unreliable or lack detail.

Information about norovirus control from both school administrators and environmental health specialists frequently touched on some of the most important measures: hand washing, exclusion of ill individuals and increased cleaning. However, notable gaps do exist. Education materials for health departments should highlight the value of routine cleaning in controlling norovirus, while school policies on norovirus need to include details about proper exclusion duration, proper hand washing steps and norovirus-approved sanitizers. Notably, education materials need to emphasize that alcohol based hand sanitizers and quaternary ammonium compounds cannot completely control transmission of the virus. Furthermore, it is crucial to remove the barriers to bleach use within schools in order for effective outbreak control to take place.

Novel education methods are needed to transmit this information to environmental health specialists, school administrators, and staff, as well as students and parents. Social media represents a potential medium for communication, but barriers to accessing social media sites at health departments will need to be addressed. Additionally, increasing the comfort of environmental health specialist with social media is crucial to adoption of the medium. Education on social media, its uses and its value could also be effective in increasing use among school populations. It is clear from this research that more must be done to educate schools about norovirus in order to encourage effective outbreak control. Further research on knowledge gaps needs to be conducted and theory-based education materials are needed to fill identified gaps.
Table 3.1

*Components of Written Norovirus Policies*

<table>
<thead>
<tr>
<th>Control Measure or Action</th>
<th>Number of Participants (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increase cleaning and/or sanitizing</strong></td>
<td>n = 26</td>
</tr>
<tr>
<td>Increase emphasis on high touch surfaces and desks</td>
<td>6 (23%)</td>
</tr>
<tr>
<td>Use bleach</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Use Clorox® wipes</td>
<td>1 (4%)</td>
</tr>
<tr>
<td><strong>Increase emphasis on hygiene</strong></td>
<td>8 (31%)</td>
</tr>
<tr>
<td>Encourage hand washing</td>
<td>5 (19%)</td>
</tr>
<tr>
<td>Provide hand sanitizer</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Close water fountains</td>
<td>1 (4%)</td>
</tr>
<tr>
<td><strong>Isolation and exclusion</strong></td>
<td>10 (38%)</td>
</tr>
<tr>
<td><strong>Notification and communication</strong></td>
<td>16 (62%)</td>
</tr>
<tr>
<td>Parents</td>
<td>10 (38%)</td>
</tr>
<tr>
<td>Health department</td>
<td>6 (23%)</td>
</tr>
<tr>
<td>Nurse</td>
<td>4 (15%)</td>
</tr>
<tr>
<td>Teachers</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>School district</td>
<td>2 (8%)</td>
</tr>
<tr>
<td><strong>Provide educational materials</strong></td>
<td>7 (27%)</td>
</tr>
<tr>
<td>Parents</td>
<td>5 (19%)</td>
</tr>
<tr>
<td>Students</td>
<td>4 (15%)</td>
</tr>
</tbody>
</table>
Table 3.2

*Information Needs in Norovirus Prevention and Control, Identified by Environmental Health Specialists*

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Number of respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for increased hand washing, proper hand washing education or hand washing supplies (ie. soap, disposable paper towels)</td>
<td>22 (28%)</td>
</tr>
<tr>
<td>Knowing the duration of time to stay home after symptoms subside, enforcement of exclusion</td>
<td>14 (18%)</td>
</tr>
<tr>
<td>Using appropriate sanitizer, especially using quaternary ammonium compounds versus bleach and the need to allow bleach use in schools/ institutions</td>
<td>13 (16%)</td>
</tr>
<tr>
<td>Need for general education about norovirus prevention and control, need for better education methods</td>
<td>13 (16%)</td>
</tr>
<tr>
<td>Address the belief that hand sanitizer is effective against norovirus and its use as a hand washing substitute</td>
<td>9 (11%)</td>
</tr>
<tr>
<td>Staff need to understand or follow appropriate contact times for sanitizers</td>
<td>7 (9%)</td>
</tr>
<tr>
<td>Provide understanding of how easily and quickly norovirus can be spread</td>
<td>6 (8%)</td>
</tr>
<tr>
<td>Provide knowledge of correct concentrations for sanitizers</td>
<td>6 (8%)</td>
</tr>
<tr>
<td>People need to learn specifically about norovirus and understand how it differs from other disease-causing agents</td>
<td>4 (5%)</td>
</tr>
<tr>
<td>Need for cooperation among all members of school, including administrators who value implementing proper controls</td>
<td>3 (4%)</td>
</tr>
</tbody>
</table>
Table 3.3

**Recommended Control Measures**

<table>
<thead>
<tr>
<th>Control Measure</th>
<th>Number of Respondents who Would Recommend (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 102</td>
</tr>
<tr>
<td><strong>Correct/ Preferred Measures</strong></td>
<td></td>
</tr>
<tr>
<td>Exclude sick food handlers</td>
<td>99 (97%)</td>
</tr>
<tr>
<td>Disinfect with bleach solution</td>
<td>95 (93%)</td>
</tr>
<tr>
<td>Enforce proper handwashing</td>
<td>94 (92%)</td>
</tr>
<tr>
<td>Exclude sick staff and students</td>
<td>93 (91%)</td>
</tr>
<tr>
<td>Close self-serve food lines</td>
<td>64 (63%)</td>
</tr>
<tr>
<td>Don’t allow the sharing of food</td>
<td>53 (51%)</td>
</tr>
<tr>
<td>Close common dining areas (kids eat outside or in classrooms)</td>
<td>34 (33%)</td>
</tr>
<tr>
<td>Disinfect with bleach-based cleaner</td>
<td>27 (26%)</td>
</tr>
<tr>
<td>Disinfect with steam/heat</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Test food</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Contact food supplier</td>
<td>5 (5%)</td>
</tr>
<tr>
<td><strong>Incorrect/ Not Preferred Measures</strong></td>
<td></td>
</tr>
<tr>
<td>Encourage the use of commercially available alcohol-based hand sanitizers</td>
<td>23 (23%)</td>
</tr>
<tr>
<td>Disinfect with quaternary ammonium compounds</td>
<td>22 (22%)</td>
</tr>
<tr>
<td>Disinfect with phenolic compounds (i.e. Pinesol, Lysol)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>Control measure selected</td>
<td>Probability of recommending control measure given respondent HAD investigated an outbreak</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Encourage use of commercially available alcohol-based hand sanitizers</td>
<td>0.09</td>
</tr>
<tr>
<td>Disinfect with quaternary ammonium compounds</td>
<td>0.09</td>
</tr>
<tr>
<td>Disinfect with phenolic compounds</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Figure 3.1

*Desired Types of New GI Illness Education Materials (N = 42)*
Figure 3.2

*Exclusion Policies for School Staff (N = 72)*
Figure 3.3

Effectiveness Rankings of Educational Resources
(1: most effective, 7: least effective)
- : No significant difference
A: Significant at $p < 0.0001$
B: Significant at $p < 0.01$

Figure 3.4

*Significant Differences in Rankings of Educational Resource Usefulness*
Figure 3.5

Barriers to Social Media Use in Health Departments (N = 34)
Figure 3.6

*Priority of Control Measures during a Norovirus Outbreak*

(1: highest priority; 7: lowest priority)
<table>
<thead>
<tr>
<th>Measure</th>
<th>Teach hand washing</th>
<th>Encourage hand hygiene</th>
<th>Send home sick individuals</th>
<th>Properly clean up vomit</th>
<th>Isolate sick individuals</th>
<th>Increase routine cleaning</th>
<th>Change dining procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teach hand washing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourage hand hygiene</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Send home sick individuals</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properly clean up vomit</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>-</td>
</tr>
<tr>
<td>Isolate sick individuals</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Increase routine cleaning</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Change dining procedures</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

- : No significant difference
A: Significant at p < 0.0001
B: Significant at p < 0.01
C: Significant at p < .05

Figure 3.7

*Significant Differences in Priority Ranking of Norovirus Control Measures*
REFERENCES


CHAPTER 4
Designing Evidence-Based Intervention Materials for Norovirus Outbreaks in Schools

Introduction
In schools experiencing a gastrointestinal illness outbreak there is evidence that control measures, including cleaning and sanitizing protocols and hand hygiene methods employed by the school, can be ineffective and lead to a prolonged outbreak (Gomez, 2008). Alcohol-based hand sanitizers, many of which are not effective against norovirus, can exacerbate the spread of the virus (Blaney et al., 2011; Gomez, 2008). Quaternary ammonium sanitizers, commonly used in schools, also have limited efficacy against norovirus, and the use of bleach or another validated sanitizer is necessary (Gomez, 2008; Marks et al., 2003). Based on responses to the surveys of school stakeholders (see Chapter 3) along with news reports and school guidelines, it is clear that many school districts use quaternary ammonium based compounds for disinfection and some even ban the use of bleach (Spenceley, 2003; Union County Public Schools, 2014).

Numerous studies have highlighted the importance of education in halting the spread of norovirus (Boxman et al., 2011; Kosa, Cates, Hall, Brophy, & Fraser, 2014; Lee & Greig, 2010; Li, Predmore, Divers, & Lou, 2012). The previous chapters of this research confirm the need for education campaigns that are based both on scientific research about norovirus and on communication research about effective behavior change. The content analysis of online activity related to norovirus outbreaks revealed many misconceptions and it is clear that more
education materials and guidelines are needed based on gaps in responses from school stakeholders. There is a large body of evidence on the most effective control measures for norovirus in schools and similar settings, but much less exists on the translation of this knowledge into practice.

The aim of this research was to integrate a theoretical framework with knowledge about the current landscape of norovirus in schools to develop science-based and theoretically-grounded intervention materials. The inclusion of behavior change theory is an important step for intervention success (Webb, Joseph, Yardley, & Michie, 2010). Both a psychological model of behavior change, the theory of planned behavior (TPB), and a message framework, the extended parallel process model (EPPM), were used to guide the development of intervention materials.

The Theory of Planned Behavior

The theory of planned behavior (TPB) is a model of human behavior that informed decisions about what data was needed to develop interventions and how to best structure those interventions to motivate behavior change (Fishbein & Ajzen, 1975). This model was selected as it has been used numerous times in health behavior change studies and has been found to be an accurate predictor of behavior (Hardeman et al., 2002; Webb et al., 2010). The TPB (Figure 5.1), creates a framework for behavior prediction which shows that actions are preceded by behavioral intention, which comprises three factors: (a) attitude towards a behavior, including evaluation of positives and negatives; (b) perceived norms, which are the opinions of others about the behavior; and (c) perceived personal control over the behavior (Ajzen, 1991). If a
A person has strong intentions to perform the behavior, has control over performing the behavior and there are no outside constraints on the behavior they will very likely perform that behavior (Fishbein, M., Cappella, J., Hornik, R., Sayeed, S., Yzer, M., & Ahern, 2002). The TPB is applicable to norovirus control behaviors as all three factors are at play in an outbreak setting and need to be considered in order to tailor message strategies.

**The Extended Parallel Process Model**

The Extended Parallel Process Model (EPPM) was used to structure the content of intervention materials and to develop specific messages (Witte, 1992). The EPPM explains how fear motivates behavior change and it is particularly valuable for communicating about norovirus because it accounts for audience emotional response to a message (McKay, Berkowitz, Blumberg, & Goldberg, 2004). Like many health threats, norovirus has the potential to create fear and ultimately hysteria and the EPPM provides a strategy to address this fear and create behavior change. This model provides a framework for how risk messages can influence behavior based on two components: perceived threat and perceived efficacy. Perceived threat involves emphasizing the magnitude of harm from a threat (severity) and the likelihood of occurrence (susceptibility). Perceived efficacy involves outlining feasible strategies to mitigate risk (self-efficacy) and highlighting how effective these strategies are in minimizing the risk (response efficacy). According to the EPPM, individuals will react to risk messages in one of three ways; (1) no response; (2) fear control processes, leading to defensive responses and rejection of the message; and (3) danger control processes, resulting in message acceptance and behavior change (Figure 5.2).
Danger control is preferable, as it is characterized by attitude and behavior changes. The use of the EPPM to craft messages aimed at eliciting danger control processes has been demonstrated repeatedly in the literature (Kline & Mattson, 2000; Moscato et al., 2001; Witte, 1997).

These theoretical models were integrated with data from existing research and new studies targeted at school populations experiencing norovirus as demonstrated in Chapters 1, 2, 3 and 4. Three final intervention materials were developed from this synthesis activity: (1) informational graphics that can be shared over social media, (2) a social media guide for health officials, and (3) a guide for media reporting on outbreaks of norovirus. The purpose of this paper is to summarize each intervention and provide supporting documentation for their creation.

Interventions

Informational Graphics for Distribution through Social Media (Appendix C)

Audience and Platform

Background research informing this intervention included a systematic literature review of articles focused on social media use in food safety and infectious disease communication (Chapter 1) and a content analysis of online material related to outbreaks of norovirus in schools (Chapter 2). Social media was chosen as the platform for delivery based on the ability to provide information immediately, to monitor the dialogue of the target audience and to respond appropriately (see Chapter 1, Benefits).
The ability to react immediately and address a wide range of groups is paramount during school norovirus outbreaks which happen rapidly and in large, diverse populations, making social media an appealing avenue for communication. Additionally, the role of social media in health behavior change is being increasingly studied and other literature indicates its potential as a tool of food safety education (Chapman, Raymond, & Powell, 2014). There is also a dearth of efficacy information on social media communications related to health issues (Vos & Buckner, 2015). This further influenced the decision to use social media as a distribution platform. The use of social media also addresses the social norms component of the TPB, by allowing for sharing among peers and visible use of the material by others.

Due to the broad reach of social media, the audience was considered to be the online community, though based on the content analysis of social media activity related to outbreaks, it is likely that the main targets online during a school norovirus outbreak will be parents and students (Chapter 2). It is assumed that these populations will already possess positive attitudes about behavior changes, as defined by the TPB, related to preventing norovirus as many will either be experiencing unpleasant vomiting or diarrhea, or will know someone who is.

**Structure**

Previous literature has shown that images are more frequently viewed and shared on social media than text alone (Guadagno, Rempala, Murphy, & Okdie, 2013; Woerdl, Papagiannidis, Bourlakis, & Li, 2008). This is because a graphic format can increase the ease of use and intrigue among the desired audience, which can then contribute to ease and speed of spread online. Additionally, best risk communication practices value graphics for explaining
risks and assessing potential threats (Covello, 2010). Though graphics are desirable due to their ease of interpretation, a large amount of the information that needs to be shared in relation to norovirus requires some amount of text based instruction (ie. what concentration of bleach to use). A flow chart format, which uses branches to illustrate possible outcomes of a decision or response, was chosen as there is evidence of its efficacy in education (All, Huycke, & Fisher, 2003; Powers et al., 2006). Flow charts allow for text-based efficacy information to be provided in an easily distributed graphic that can be accompanied with small images to enhance certain messages. This ease of gathering information from the flowchart can contribute to the audience’s perceived self-efficacy, as they will be able to locate and gather the needed information to take precautions against norovirus.

Messages and Content

The EPPM was used to structure the content of the graphics in order to target danger control processes and provide efficacy information. Threat information was not addressed in these graphics as they were aimed at groups experiencing norovirus outbreaks, who likely already have a high perceived threat of becoming ill, as during an outbreak many people are already ill or know many people who are. In addition to addressing feelings of self-efficacy, the graphics were also designed to target feelings of response efficacy. Examples of control measures that do not work, for example commonly available alcohol-based hand sanitizer, were provided to highlight the importance of following the correct control actions. The messages in the graphics were structured in a way that was easily accessible to a range of audiences in order to promote quick and easy understanding, and ultimately feelings of self-
efficacy. As a strategy for reducing text, multiple graphics were created aimed at different situations and control strategies. Creating separate graphics also tailors the information towards different populations, which is considered an effective strategy in communicating food safety information (Jacob, Mathiasen, & Powell, 2010).

The graphics included operational efficacy steps supported by contextual norovirus information. Humor was an important part of the graphics, as a content analysis of online activity related to school norovirus outbreaks showed humor to be very common in Twitter activity (Chapter 2). Additionally, humor was found frequently in highly engaged social media content, such as parody accounts and outbreak specific hashtags. Building on this knowledge, the intervention text was written in a conversational tone, included humor and care was taken to eliminate the use of jargon or overly-technical explanations.

Social Media and Norovirus: A Guide for Health Officials (Appendix D)

Audience and Platform

Previous literature has indicated the value of social media in health behavior change and in food safety related communications (Korda & Itani, 2013; Mayer & Harrison, 2012; Webb et al., 2010). However, social media is relatively underutilized by health departments (Avery et al., 2010; Fallon & Schmalzried, 2013; Thackeray, Neiger, Smith, & Wagenen, 2012). Health official involvement on social media is important as data shows that consumers are seeking more credible information and are more likely to trust information coming from official sources (Leak et al., 2014; Mou & Lin, 2014; Rutsaert et al., 2014).
As discussed in Chapter 3, few health departments have an active social media presence and many are opposed to the idea. The most commonly identified barriers were lack of comfort with the medium or no established presence. *Social Media and Norovirus: A Guide for Health Officials* was designed to address this barrier by providing health officials with information about why social media use is important and then giving them concrete and in depth instructions to use social media for norovirus communications. The secondary audience for this guide is the general public as advice on communicating with the public during norovirus outbreaks was provided in the guide.

**Structure**

*Social Media and Norovirus: A Guide for Health Officials* was constructed to present users with information about why social media is important to norovirus communications and then to provide thorough steps for using social media accounts. Step-by-step instructions were included on how to create an account, how to structure messages and how to handle user comments and posts. These concrete steps aimed to increase health officials’ feelings of self-efficacy and increase their comfort with using social media. Additionally, example messages were provided as further efficacy actions.

**Messages and Content**

*Social Media and Norovirus: A Guide for Health Officials* addressed both health officials’ behaviors in using social media and to provide messages and strategies to change the public’s behaviors through social media. For health officials’, the guide was intended to
increase positive attitudes towards using social media and increase perceived control, as defined by the TPB. Instructions for public communication aimed to address all three components of TPB by encouraging the public to be concerned about norovirus, showing them that others are concerned using social media interactions and enhancing their perceived control by giving concrete solutions. The content of instructions to health officials’ as well as public social media messages were constructed using the EPPM.

Instructions to health officials addressed both perceived threat and perceived efficacy. This was accomplished by first highlighting the negative impacts of norovirus and providing evidence for the need to engage on social media. The aim was to convince health officials of the importance of being on social media and the potential risks of not engaging online. Most of the social media guide was aimed at perceived self-efficacy, as the biggest identified barrier for use among health officials was lack of comfort (Chapter 3).

Suggested content for social media messages related to norovirus focused on three main control priorities. Prioritizing was done as it has been suggested as an effective way to control for the potential information overload that can occur on social media (Hale, Pathipati, Zan, & Jethwani, 2014; Watson & McKinstry, 2009). These three priority measures were (1) exclusion of those who are ill, (2) proper hand hygiene, and (3) proper cleaning and sanitizing of vomit and surfaces.

**Exclusion**

Exclusion was included as research has suggested it to be effective in stemming the spread of an outbreak and as the best way to keep infectious individuals out of the population
The duration of exclusion was also repeatedly emphasized as those with norovirus symptoms are at increased likelihood for spreading the virus for up to 72 hours after symptoms subside (Atmar et al., 2008). Information about exclusion duration was relatively absent from online communications related to norovirus, further necessitating its emphasis in the social media guide (Chapter 2).

Hand hygiene

Proper hand washing was prioritized as a control measure because multiple studies have indicated its value in reducing norovirus spread (Hall et al., 2011; Lee & Greig, 2012; Liu et al., 2013; Liu, Yuen, Hsiao, Jaykus, & Moe, 2010). The need to implement hand washing over hand sanitizer use was covered numerous times as various studies have shown that hand sanitizers are not effective against norovirus and may actually prolong an outbreak (Blaney et al., 2011; Liu et al., 2010; Vogel, 2011). Emphasizing this is critical, as background research indicated that a portion of health officials would suggest hand sanitizer to combat norovirus (Chapter 3) and that explicit information on hand sanitizer was frequently absent from online norovirus communications (Chapter 2). This is consistent with other studies highlighting the need to better communicate the limitations of hand sanitizer in combating norovirus (Gomez, 2008; Kosa et al., 2014; Todd et al., 2010).

Cleaning and sanitizing

The third control measure prioritized was proper cleaning and sanitizing of vomit incidents and surfaces. Studies have highlighted the important role environmental transmission
plays in the spread of norovirus, particularly because the virus can remain infectious on surfaces for up to two weeks (D’Souza et al., 2006; Lopman et al., 2012; Lyman et al., 2009). Additionally, vomiting incidents play an important role in transmitting norovirus as they can contain a very high amount of infectious virus which can then be aerosolized (Atmar et al., 2008; Kirking et al., 2010; Marks et al., 2003; Tung-Thompson, Libera, Koch, De Los Reyes, & Jaykus, 2015). Norovirus cannot be inactivated by many common sanitizing compounds used by schools, including phenolic compounds and quaternary ammonium compounds (Doultree, Druce, Birch, Bowden, & Marshall, 1999; Eleraky, Potgieter, & Kennedy, 2002). The use of these compounds over effective sanitizers, most commonly hypochlorite (chlorine bleach), may make outbreaks worse (Gomez, 2008). Emphasizing the correct sanitizers is extremely important when covering control measures for norovirus as background research indicated that some health officials would recommend ineffective sanitizers (Chapter 3).

Health officials were advised to focus on rapid response and regular posting of content to ensure effective reach on social media. Responsiveness on health department social media accounts has been shown to be lacking, while research indicates that frequent and rapid responses are important in social media communications (Fallon & Schmalzried, 2013; Jacob et al., 2010). Additionally, emphasis was placed on taking advantage of the interactive capabilities of social media. Previous work has shown that health officials rarely use social media to engage with the audience, despite its potential value in encouraging behavior change (Avery et al., 2010; Thackeray et al., 2012). One suggested method to encourage engagement was asking users to share their personal experiences which research has shown may increase perceptions of trust among users (Sillence, Briggs, Harris, & Fishwick, 2007). A large
emphasis was placed on humor in social media messaging as background data showed more engagement with humorous social media posts and accounts. The use of parody accounts and outbreak specific hashtags were covered as background research found a high level of engagement on these types of social media (Chapter 3).

**Reporting on Norovirus Outbreaks: Recommendations for News Professionals**  
(Appendix E)

**Audience and Platform**

The audience for the final intervention was media personnel (journalists, editors, reporters, producers) who are reporting on norovirus, usually due to a local outbreak. This audience was targeted because studies have indicated the importance that the media can play in disseminating health information and in providing control information (Dentzer, 2009; Voss, 2002). The role of news personnel as nodes of information during a norovirus event was discussed in Chapter 2. Though much of the information provided by media personnel was not outright incorrect, gaps were common, including not specifying sanitizer types or duration of exclusion when ill. *Reporting on Norovirus Outbreaks: Recommendations for News Professionals* aims to provide news personnel with the knowledge to quickly and accurately create a story on norovirus while highlighting the most important and effective control measures.
Structure

The goal of Reporting on Norovirus Outbreaks: Recommendations for News Professionals was to provide a quick reference of science-based norovirus information and easily used pieces of information for news stories. Background information about norovirus was kept to a minimum, as the true aim was preventing and controlling the spread of norovirus. In addition to the guide, in-depth instructions for hand washing and cleaning and sanitizing were provided in separate text boxes that can be easily placed into an article or shared. The last page of the document is a checklist covering the most important points for an article on norovirus. The checklist was designed to be printed out and referenced quickly to ensure that the news article included the most critical prevention measures and avoided providing misinformation.

Messages and Content

The news guide aimed to address news personnel’s perceived control over communicating effectively about norovirus, as defined by the TPB. Previous research has shown that reporters rely heavily on sources during medical articles and this guide can serve as an easy to use, accurate source for norovirus news articles (Tanner, 2004). The messages in this guide focused on both perceived threats and perceived efficacy, as defined by EPPM. Specific control measures were provided, along with data based measures of risk, as data has shown a need for precise health information in news articles (Roche & Muskavitch, 2003). Information on the high prevalence and ease of norovirus transmission were included to encourage news personnel to be concerned about reporting norovirus appropriately. These
messages could then be shared with viewers to encourage them to take appropriate control steps.

Concrete efficacy information was written in a manner that could easily be inserted directly into a news article. Additionally, three control measures were prioritized to help reduce possible information overload (Watson & McKinstry, 2009). These control measures—exclusion, hand hygiene and cleaning and sanitizing—were also prioritized in Social Media and Norovirus: A Guide for Health Officials. Rationale for selecting these measures can be found in the Messages and Content section for Social Media and Norovirus: A Guide for Health Officials.

**Delphi Evaluation**

Evaluation of each of the intervention methods will need to be undertaken in order to determine if each method achieves the desired goals. The Delphi method aims to elicit expert opinions systematically and was chosen because it provides the ability to access diverse opinions at a low resource cost. It has been used by others to evaluate educational materials and in a range of food safety applications (Sackman, 1974; Soon, Davies, Chadd, & Baines, 2012; Williams, Boone, & Kingsley, 2001). Evaluation of the content of the three intervention materials developed in this research will be performed using a Delphi-like method, modeled after the one employed by Chapman, et al. (Chapman, MacLaurin, & Powell, 2011). This method still possesses the main characteristics of a Delph as defined by Rowe and Wright (1999): “anonymity, iteration, controlled feedback and aggregation of responses.”
The first stage will involve assembling an expert panel, whose criteria will vary for each intervention material. Experts for the social media graphics will be those with knowledge of norovirus control and/or risk communication. The panel for the social media guide will include these individuals, plus health officials and employees of public health departments, while the news guide panel will include reporters and media personnel.

The first phase of the Delphi will be a semi-structured questionnaire, where users will view the intervention item and then provide anonymous feedback. The questions for phase one will be the same for each intervention, due to the generic nature of the questions. Questions for evaluation will be:

- Would this intervention be used by the target audience? Why or why not?
- How would this intervention be used by the target audience?
- Is the content of the intervention appropriate for reaching the target audience?
- Is the structure of the intervention appropriate for reaching the target audience?
- Are there any pieces of information missing from this intervention?
- What could improve this intervention?

The answers from the first round will be used to redesign the intervention material and to create a structured second round questionnaire. Content analysis will be used to determine common themes, which will likely be appropriateness, content, and design (Chapman et al., 2011). Responses will be grouped into these categories and then counts will be assigned based on frequency mentioned by each participant (Williams et al., 2001). These counts and themes will be used to determine what changes to make to each intervention before submitting it to a second round of evaluation. The second round of evaluation will be a structured questionnaire.
containing ranking and Likert-scale questions asking participants to evaluate various characteristics of the intervention material. The quantitative data from this second round will be grouped with qualitative information to determine if further edits are needed and to provide an overall summary of the results from the Delphi panel.
Figure 5.1

Theory of Planned Behavior
Figure 5.2

*Extended Parallel Process Model*
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CONCLUSION

It is well established in the literature that addressing the high health and economic burden of norovirus requires education and behavior change. However, little research on how to communicate about norovirus in a way that will lead to an increase in the use of appropriate control measures has been carried out. Though a plethora of education materials exist on norovirus, data on information gaps, target audiences and best practices for structuring and delivering content are either nonexistent or not frequently used. Science-based materials for norovirus education are a crucial part of reducing the prevalence and spread of this disease. Behavior change campaigns need to be grounded in research in order to: determine which populations to communicate with, what information to communicate, and what methods are the most effective for eliciting the desired response. This research aimed at addressing each of these three factors as they relate to norovirus in school settings and applying them to the creation of three new intervention materials. The method developed in this work has applications in many other food safety and health related scenarios where behavior change is needed to prevent illness.

Recommendation 1: Determine target populations and understand the population

Determining a target population or populations is a first step in the development of research-based interventions. Often, resources are limited and different demographics require tailored materials, making the identification of specific groups both pragmatic and necessary to optimize the effectiveness of an intervention. Identifying these groups is best done using a
variety of methods, as groups thought to be unrelated may become important through research. Methods to do this include surveys of people considered key stakeholders to determine their true role, literature reviews of similar health situations to determine who is normally involved, and reviews of online activity related to the situation to understand what groups are involved in receiving and transmitting information. The target populations identified for school norovirus outbreaks were parents and students, environmental health officials, news reporters reporting on norovirus, and potentially school nurses and custodial staff. These populations were identified by synthesizing results from a systematic literature review, online content analysis and surveys of main stakeholders in school norovirus outbreaks.

**Recommendation 2: Use the best possible science to develop messages and update these messages regularly**

The next step in developing research-based intervention materials is determining the content to provide. This requires an understanding of what information the target population already knows, what they need, and what the most important and accurate information is based on past research. Addressing what a population knows and does not know will likely require survey based methods or content analyses of communications made by the target audience. A thorough understanding of the most current research related to the specific health issue is needed to ensure that correct information is being communicated. For school norovirus outbreaks, literature reviews on norovirus and control guidelines were used to prioritize the most important control measures as (1) exclusion, (2) personal hygiene, and (3) proper cleaning. Information gathered from a content analysis of online communications related to
norovirus, in addition to surveys of key stakeholders, also indicated that public knowledge in these three areas was lacking, further validating the choice to focus the intervention materials on them.

**Recommendation 3: Base interventions on theoretical models**

The final step in developing effective health behavior change campaigns is to determine a structure and delivery method for materials. A grounding in established communication theory is necessary to ensure that messages will be received by the target population and translated into action. The choice of a communication theory will vary depending on the material and subject, but the most important thing is that a theory is chosen and followed throughout the design of interventions. This study utilized both a psychological model of behavior change, the Theory of Planned Behavior (TPB) and a model for structuring messages, the Extended Parallel Process Model (EPPM). All of the communication theories require that the intentions, motivations and emotions of the audience be considered when developing educational campaigns. This is perhaps the most important aspect of developing science-based, effective interventions, and also the most difficult, which may explain its relative absence from many intervention materials. Understanding where an intervention fits into a theory will allow the intervention to be more effective, by reducing the inclusion of unnecessary information, increasing the receptiveness of the audience to a message, and delivering the item in the most efficient way. Additionally, background research on the target population can provide information that enhances how the theories are used to structure interventions. For example, social media was selected as an important platform in this study based off research indicating
its value in food safety communication, as well as its ability to address a key component of the TPB, social norms.

**Recommendation 4: Conduct evaluations**

After a research-based intervention material is created, evaluation is critical. Evaluating a material subjects it to peer review and validation that allows for adjustments and ultimately the ability to make claims about its effectiveness. All three intervention materials produced in this research still require further evaluation to determine their effectiveness in encouraging behavior change. After content changes are made, further evaluations should be conducted once the materials are used. The two guides developed—the social media guide and the news guide—need to be evaluated for their practical use and impact on behavior in the target populations. This will likely be accomplished by either focus groups or surveys. Additionally, the message strategies presented in the guides need to be evaluated for their ability to increase knowledge and encourage attitude or behavior change among the general public. This could involve using simple online analytics to determine how the messages move online, or more in-depth survey based methods examining attitudes and knowledge in groups exposed to the messages. The graphics also require evaluation examining the effects on behavior change and their reach on social media, which could be done in a similar manner as the messages from the guides.

This research presents a framework for developing research-based intervention materials for schools experiencing norovirus outbreaks. The framework can serve as a
preliminary solution to the current absence of practical, evidence-based methods for developing norovirus related education materials. Additionally, the research can be valuable in a range of disciplines where behavior change campaigns are necessary. Though further refinement, evaluation and validation is critical, this work provides an important starting point in improving norovirus related communications with the public. Education should be considered a necessary control measure in addressing norovirus and be subject to the same academic rigor as other research related to controlling norovirus.
APPENDIX A

School Administrator Survey

The NoroCore Food Virology Program and NC State University are collaborating to find out if your school knows about norovirus illness, and if so, how you respond to norovirus cases in your school. The following survey will help us as we try to understand how schools respond to norovirus. Please answer the questions as best you can, if you don’t know the answer that’s fine. There are a lot of things being said about norovirus, and we’re just interested in what is being communicated to schools.

1. This survey is completely voluntary and confidential. For your privacy, we ask that you not refer to yourself or your school by name. If at any point you would like to withdraw from the survey, you are free to do so and your answers will not be used. If you have questions at any time about the study or the procedures, you may contact the researcher, Benjamin Chapman at 919.515.8099. You may also contact the North Carolina State University Institutional Review Board at 919.515.4514 if you have questions about your rights as a research participant.

By continuing with this survey, I affirm my consent to participate and I acknowledge that I am 18 years of age or older.

2. Are you familiar with norovirus?
   - Yes
   - No

3. Do you know how norovirus is spread?
   - Yes
   - No

4. Do you remember your school experiencing an outbreak of norovirus illness at any time in your career?
   - Yes
   - No

5. Can you describe this instance?

6. How many staff and students do you think were affected?

7. How did the school respond to the increase in norovirus illness?

8. Has your school received any specific guidelines for norovirus prevention or control from local, state or federal agencies?
   - Yes
   - No

9. What agency or agencies provided these guidelines? (ex. county health departments, state health departments, universities, national organizations)
10. Does your school have a plan in place should a norovirus (or other gastrointestinal) illness outbreak occur?  
- Yes  
- No  

11. Would you please describe this plan?  

12. Do you have a school policy on determining when a child with gastrointestinal illness must be sent home?  
- Yes  
- No  

13. Is it a written policy?  
- Yes  
- No  

14. Can you copy that policy here?  

15. Have you ever had to contact the health department about a norovirus outbreak in your school?  
- Yes  
- No  

16. Can you describe the outbreak, who you contacted and any actions the health department took?  

17. Have you ever had to close your school due to a norovirus outbreak?  
- Yes  
- No  

18. Please describe  

19. What is your policy on teachers and staff staying home from work when vomiting/ experiencing diarrhea?  

20. Do you have similar policies for students?  
- Yes  
- No, we do not have a policy like this for students  
- No, we have a different policy for students (please describe)  

21. Are student absences usually called in by parents/ guardians?  
- Yes  
- No  

22. Are types of illnesses/ symptoms recorded when students are absent or reported sick?  
- Yes  
- No
23. Do you have written protocols in place for the cleaning and disinfecting of areas exposed to stool or vomit?
   - Yes
   - No

24. Could you share these protocols with us?

25. Do you know what types of cleaning and disinfection compounds you use in areas exposed to stool or vomit?
   - Yes
   - No

26. Can you describe this cleaning and disinfecting procedure in detail? (i.e. What concentration of disinfectant, what contact time is used, etc.)

27. Are your sanitation staff members trained specifically in how to clean up stool and vomit?
   - Yes
   - No

28. Can you tell us about that training?

29. Do you provide general information to parents and/or students in prevention of gastrointestinal disease?
   - Yes
   - No

30. What do you find is the most efficient way of giving this health-specific information to parents and students?

31. Is this something you would be interested in?
   - Yes
   - No

32. Do you provide resources to parents of sick or exposed students during a norovirus outbreak?
   - Yes
   - No

33. What was/is the source of the information you provide?

34. Can you share those resources with us? (please copy and paste the URL if possible)

35. Is there a need for more or better resources about gastrointestinal illness?
   - Yes
   - No

36. What kind of resources might those be? (may select multiple options)
   - Posters
- Pamphlets
- Infosheets
- Brief class presentations
- Demonstrations
- Flyers/ handouts
- Videos
- Infographics
- Information packets
- Other (please specify)

37. Would it be helpful if someone provided written policies for your educational and/ or janitorial staff?
- Yes
- No

38. Would you or have you utilized social media (Facebook, Twitter, Instagram, blog) to communicate health information associated with your school?
- Yes we have utilized social media
- No we have not utilized social media, but we would like to
  No we have not utilized social media and would not like to in
APPENDIX B

Environmental Health Specialists Survey

The NoroCore Food Virology program and NC State University are collaborating to research how schools in North Carolina respond to outbreaks of norovirus. We want to learn about how your health department interacts with schools in regards to norovirus cases and outbreaks. Your participation in this survey is not required, but is very helpful. If at any point you would like to withdraw from the survey you are free to do so and your answers will not be recorded.

1. Have you investigated a potential or confirmed norovirus outbreak at a school during your career?
   - Yes
   - No

2. Has a school ever contacted you for advice on dealing with norovirus?
   - Yes
   - No

3. Has your department received any specific guidelines for norovirus?
   a. CHECK ALL:
      - local agencies
      - state agencies
      - federal agencies
      - other (fill in)
      - I don’t know
      - not applicable
   b. If you have these guidelines available in a publicly accessible online version, please copy and paste the URL into the comment box below.

Training and Advising:

4. Does your department provide any training on norovirus to school staff?
   - Yes [go to 5]
   - No [go to 9]

5. Please describe any type of training you may provide to school officials for managing a norovirus outbreak.

6. How effective have you found the following types of training tools/methods in your work?
   Please use the following scale to rank each item:
   1: Not at all effective
   2: Somewhat effective
   3: Effective
   4: Very effective
   5: Extremely effective
7. How do you measure effectiveness of the training methods?
   - Pretests
   - Posttests
   - Observation
   - Evaluation
   - other (fill in)

8. What type of new educational resources might be helpful for training school staff on handling norovirus episodes and outbreaks? Please use the following scale to rank each item:
   1: Not at all helpful
   2: Somewhat helpful
   3: Helpful
   4: Very helpful
   5: Extremely helpful
   - Posters
   - Pamphlets
   - Infosheets
   - Infographics
   - Brief class presentations
   - Videos
   - other/none

9. Does your department provide any training in the classroom for students?
   - Yes [go to 10]
   - No [go to 11]

10. Please describe in-class student training.

11. What type of new educational resources might be helpful for training students in the classroom on handling norovirus episodes and responding to outbreaks? Please rank the following in order of value:
   - Posters
   - Pamphlets
   - Info sheets
   - Brief class presentations
   - Videos
   - Coloring and activity sheets
12. Please rank the following prevention and control measures from greatest to least priority when dealing with a norovirus outbreak. *Please rank the following in order of priority:*
- Increase routine cleaning
- Quarantine sick individuals
- Encourage good hand hygiene
- Teach/demonstrate proper hand washing
- Close common dining areas/change dining procedures
- Send home sick staff and students
- Properly clean stool and/or vomit spills

13. Which of these mitigation steps would you recommend to schools for the prevention and control of norovirus? *Please check all that apply:*
- Disinfection with bleach solution
- Disinfection with bleach-based cleaner
- Disinfection with quaternary ammonium compounds
- Disinfection with phenolic compounds (i.e. Pinesol, lysol)
- Disinfection with steam/heat, excluding sick food handlers
- Close common dining areas (kids eat outside or in classrooms)
- Close self-serve food lines, don’t allow the sharing of food
- Test food
- Contact food supplier excluding sick staff and students
- Enforce proper handwashing
- Encourage the use of alcohol-based hand sanitizers
- Other (fill in)
- I don’t know

14. Please describe observed gaps in the knowledge of norovirus and the proper protocols surrounding its prevention and control, if any.

**Outbreak Situation:**
15. If your department identifies an increase in norovirus in the local population do you alert schools?
- Yes [go to 16]
- No [go to 17]

16. What communication methods would you utilize in this type of situation? *Please check all that apply:*
- Email
- Phone call
- Letter
- Social media
- Other
- No protocol
17. Who would you identify as the primary point of contact at a school during a norovirus outbreak?
- Principal
- Assistant principal
- Secretary
- School nurse
- Other (fill in)
- I don’t know

18. According to your department, what threshold of illness (how many cases) at a school or institution would be necessary to constitute a norovirus outbreak?
- 2+ cases of acute symptoms in 48 hours
- 3-5 new cases in a 3 day period
- 4+ persons with acute symptoms in a classroom or defined group
- 5% or more of population
- 10% or more of population
- 15% or more of population
- Twice the normal absences due to symptoms for that time of year
- Other (fill in)

19. Do you train others how to clean up stool and vomit?
- Yes [go to 20]
- No [go to 21]

20. Please highlight education points that you deem important.

21. Does your department provide general information to schools to give to parents and/or students about gastrointestinal disease?
- Yes [go to 22]
- No [go to 23]

22. Does your department use any of the following methods to transmit health-specific information to parents and students? Please check all that apply:
- Email
- Letter
- Flyer
- Phone call/voicemail
- Text messages
- School website
- Other

23. Has your department utilized social media to communicate health information?
- Yes [go to 24]
- No [go to 25]
24. Which platforms have you used? *Please check all that apply.*
   - Facebook
   - Twitter
   - Instagram
   - Blog
   - Tumblr
   - Pinterest
   - Vimeo
   - Youtube
   - Other social media platform

25. Does your department have plans to use any of the following methods to transmit health information in the future? *Please check all that apply.*
   - Email
   - Letter
   - Flyer
   - Phone
   - Text messages
   - Facebook
   - Twitter
   - Blog
   - Instagram
   - Pinterest
   - Vimeo
   - Youtube
   - School website
   - Other
   - No [go to 26]
   - I don’t know [go to 26]

26. What factors might prevent your department from using social media? *Check any that apply:*
   - Don’t have a presence on social media
   - Staff are not comfortable using it
   - Language barrier (don’t want to translate information on multiple platforms)
   - We do not think it’s necessary
   - Too much time required to manage accounts
   - Internet access issues
   - Other (fill in)
APPENDIX C

Flowcharts for Norovirus Cleaning and Control

Are you vomiting?

No

Is someone around you vomiting?

Yes

Does the person vomiting have a logical reason for doing so (e.g., alcohol, pregnancy, other known illness)?

Yes

No

Is a facility you and/or this person attend regularly having an outbreak of norovirus?

Yes

No

You or this person may have norovirus, time to make sure it gets cleaned up properly

Do you have all the materials to properly clean up?

Yes, I'm super prepared

Great! Just to be safe though, go ahead and double check our list

What are they?

- Protective gear: Mask, apron, gloves
- Designated trash bags
- Absorbent material: paper towels or something designed to absorb the chucks
- Bleach: Lots of bleach. And water to dilute it

Do you know how to dilute your bleach when cleaning up vomit?

No, can't I just pour it on there?

Diluted bleach is actually more effective than super high concentrations or pure bleach.

For addressing vomit that has the potential to contain norovirus, a concentration of 5000 ppm (25 tsp of household strength bleach/ gallon of water) is recommended.

Bleach solution should be made fresh
**START HERE:** Do you know what norovirus is?

- Yes
  - AKA "stomach bug" or "stomach flu", but actually has nothing to do with the flu. Leading cause of foodborne illness in the U.S. and causes vomiting and diarrhea.

- No
  - Person to person, contaminated surfaces, and in contaminated food and water. Sick people are super contagious and it doesn't take much virus to make someone sick.

Do you know how norovirus is spread?

- Yes
  - Congratulations! Keep up the hand washing.

- No
  - Are you interested in not getting norovirus?
    - Yes
      - Good for you! Here are some steps to minimize your chances of becoming RIFFs with your toilet.
    - No
      - Well... That's weird

Are you armed with your cleaning wipes to prevent norovirus?

- Yes
  - Unfortunately many common household products don't work on norovirus. **Bleach is your best option.** When in doubt, check the container—the label will tell you if the product works against norovirus.

- No
  - Nope, I know that many household cleaners don't work on norovirus and I am all about the bleach.

Are you armed with your hand sanitizer?

- Yes, I'm a sucker for the cute bottles
  - Though hand sanitizers are great for a lot, they generally aren't effective against norovirus. If you use them as substitutes for hand washing you could get sick or spread the virus. Check the label if you're concerned, but you can't go wrong with hand washing.

- No, hand washing all the way for me
  - Stay home when sick
    - Make sure if you do get symptoms, to stay home until you are symptom free for at least 24 hours (48-72 is preferable). Additionally, do not prepare food while experiencing symptoms (or for 24-72 hours after feeling better).

Personal Hygiene

Hand washing is your best friend during norovirus outbreaks. Pretend like you’re back in kindergarten and sing yourself a tune to make sure you’re doing it long enough (about 20 seconds).

Use soap, scrub well, rinse in clean water and dry with a disposable paper towel or hand dryer. Wash frequently!
1. Why Use Social Media to Combat Norovirus?

Norovirus is the leading cause of acute viral gastroenteritis and foodborne illness in the United States and is estimated to cause 19-20 million illness, 56,000-71,000 hospitalizations and 570-800 deaths annually. Many of the most important control measures for norovirus require behavior change and the implementation of educational campaigns. Social media presents an opportunity as a medium to educate about norovirus and encourage proper control measures during an outbreak.

Social media is growing in popularity and numerous sources suggest it is useful for the dissemination of health related information and could be a valuable tool in combating foodborne illness. Online conversations that occur on social media can reach a wide audience and may contain many misconceptions or misinformation, making the interjection of public health officials of particular importance. Though there are some challenges to utilizing social media, particularly when first starting, the benefits are numerous.

This guide aims to outline the best practices for using social media during norovirus outbreaks for health organizations. However, much of the advice is valuable for general social media use for a range of health related communications by various users.
1.1 Wide Reach

Social media use is growing among US adults online, with about 70% reporting they are on social media. This allows access to a large and diverse portion of the population. Additionally, using social media is a relatively low cost way to reach a very wide audience.

1.2 Real Time Information

Social media is a rapid medium based off instant, up-to-date information. This is particularly valuable during crisis situations when the public may want or need information faster than traditional media can provide it. Social media allows for real time updates without the need to go through a third party (i.e. traditional news source), which can give your organization more control over the messages being released.

1.3 Information Gathering

Social media is a valuable tool for understanding public perceptions, opinions and concerns. It provides the ability to monitor what people are saying about a certain health topic, how they are responding to content about that topic and any questions they may be asking. This information can then be used to evaluate the effectiveness of current education methods and to better tailor future messages to address areas of greatest need.

1.4 Engagement

The two way format of social media is a key benefit that distinguishes it from traditional communication channels. Users are able to ask questions and trained officials can respond to them, preventing potential mix-ups that may occur through a third party, such as a newscaster.

Engagement is also important for behavior change. People’s attitudes towards a health issue and control measures are a crucial piece in whether or not they will follow recommendations. If people are able to engage with officials and each other on a health topic, they will likely take more interest in the topic or feel more empowered to make positive behavior changes.
2. What is Social Media?

Social media is characterized by a *two way transfer of information*. In addition to passively viewing information, the audience is able to comment and share content, as well as creating their own content. Social media includes platforms like Facebook, Twitter, Instagram, Pinterest, Vimeo and Snapchat, as well as blog formats.

More traditional media, such as television, info sheets, static webpages and phone calls are not considered social media, though some messaging strategies provided in this guide can still be valuable. Additionally, traditional media has been found to be an important complement to social media messages.

3. How Do I Get Started on Social Media?

3.1 Choose a Platform

There are multiple social media platforms to choose from depending on your needs. The most popular are listed below.

<table>
<thead>
<tr>
<th><strong>Platform</strong></th>
<th><strong>Type</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs</td>
<td>Weblog</td>
<td>Regularly updated webpage, written in an informal/ conversational tone</td>
</tr>
<tr>
<td>Facebook</td>
<td>Social network</td>
<td>Post text, photos and videos, no character limit; create communities</td>
</tr>
<tr>
<td>Instagram</td>
<td>Photo sharing</td>
<td>Post photos, with text captions</td>
</tr>
<tr>
<td>Pinterest</td>
<td>Bookmarking</td>
<td>Save various websites (“pins”) in a central location (“board”) for later viewing, commenting or sharing</td>
</tr>
<tr>
<td>Twitter</td>
<td>Micro-blogging</td>
<td>Post text, photos and videos, limited to 140 characters</td>
</tr>
<tr>
<td>Vimeo</td>
<td>Video sharing</td>
<td>Post videos, with text captions</td>
</tr>
<tr>
<td>Wikis</td>
<td>Collaborative</td>
<td>Multiple users can collaborate on creating and editing content (ie. Wikipedia)</td>
</tr>
</tbody>
</table>

Facebook and Twitter are great options as the majority of social media users are on these platforms. Additionally, these sites allow for flexibility in the types of content you choose to share.
Wikis have also been indicated as a trusted source of health related information by consumers and represent potential for contribution from health officials\textsuperscript{5,6}. Wiki content is different than other social media platforms in that regular individual posting and sharing isn’t common. Instead, users contribute to and edit entries on different subjects. This applies to norovirus outbreaks, as public health officials can examine wikis related to norovirus (ie. the Wikipedia page for “norovirus”) to check for correct information and ensure that proper control measures are highlighted.

This guide will mostly focus on social networks and micro-blogs (ie. Facebook and Twitter) where small posts and bits of information can be shared to followers on a regular basis.

3.2 Create the Account

- **Determine who will run the account.** This can be one designated person or a group of people, but be sure to coordinate who will be posting and when.
- **Create a username** (on Twitter it’s called a handle). These should clearly communicate what your organization is. The shorter and clearer the better.
- **Set up the account.** Choose or create an email address to associate with the account and add account details, including a name. On Facebook you can create a page for an organization, while on Twitter you can enter your organization name instead of a personal name.
- **Choose a profile picture.** Organization logos are great for this. Remember, when people see these they will usually be very small, so clear and simple pictures are best.
- **Gather friends/ followers.** The best way to do this is start by friending/ following people first, particularly groups whose mission is similar to yours or who are in your area. You can also advertise your social media accounts on your other communication platforms, like handouts and webpages.
- **Make your first post!** Start engaging with your friends/ followers by posting regularly. The more content you have, the easier it will be to attract a bigger following.

**It is important to build your social media presence before outbreaks occur.** A large following and online presence will make communication efforts during an outbreak more effective and you will be able to reach a wider audience.

3.3 General Posting

What your page posts on a regular basis is wholly up to your group, but there are a few good guidelines to keep in mind:
1. **Frequent:** Try to post at least once a week, if not a few times a week or even every day. The more active you are, the more likely people will come to the page and engage with you in the future. Additionally, repetition is okay as research has shown repeated messages are the most effective.

2. **Short:** Social media content is all about quick bits of information which can prove challenging when trying to provide important information. This is where things like external links or infographics can be helpful. If you have an infographic and you feel it is too big, cropping it into smaller pieces (the program paint is great for this) is a good option.

3. **Relevant:** Users may be confused if you post content unrelated to your organization. Try to ensure that the posts you make relate to your organization and its activities.

### 3.4 Responding to Comments and User Posts

If people comment on your posts, your page, or tweet to your group, it is important to read the posts promptly and determine if a response is necessary. Often, a simple response such as liking a post or sharing something particularly interesting is more than enough.

If the user is asking a direct question, it is very important to respond to it as soon as possible. In cases where a user is asking for information you do not have or cannot provide, a response is still important. The best way to handle this situation is either to direct the user to another source or to indicate why the information is not available/when it might be available. In these cases, simplicity and politeness are critical.

If the comment or post is obscene, threatening or otherwise inappropriate you have the ability to remove the post and block or report the posting account. In these cases the best strategy is usually to remove the post instead of engaging with the user.

However, if the post is angry or critical but not inappropriate, a response is important. Ideally, a public response should be used to address the user’s concerns. If the problem is more complex, a post apologizing for the issue, offering assistance and then suggesting direct contact (through email, private message, etc.) is appropriate. It is important to never engage in an argument with a user on social media. If things appear to be escalating, halt public responses to that post and either remove the content if it is extremely inappropriate or contact the user separately.
4. Posting During a Norovirus Outbreak

This time is critical and is when a social media network can be particularly beneficial. Once an outbreak is identified, swift online action is important and more frequent posting (multiple times a day) will be necessary to effectively participate in the online conversations about the outbreak.

4.1 Important Messages

During a norovirus outbreak, it is important to prioritize control measures and to provide the audience with concrete steps they can take to address norovirus.

It is important to highlight the following control measures during an outbreak:

1. STAY HOME:
   Emphasize that isolating those who are sick and limiting contact with those infected is crucial since the virus is so easily spread. Those who become sick with norovirus remain infectious for 24-72 hours AFTER symptoms are gone. People who are ill should remain home for at least 24 hours, and preferably 48-72 hours after symptoms go away.

2. HYGEINE:
   It is very important to highlight hand washing and specifically state commercially available alcohol-based hand sanitizers (anything they could buy in a store) do not inactivate norovirus. The use of hand sanitizers can actually prolong an outbreak because people will forgo hand washing.

3. CLEAN:
   Cleaning surfaces during a norovirus outbreak is very important as contaminated surfaces and vomit incidents play a big role in spreading norovirus. Regular cleaning of surfaces and appropriately handling vomiting incidents can be critical in stemming the spread of norovirus. Particular attention should be given to high touch areas, including door knobs and hand rails.
   It is important to emphasize that only specific sanitizers are effective against norovirus. The most common sanitizer recommended is hypochlorite (household bleach). Many household cleaning products, such as Clorox and Lysol wipes, do not contain bleach or are not approved for norovirus. Encourage your audience to check the label of their products to see if it is approved for norovirus.
4.2 Message Structure

Research has shown that behavior change is motivated by a combination of perceived threat and perceived efficacy. This means that users need to understand the risks, their severity and their frequency, while also feeling that they are able to take concrete and effective control steps. Both threat and efficacy messages are important, as perceived threat motivates the audience to actually change and efficacy gives them the tools and confidence to do so.

**Risks of norovirus:** This can be highlighted in a few ways. If an outbreak is active in a community, the perceived threat will likely already be high, especially if the outbreak is large. Other ways to address perceived threat for norovirus include:
- Highlighting the number of people who get ill from norovirus
- Discussing the economic consequences of norovirus (ie. missed school and work)
- Emphasizing the unpleasant symptoms of norovirus and how easily and rapidly it’s spread

**Efficacy steps for norovirus:** In order to prevent the risk messages from inciting fear in the audience, the inclusion of concrete control instructions is critical. The three messages highlighted in section 4.1 should be prioritized along with comments about each measure’s effectiveness against norovirus. Some examples of this are:
- Highlighting the ease of norovirus transmission, then suggesting staying home as an effective way to prevent this
- Discussing how hand sanitizer does not work against the virus, then providing frequent hand washing as a better method

See Section 6 for example messages.

4.3 Addressing Misconceptions

The internet is rife with misinformation and misconceptions, and conversations about norovirus are no exception. Health officials have a great opportunity to use social media to interject into these conversations and provide accurate information. Some commonly identified misconceptions are discussed below, along with supporting information to debunk these ideas that can be used in social media messaging.

- **Norovirus is like the flu:** Though norovirus is frequently called the stomach flu, it is not related and cannot be treated the same as the flu. Besides hand sanitizers not working on norovirus, there is no vaccine available. Additionally, covering coughs and sneezes, though a good practice, has little impact on norovirus transmission.
- **Norovirus mostly impacts cruise ships:** As norovirus has been dubbed the “cruise ship” virus by popular media, this can be hard to dispel, but it is important to note that
norovirus can occur just about anywhere people live and eat in close contact with each other. Outbreaks are actually most common in hospitals and long term care facilities, and also occur in schools and military bases.

- **Hand sanitizers work on norovirus:** Commercially available, alcohol based hand sanitizers (anything you can buy in the store) do not work against norovirus and research has actually shown that these can prolong an outbreak because people forgo hand washing. Frequent hand washing is the best way to address norovirus, as it physically removes the virus from hands.

- **There are vaccines/ drugs for norovirus:** No vaccine or drug currently exists for norovirus, the best steps for treatment are staying home, increasing personal hygiene, rest and hydration. Antibiotics do not work against norovirus, as it is a virus and not a bacteria.

## 4.4 Engaging with Users During an Outbreak

The ability to have a two way conversation with users is a huge benefit of social media that is often underutilized by health officials. **Engaging with users is a great way to understand their health needs, provide targeted information and encourage them to change behaviors.**

The first step in engagement during an outbreak is determining if and where people are talking about norovirus. Using the Facebook or Twitter search bars, you can search for the location of the outbreak (ie. specific school) and the word norovirus. This could turn up posts people have made about the outbreak or other posts, like news articles, that have comments on them.

You can also create a hashtag for the outbreak and encourage your users to use it if they have questions (see Section 5.2).

The second step is interjecting into the conversations to provide information and dispel misconceptions. If you created a hashtag, or there is already a hashtag for the outbreak, tweeting and posting using this hashtag is a good first step. Next, addressing specific questions raised in posts or comments is a straightforward way to engage with the public.

Finally, commenting directly to address incorrect (or correct) information can be important. This is a little trickier than merely addressing directed questions, as you do not want to offend a user. Some techniques to do this effectively include:

- **Encouragement:** Instead of just correcting wrong statements, highlight correct statements. For example, if a user says something like “I’ve heard hand sanitizers don’t work, so everyone should wash their hands” your organization could respond by saying, “Hey [user], you’re right! Hand washing is the best way to protect yourself.”
- Humor: The public is more likely to respond to humorous posts and humor can be used to make corrections less aggressive. Humor that also transmits information is ideal, but difficult to achieve. An alternative method is to provide a humorous comment, then control information. Examples of this can be seen in Section 6.
- Sharing experiences: Calling for the public to share their norovirus experiences (ie. “tell us your vomit stories!”) is a great way to get people talking about norovirus. It is then possible to either comment on these stories with control information or to build followers who are then more likely to see the control information released by your group.

5. Special Social Media Campaigns

Research on social media related to norovirus outbreaks found two unique types of social media interaction, in addition to traditional posting and commenting. These techniques can be effective for your organization during norovirus outbreaks.

5.1 Parody Accounts

These are accounts where a user pretends to be the norovirus responsible for a specific outbreak. For example, if Harvard University was having a norovirus outbreak, you could create an account for “Harvard Norovirus.” These can be especially effective during large outbreaks among high school and college aged students, who will be the most likely to engage with the account. **Parody accounts rely heavily on humor, rapid responses and very frequent posting.**

These accounts are more time intensive than regular posting, as their major benefits come from direct interactions. To see an example of an effective parody account, visit the Twitter account for @GWNorovirus ([https://twitter.com/gwnorovirus?lang=en](https://twitter.com/gwnorovirus?lang=en)). This account was created for a norovirus outbreak at George Washington University and garnered a few hundred followers. Messages from before February 20, 2012 provide great examples for posting as a parody account.

Another benefit of parody accounts is anonymity, as your organization does not have to be affiliated with the account, though it can engage with the account.
5.2 Outbreak Specific Hashtags

These are outbreaks where a hashtag specific to that outbreak has been created and is used by those in the affected community. Hashtags serve as a way to identify all posts related to a subject. They can be an effective way to find conversations or to start a conversation about an outbreak.

Hashtags will usually include something to identify the location (ie. RHS, Yale) and then something signifying norovirus (ie. virus, norovirus, plague). In high school and university outbreaks where the affected community is highly active on social media a hashtag may already be created. If not, your organization may elect to create one as a way to increase engagement.

This strategy works best in outbreaks in populations already highly engaged on social media. Additionally, frequent use of the hashtag on posts about the outbreak is important to increase visibility and use. The hashtag is a great way to find and address comments about the outbreak and to mark the information you provide related to the outbreak so other users may easily find it.

6. Example Messages

6.1 Stay home:

“An outbreak of norovirus has hit [location], this virus spreads rapidly and is easily transmitted, so be sure to stay home until you’re symptom free for at least 24 hours.”

“Norovirus has been identified in [location], if you have symptoms be sure to stay home until you’re symptom free for at least 24 hours.”

“You can spread norovirus for 1-3 days after symptoms go away, so make sure to stay home for at least 24 hours after feeling better.”

Stay home with humor:

“Sharing is caring, except when you have norovirus. Stay home until symptom free for at least 24 hours to prevent sharing norovirus with everyone.”

“Don’t be that jerk who gave everyone in the office norovirus. Stay home for at least 24 hours after your symptoms go away.”
“No one likes the person responsible for making them vomit for two days straight. Stay home if you have norovirus symptoms, and for 24 hours after feeling better.”

“Norovirus is the gift that keeps on giving. You can be infectious for 1-3 days after feeling better, so make sure to stay home during this time period to prevent infecting others.”

6.2 Hygiene

“Hand washing is the best proactive way to protect yourself from norovirus.”

“Frequent hand washing is crucial to prevent the spread of norovirus.”

“Wash your hands using running water, soap and scrub for 10-15 seconds to reduce the spread of norovirus.”

“Hand sanitizers you buy in the store don’t work on norovirus, so make sure to wash your hands.”

“Using hand sanitizers instead of hand washing can actually prolong a norovirus outbreak, as they do not work against norovirus.”

Hygiene with humor:

“Avoid becoming best friends with your toilet, follow our recommendations for controlling norovirus” (provide a link to your site or CDC site)

“No one likes vomiting for two days straight, hand washing may save you from this terrible fate”

“We know those cute little bottles of hand sanitizer smell great, but all they do is push norovirus all over your hands, so make sure to wash your hand instead”

“During a norovirus outbreak, hand sanitizer is effectively norovirus lotion as it doesn’t work against the virus. Don’t use norovirus lotion. Wash your hands instead.”

6.3 Cleaning

“Regularly cleaning high-touch surfaces is extremely important to control norovirus.”
“Using the appropriate sanitizer during norovirus can make all the difference - bleach is your best bet. Check out the guide here: [provide CDC link or link to other information source].”

“Did you know that too much bleach can be a bad thing? Make sure to dilute your bleach according to the instructions on the bottle to effectively get rid of norovirus.”

“Norovirus in your house? Make sure you know how to clean up vomit to prevent spread [provide link].”

**Cleaning with humor:**

“Excited for the upcoming break/ weekend? Well, norovirus may be waiting for you when you get back - it can live on surfaces for up to three weeks!”

“We love cleaning wipes too, but if you’ve got a norovirus outbreak on your hands, they just won’t work. Use bleach instead to insure your house stays a norovirus free zone.”

“Vomit = a norovirus bomb. Control the spread with these steps: [provide external link]”

“Vomit = a norovirus bomb. Control the spread with these steps: wear protective gear, absorb the chunks first, and use a 1:10 dilution of household bleach (1 part bleach to 9 parts water) to disinfect the soiled area and the splash zone around it.”

“Door knobs are gross. Make sure they aren’t giving you norovirus by regularly cleaning with a bleach solution made with 5 tbsp of household bleach in one gallon of water.”

**6.4 Images**

Research has shown that images are a great way to get readers to pay attention to and share your message\textsuperscript{10,11}. Various norovirus infographics are available online and can be shared with your viewers. Memes are also a great way to add humor to your control measures. Memes are images with short, funny captions and pop culture references. As long as your organization does not use pop culture images for profit, you are able to use them on your social media.

Memes can be a great way to relate to your audience and capture their attention. The internet is a good resource for locating popular memes and meme generators exist that allow you to easily create images that are tailored to your messages.

Examples of memes include:
6.5 External Links

Providing links in posts is a great way to supply more detail to users while still keeping posts succinct. Many websites exist to shorten links so that you can meet a character requirement and keep your posts short. The most popular are https://bitly.com/ and http://tinyurl.com/

In addition to your organization’s website and any materials you have created, here are some other good links to share about norovirus:

**CDC Resources:**
Preventing norovirus: http://www.cdc.gov/norovirus/preventing-infection.html
http://www.cdc.gov/Features/Norovirus/
Guides for health officials: http://www.cdc.gov/norovirus/php/index.html

Norovirus infosheets from the Somerset (NJ) County, Department of Health, NEHA, Water Quality & Health Council, and American Chemistry Council here: http://www.disinfect-for-health.org/resources
EPA approved cleaning products for norovirus: 

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Why Does Reporting Norovirus Matter?

The media plays an important role during norovirus outbreaks by acting as a source of outbreak control information for the public. Additionally, news stories about norovirus can address common misconceptions and provide the public with concrete steps they can take to help prevent norovirus. Systematic research has highlighted the impact that media reporting can have on health outcomes and has indicated the importance of news stories in providing information about health topics\textsuperscript{1,2}. 

The aim of this document is to provide research-based guidance on covering norovirus outbreaks and to highlight the most important control measures. A checklist is included at the end of this document that outlines simple points that can help news stories limit the spread of the disease, and more detailed control advice is provided in text boxes. By following these guidelines, media reports can help reduce the duration of a local norovirus outbreak by giving the public information needed to appropriately address norovirus.
For this to be an effective strategy, it is important that information presented about norovirus is accurate, clear and avoids any misconceptions that could prolong an outbreak. The most important messages during a norovirus outbreak are proper cleaning and control measures. Norovirus outbreaks are actually very common and reducing panic in favor of information about the virus and its control are preferable. This guide will enable news professionals to make informed decisions about their reporting practices.

1. What is Norovirus?

Norovirus, which you may have heard people call “the stomach bug,” “the stomach flu,” or Norwalk virus, is the leading cause of acute viral gastroenteritis and foodborne illness in the United States. It is estimated that 19-20 million people become ill from norovirus each year in the United States, of which 56,000-71,000 are hospitalized and 570-800 die. Though many people associate norovirus with cruise ships, it is common in many other locations, including schools, where it has been reported as the primary cause of viral gastrointestinal outbreaks, as well as in hospitals, nursing homes, dormitories and military bases3-7.

1.1 What are the Symptoms of Norovirus Infection?

Symptoms usually include sudden vomiting and nausea, occasionally accompanied with diarrhea or a mild fever. The illness tends to be self-limiting (meaning that it goes away on its own) within 24-48 hours, but can cause severe complications, such as dehydration8. Norovirus can affect people of all ages, though symptoms are most severe in high-risk groups, including infants and young children, the elderly and those with weakened immune systems9.

1.2 How Does Norovirus Spread?

There are four important points about how norovirus infects humans:

- Human norovirus cannot be spread to or by animals and is primarily spread by the fecal-oral route.
- Anyone can become infected with norovirus and people can become infected multiple times in their life.
- It is spread from person to person, from surfaces contaminated with the virus, and in contaminated food and water.
- Norovirus is very easily and rapidly transmitted.
The virus is so easily spread because those who are sick may shed a lot of virus particles. Up to 100 billion virus particles can be in one gram of stool, about the weight of a paperclip—that’s 100,000,000,000 virus particles! However, it takes very little make someone sick—between 10 and 100 virus particles. Additionally, people can continue to shed viruses and make other people sick for days after symptoms stop and some people can be infectious even if they’ve never experienced symptoms.

Norovirus can also be aerosolized—that is, it can be present in small liquid droplets—in vomit and may spread up to 25 feet outside of visually affected areas. Norovirus particles are extremely environmentally stable and can remain infectious on surfaces for many weeks and in water for up to 3 months.

It is important to note that specific control guidelines need to be followed when dealing with a norovirus outbreak as the virus does not respond to many common control measures.

2. Recommendations for News Reports

2.1 How Can I Verify a Norovirus Outbreak?

In many norovirus outbreaks, there may never be an official confirmation of norovirus, or the confirmation may occur after the outbreak has stopped. This is because testing for norovirus is a long process that can be expensive. Often, institutions will treat an outbreak of gastroenteritis as norovirus regardless of confirmation because the controls for norovirus are the most robust.

It is perfectly acceptable to report an outbreak as a “suspected” case of norovirus if lab-based confirmation is unavailable. If norovirus-like symptoms (vomiting, diarrhea) are occurring in a large population the outbreak is most likely norovirus and should be treated as norovirus due to the difficulty in controlling the virus. The measures used for norovirus will control for most other agents responsible for similar symptoms.

2.2 How Should I Describe Norovirus?

When describing norovirus, it is important to emphasize that norovirus is different from “the flu” referred to in everyday language, despite often—incorrectly—being called a “stomach flu.” Most importantly, norovirus is unrelated to any respiratory symptoms, does not have a vaccine like the flu, and cannot be inactivated by the same cleaners as the flu. In an article,
the term norovirus is ideal. “Norwalk virus” or simply using the term virus, after initially mentioning norovirus, are also appropriate.

Emphasizing infection routes and the ease with which norovirus spreads can be key in motivating people to follow appropriate control measures. This method is most effective when coupled with clear instructions about steps the public can take to prevent norovirus. Studies have indicated people are most likely to listen to a message when their sense of being able to take action is greater than their fear of the negative outcome\textsuperscript{13}.

For those infected with norovirus, it is important to note that the best and only treatments are rest and hydration. There is currently no vaccine for norovirus and no medication that will treat a norovirus infection. Antibiotics will not work, as norovirus is a viral infection rather than a bacterial infection.

2.3 How Can I Help Stem the Spread of an Outbreak?

The most crucial way news personnel can help during a norovirus outbreak is by providing control advice. Accurate control information provided in a news story can have a far reaching audience and has the potential to dramatically affect public response to a local outbreak.

Control advice based off norovirus research has been grouped into three main priorities: (1) staying home; (2) personal hygiene and; (3) proper cleaning.

Priority #1: Stay Home when Sick

Emphasizing the need to isolate those who are sick and to limit contact with those who are infected is crucial since the virus is so easily spread. Those who become sick with norovirus remain infectious for 24-72 hours AFTER symptoms are gone. This is important to highlight, as those who become ill should remain home for at least 24 hours, and preferably 48-72 hours, after feeling better. Additionally, those who suspect they have norovirus should be advised to refrain from preparing food until at least 24 hours (preferably 48-72 hours) after symptoms stop. This reduces the likelihood for direct contamination of food and the potential to infect a large number of people.

Priority #2: Hand washing
Stressing hand washing along with good personal hygiene is critical in preventing the spread of norovirus. **Regular hand washing during an outbreak is the best proactive way to prevent getting sick.**

One reason hand washing is so important during a norovirus outbreak is because commercially available, alcohol-based hand sanitizers (i.e., any hand sanitizer you can buy in a store) DO NOT WORK against norovirus. There is research that suggests using hand sanitizer can actually increase the length of an outbreak, further increasing the importance of addressing this misconception\textsuperscript{14,15}.

The virus is spread via the fecal oral route, meaning that if small particles of fecal material or vomit come into contact with someone’s mouth, that person can become infected. Because of this, thorough hand washing after using the restroom is crucial, along with before and after cooking and eating and after coming into contact with someone who may have norovirus.

**Priority #3: Appropriate Cleaning Measures**

Contaminated surfaces and vomit incidents play a big role in spreading norovirus. **Regular cleaning of surfaces and appropriately handling vomit can be critical in stemming the spread of norovirus**\textsuperscript{16}. Particular attention should be given to high touch areas, including door knobs and hand rails.

It is important to emphasize that only specific sanitizers are effective against norovirus. The most common sanitizer recommended is household bleach (hypochlorite). Many household cleaning products, such as Lysol and Clorox wipes, do not contain bleach or are not approved for norovirus\textsuperscript{17}. Encourage your audience to check the label of their products to see if it is approved for norovirus.

A list of approved products can be found at: [http://www.epa.gov/sites/production/files/2015-10/documents/list_g_norovirus.pdf](http://www.epa.gov/sites/production/files/2015-10/documents/list_g_norovirus.pdf)

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**Proper Hand Washing**

- Use clean, running water and soap (does NOT need to be antimicrobial)
- Scrub all parts of the hand, including nails and between fingers, for 10-15 seconds
- Thoroughly rinse hands
- Completely dry hands, preferably with a paper towel, as the physical removal can be beneficial in reducing the amount of virus\textsuperscript{18}
Using Bleach

When reporting on the use of bleach, there are a few important steps to ensure effectiveness.

People need to:
- **Clean the surface first, particularly if soiled.** The presence of dirt and other organic material can reduce the effectiveness of bleach.
- **Use the appropriate concentration.** Bleach is only effective if properly diluted and too much will actually prevent bleach from treating norovirus. A concentration of 1000-5000 ppm bleach is recommended, which translates to 5-25 tablespoons of household bleach (5.25% concentration, this value will be on the container) per gallon of water.
- **Leave sanitizer on surface for appropriate contact time.** Sanitizers require time to work effectively, so it is important to be aware of these times and to follow them.
- **Follow the directions on the bottle.** Ultimately, not all sanitizers are the same, so encouraging the public to follow the directions on their norovirus approved sanitizers will ensure proper use and inactivation of norovirus.

Cleaning Up Vomit and Bodily Fluids

Cleaning up an episode of vomit quickly and appropriately is very important in reducing virus spread.

Steps include:
- **Use protective clothing**, including disposable gloves, apron and face mask
- **Use absorbent material** to pick up liquid and visible material, dispose in designated trash bag or biohazard bag
- **Use soapy water** to wash area and nearby surfaces
- **Disinfect with chlorine bleach** or other norovirus approved disinfectant. For chlorine bleach, prepare a 5000 ppm solution (25 tbsp of household bleach [5.25% concentration] in one gallon of water) and leave wet on surface for 5 minutes
- **Dispose of protective clothing and wash your hands**

For more information, see the Clean-Up and Disinfection for Norovirus infosheet from the Somerset (NJ) County, Department of Health, NEHA, Water Quality & Health Council, and American Chemistry Council here: http://www.disinfect-for-health.org/resources
3. Norovirus Article Content Checklist

**About Norovirus**
- Use appropriate terminology for norovirus including norovirus, Norwalk virus, or virus (NOT bacteria)
- Refrain from comparing norovirus to the “flu” or calling it “stomach flu”
- Highlight the main symptoms of norovirus, including vomiting and diarrhea

**Norovirus Spread**
- Mention the three main ways norovirus can be spread: (1) from person to person, (2) from contaminated surfaces, and (3) in food or water
- Highlight how infectious norovirus is and how it can spread easily and rapidly

**Control Measures**

Does your news article provide control advice, such as…

- **[Priority #1]** Staying home and not preparing food while sick and for 24-72 hours AFTER symptoms stop

- **[Priority # 2]** Proper hand washing (see “Proper Hand Washing” box) and personal hygiene practices
  - NOT using hand sanitizer, as it does not work against norovirus

- **[Priority # 3]** Increasing routine cleaning of surfaces
  - Using the correct surface sanitizers for norovirus, either bleach or those explicitly approved for norovirus
  - Following proper guidelines for sanitizers (see “Bleach Use” box)
  - Cleaning up vomit quickly and following appropriate method (see “Cleaning Up Vomit and Bodily Fluids” box)
Further resources about norovirus can be found on the CDC website: http://www.cdc.gov/norovirus/index.html

References

13. Witte, K. Fear control and danger control: A test of the extended parallel process


