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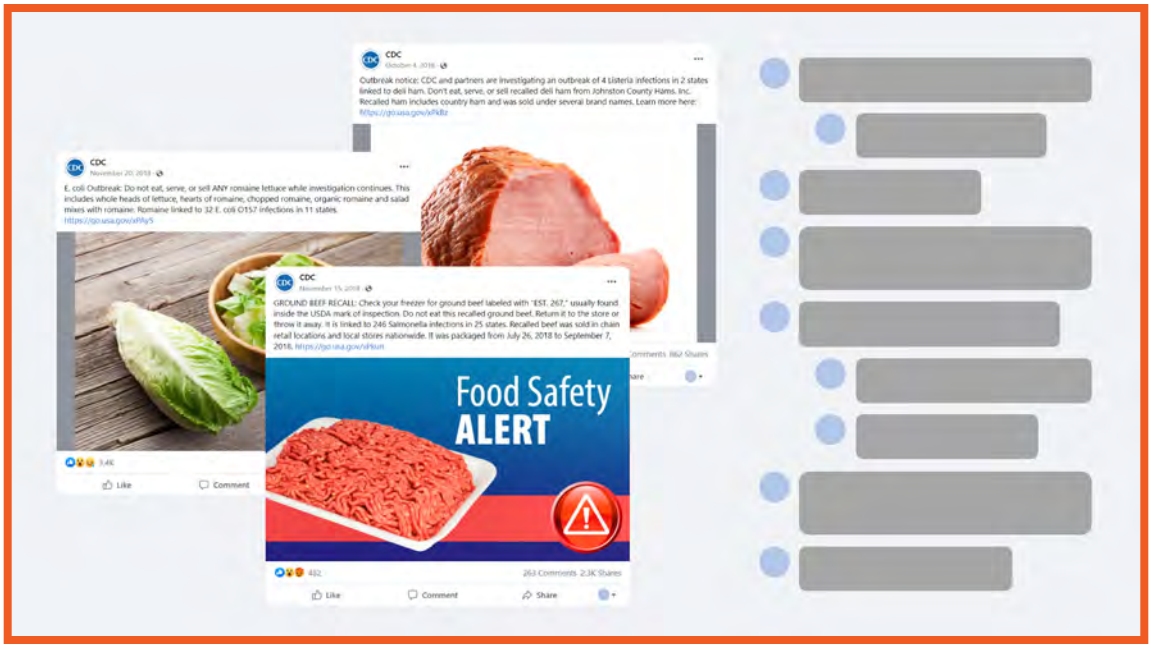

A Qualitative Content Analysis of Responses to CDC's Foodborne Outbreak Messages on Facebook

ABSTRACT

The Centers for Disease Control and Prevention (CDC) coordinates investigations of multistate foodborne outbreaks. To better inform future communication efforts with the public during these outbreaks, we conducted a qualitative content analysis of comments on multistate foodborne outbreak Facebook posts distributed on the CDC's Facebook page September to December 2018. The CDC created 27 Facebook posts for nine multistate foodborne outbreaks (one to eight posts per outbreak), and 2,612 comments were analyzed. The CDC used two Web tools to deliver outbreak information: food safety alerts (FSAs) and investigation notices (INs). Qualitative analyses were conducted separately for Facebook posts resulting from FSAs and INs. Using an inductive coding approach, we identified nine categories of comments: information sharing (e.g., tagging others), actions (e.g., discarding contaminated food), convictions and beliefs (e.g., food-related preconceived notions), questions (e.g., clarifying outbreak location), emotional responses (e.g., worry), blame (e.g., responsibility for outbreak), food specific (e.g., repackaging ground beef and losing identifying information), promoting another cause (e.g., vaccine hesitancy), and unrelated. No differences were found between FSAs and INs. Facebook users helped further disseminate important outbreak information but identified barriers that prevented them from taking recommended actions. Real-time evaluation of social media during outbreaks provides opportunities to refine messaging and improve communication.

INTRODUCTION

The Outbreak Response and Prevention Branch within the Division of Foodborne, Waterborne, and Environmental Diseases at Centers for Disease Control and Prevention (CDC) coordinates investigations of multistate foodborne outbreaks. Although most foodborne outbreaks occur locally, multistate foodborne outbreaks cause a disproportionate number of illnesses, hospitalizations, and deaths based on their occurrence *(6)*. During multistate foodborne outbreak investigations, the CDC uses a variety of communication methods, including the CDC Website, Facebook, Twitter,

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Instagram, partner social media accounts, and news media, to notify the public about ongoing multistate foodborne outbreaks and inform people about what they can do to protect themselves from getting sick. Public notification is an essential part of the public health response effort, providing timely access to reliable information and encouraging the public to make informed choices to prevent additional illnesses *(11)*.

Outbreak investigations often require unique public health messages, making timely and accurate public communication essential for preventing illnesses. Public communication during outbreaks serves several functions, including notifying consumers of an outbreak, sharing information about the results of an investigation, providing advice, and enumerating actions consumers and retailers can take to protect themselves and their customers. Such actions can include avoiding eating or selling certain foods for a specific time, returning or discarding foods, following routine food safety recommendations, and seeking health care. The CDC uses two Web-based communication tools to disseminate information about foodborne outbreaks to the public at different phases of an outbreak investigation: food safety alerts (FSAs) and investigation notices (INs) *(4)*. An FSA provides urgent, specific advice to consumers, restaurants, and retailers about foods to avoid eating or selling. This advice often includes information about a recall or other warnings and is used when an outbreak vehicle has been identified. An IN provides information about an outbreak not yet linked to a food source or an outbreak linked to a general type or category of food rather than a specific food and often reiterates existing food safety recommendations. Both FSAs and INs could be used to communicate about a single outbreak. For example, early in an investigation when the outbreak vehicle has not yet been identified but communication about the outbreak is needed, an IN could be used. Later, when the outbreak vehicle is identified, an FSA may be issued.

Facebook is one of the social media platforms that the CDC uses to communicate with the public. More than 1.62 billion global users visit Facebook daily for a variety of reasons, including to get news, for entertainment, and to keep in contact with friends and family *(1)*. As of February 2021, the CDC's Facebook account had >3.8 million followers and is used to promote health campaigns, share health-related messaging and resources, and notify the public of disease outbreaks. The CDC develops multistate foodborne outbreak-related Facebook posts based on the content of the FSAs and INs.

To better inform future communication efforts with the public during multistate foodborne outbreaks, we conducted a qualitative content analysis of comments on CDC-developed multistate foodborne outbreak Facebook posts from September to December 2018. This is the first in which we have systematically assessed responses to the CDC's outbreak messaging on Facebook. The objective of this project was to better understand how people respond to the CDC's messages about multistate foodborne outbreaks. Although FSAs and INs are both used to communicate to the public about foodborne outbreaks, it is unclear how people respond to these different types of messages. We compared people's responses to Facebook messages created from FSAs with people's responses to INs to evaluate any meaningful differences.

MATERIALS AND METHODS

We analyzed comments on foodborne outbreak posts on the CDC's Facebook page during from 1 September to 31 December 2018. Sprout Social, a social media management platform, was used to export all comments to an Excel spreadsheet (Microsoft, Redmond, WA). The critical data elements that were exported included the date and time of the comment, the name of the Facebook user, the comment, and the URL for the Facebook post to which the comment was related.

To be included in the final dataset for analysis, a comment had to be (i) created within 7 days of the CDC's foodborne outbreak Facebook post, (ii) created by a user whose privacy option was set as "public," and (iii) a comment directly responding to the CDC's foodborne outbreak Facebook post and not a reply to someone else's comment. User profiles with privacy options not set to "public" were intentionally excluded to respect the intentional action of the users in setting the privacy options. To distinguish between comments on the CDC's foodborne outbreak posts and direct replies to those comments, the original outbreak post was cross-checked on the CDC's public Facebook page because the data export alone did not contain information to differentiate between the two comment types. On the Facebook post, comments to a post versus a reply are clearly distinguished by an indentation under an original comment. Before data analysis, all personal information was removed from the database including any information that could link someone back to a specific user's profile (name of the user). Emojis were not available to export into Excel, so they were excluded from the analysis.

The CDC provides critical information about the foodborne outbreaks that it announces, including how many people are sick, what state sick people live in, foods implicated in the investigation (when known), advice to consumers and retailers, and signs and symptoms of the illness. The choice of which of the two Web-based communication tools to use (FSA or IN) depends on the stage of the investigation. Once FSAs and INs are developed, key messages from them are posted to the CDC's social media accounts, including Facebook. Outbreak posts on Facebook were divided into two categories for this analysis: posts resulting from an IN and posts resulting from an FSA.

A traditional inductive coding methodology or grounded theory approach *(9, 14)* was used to analyze comments on the CDC's foodborne outbreak Facebook posts. To start the analysis process, coders began by reading through the text data to familiarize themselves with the comments. After this first pass through the data, coders then began labeling Facebook comments with various codes to categorize a segment of text

data by a particular topic. A consensus approach was used to develop an overall coding scheme and reduce the initial codes into subcategories and then again into final categories. Three coders met a total of 18 times over a 6-month period to reach consensus on codes and categories that emerged from the analysis of comments. Comments associated with INs and FSAs were analyzed separately. Comments resulting from INs were analyzed by creating codes and then categories. After this analysis was complete, the same process was used for comments resulting from FSAs. Then categories for INs and FSAs were compared. Themes were not developed after category creation for each type of outbreak message. A theme adds additional context or meaning to a category that is usually emotional *(7)*. Not all comments were analyzed because investigators determined that inductive thematic data saturation was reached and ceased analysis. Data saturation is a well-accepted methodology for qualitative approaches *(13)*.

RESULTS

Between 1 September and 31 December 2018, the CDC publicly announced nine multistate foodborne outbreak investigations on Facebook. Foods linked to these outbreaks were eggs, ground beef, romaine lettuce, turkey, deli ham, chicken, tahini, cake mix, and pork patties *(Table 1)*. In response to these nine outbreaks, the CDC created a total of 27 multistate foodborne outbreak Facebook posts (one to eight posts per outbreak). From these posts, 5,377 comments were generated and exported into the database. Of these 5,377 comments, 2,765 were excluded from the final dataset because they did not meet the inclusion criteria; 2,612 comments remained and were included in this analysis *(Fig. 1)*.

INs

Three multistate foodborne outbreak investigations resulted in an IN with a total of five (19%) Facebook posts *(Table 1)*. The number of posts for each outbreak investigation ranged from one to three (one for an outbreak linked to chicken, three for an outbreak linked to turkey, and one for an outbreak linked to cake mix). These five Facebook posts generated 158 comments (6% of all comments analyzed), with a range of 13 to 65 (median of 21) comments per post.

All 158 comments were analyzed and coded, resulting in 23 unique codes in six categories: information sharing, actions, questions, convictions or beliefs, emotional responses, and promoting another cause *(Table 2)*. The information sharing category included both directive and awareness statements that incorporated sharing the CDC's post or message with other Facebook users via tagging. The actions category included any mention of a past action or future action that the Facebook user would take as a result of the CDC's message. Past actions often included mention of eating or purchasing the food that was implicated in the outbreak, and future actions often included avoiding the food altogether. The questions category included any question that was posed by a Facebook user

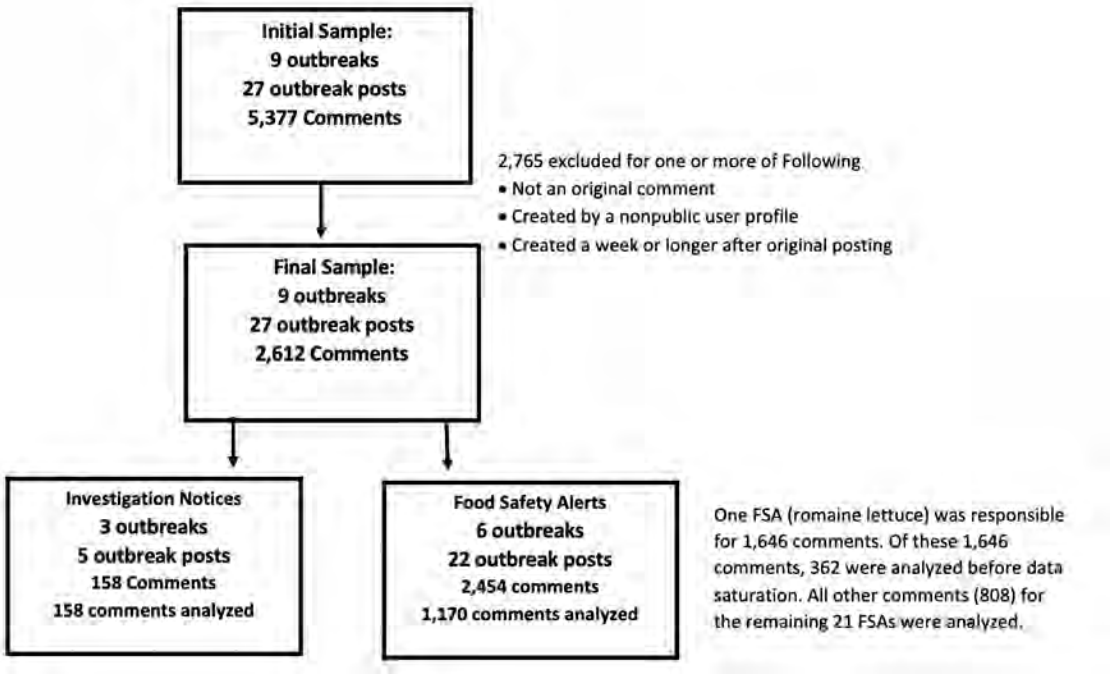

Figure 1. Exclusion criteria chart.

TABLE 1. Types of CDC Web announcements for multistate foodborne outbreaks, outbreak vehicles, and number of comments

Type of announcement	Outbreak vehicle	Posting date in 2018 (mo/day)	No. of comments	Facebook post
Investigation notice	Raw chicken	10/18	21	CDC is investigating a multistate outbreak of *Salmonella* infections linked to a variety of raw chicken products. Always handle raw chicken carefully and cook it to 165°F. CDC is not advising that consumers avoid eating chicken. Learn more here: https://go.usa.gov/xPnxT
	Turkey	11/8	13	Thaw your turkey safely for Thanksgiving! Thaw it in the refrigerator, NOT on the counter. A total of 164 people have been reported in an outbreak of *Salmonella* infections linked to raw turkey products. https://go.usa.gov/xPvKw
		11/16	42	GROUND TURKEY RECALL: Check your fridge and freezer for Jennie-O ground turkey labeled with "P-190," usually found inside the USDA mark of inspection, and use-by dates of 10/1/2018 or 10/2/2018. Do not eat this recalled ground turkey, which may be contaminated with *Salmonella*. Return it to the store or throw it away. https://go.usa.gov/xP7K3
		12/21	17	*Salmonella* outbreak update: Raw and undercooked turkey has sickened 216 people in 38 states. Take steps to stay healthy: COOK to 165°F and check with a food thermometer. CLEAN your hands after handling raw turkey and anything it touched, like counters, cutting boards and utensils. More tips to safely thaw, handle, and cook your holiday bird. https://go.usa.gov/xPNqS
	Cake mix	11/7	65	RECALL ALERT: Four varieties of Duncan Hines cake mix were recalled for *Salmonella* contamination. Check your home for recalled mixes. Don't bake with them and don't eat cake or batter made with them. Return recalled mixes to the store for a refund or throw them away. Find out how to identify recalled mixes: http://go.usa.gov/xPdpu
Food safety alert	Eggs	9/10	69	Outbreak notice: CDC and partners are investigating an outbreak of 14 *Salmonella* infections in 2 states linked to shell eggs. Don't eat, serve, or sell cage-free large eggs from Gravel Ridge Farms. Recalled eggs were sold in Alabama, Georgia, and Tennessee. https://go.usa.gov/xPCPB
		9/12	15	RECALL ALERT: Don't eat Gravel Ridge Farms cage-free large eggs. These eggs have been recalled because they are linked to an outbreak of 14 *Salmonella* infections in Alabama and Tennessee. Learn more: https://go.usa.gov/xPCPB
		9/13	4	*Salmonella* outbreak: Do you have recalled Gravel Ridge Farms cage-free large eggs at home? Throw them out or return them. Wash and sanitize refrigerator drawers and shelves that held these eggs. https://go.usa.gov/xPCEK
		10/2	35	Outbreak update: An outbreak of *Salmonella* infections linked to shell eggs now includes 38 ill people. Don't eat, serve, or sell cage-free large eggs from Gravel Ridge Farms. Recalled eggs were sold in Alabama, Georgia, and Tennessee. https://go.usa.gov/xPCPB
		10/4	18	RECALL ALERT: Check your fridge for Gravel Ridge Farms cage-free large eggs. These eggs have been recalled because they are linked to an outbreak of 38 *Salmonella* infections in 7 states. Learn more: https://go.usa.gov/xPCPB

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TABLE 1. Types of CDC Web announcements for multistate foodborne outbreaks, outbreak vehicles, and number of comments (cont.)

Type of announcement	Outbreak vehicle	Posting date in 2018 (mo/day)	No. of comments	Facebook post
Food safety alert	Deli ham	10/4	33	OUTBREAK NOTICE: CDC and partners are investigating an outbreak of 4 *Listeria* infections in 2 states linked to deli ham. Don't eat, serve, or sell recalled deli ham from Johnston County Hams, Inc. Recalled ham includes country ham and was sold under several brand names. Learn more here: https://go.usa.gov/xPkBz
		10/6	31	RECALL ALERT: Don't eat recalled deli ham (including country ham) from Johnston County Hams, Inc., sold under various brand names. This ham is linked to an outbreak of 4 *Listeria* infections. If you don't know if your ham is recalled, check with your store: https://go.usa.gov/xPkBz
	Ground beef	10/5	23	RECALL ALERT: Ground beef produced by JBS Tolleson, Inc. has been linked to an outbreak of 57 *Salmonella* infections in 16 states. Do not eat, serve, or sell recalled beef labeled with "EST. 267" inside the USDA mark of inspection. Return it to the store or throw it away. https://go.usa.gov/xPkun
		10/7	30	CDC, USDA-FSIS, and several states are investigating a multistate *Salmonella* outbreak linked to recalled ground beef. The recalled products were sold nationwide at many stores. Look for ground beef in your home labeled with establishment number "EST. 267" inside the USDA mark of inspection. Do not eat recalled ground beef. Return it or throw it away. https://go.usa.gov/xPkun
		10/23	31	RECALL REMINDER: Check your fridge and freezer for ground beef labeled with "EST. 267," usually found inside the U.S. Department of Agriculture mark of inspection. Do not eat this recalled ground beef. Return it to the store or throw it away. It is linked to 120 *Salmonella* infections in 22 states. https://go.usa.gov/xPkun
		11/15	100	GROUND BEEF RECALL: Check your freezer for ground beef labeled with "EST. 267," usually found inside the USDA mark of inspection. Do not eat this recalled ground beef. Return it to the store or throw it away. It is linked to 246 *Salmonella* infections in 25 states. Recalled beef was sold in chain retail locations and local stores nationwide. It was packaged from July 26, 2018 to September 7, 2018. https://go.usa.gov/xPkun
		12/4	112	GROUND BEEF OUTBREAK UPDATE: 5 million more pounds of products recalled. Check your freezer for ground beef labeled with "EST. 267," usually found inside the USDA mark of inspection. Do not eat this recalled ground beef. Return it to the store or throw it away. Recalled beef was sold in chain retail locations and local stores nationwide. It was packaged from July 26, 2018 to September 7, 2018. https://go.usa.gov/xPkun
	Tahini	11/28	32	RECALL ALERT: Tahini products from Achdut Ltd. might be contaminated with *Salmonella*. Products were sold under several brand names, with expiration dates of April 7, 2020 to May 21, 2020. Return tahini to the store or throw it away. https://go.usa.gov/xPFKb

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TABLE 1. Types of CDC Web announcements for multistate foodborne outbreaks, outbreak vehicles, and number of comments (cont.)

Type of announcement	Outbreak vehicle	Posting date in 2018 (mo/day)	No. of comments	Facebook post
Food safety alert	Romaine lettuce	11/20	1,646	*E. COLI* OUTBREAK: Do not eat, serve, or sell ANY romaine lettuce while investigation continues. This includes whole heads of lettuce, hearts of romaine, chopped romaine, organic romaine and salad mixes with romaine. Romaine linked to 32 *E. coli* O157 infections in 11 states. https://go.usa.gov/xPAy5
		11/23	28	OUTBREAK ALERT: If you have romaine lettuce at home, including whole heads and hearts of romaine, chopped romaine, organic romaine and salad mixes with romaine, don't eat it and throw it away. If you don't know if the lettuce is romaine, don't eat it. https://go.usa.gov/xPAy5
		11/26	69	*E. COLI* OUTBREAK UPDATE: Do not eat, serve, or sell ANY romaine lettuce from the Central Coastal growing regions of northern and central California. Labels with growing region will be available soon. If you don't know where the romaine lettuce is from, don't eat it. https://go.usa.gov/xPAy5
		11/28	34	Do not buy or eat romaine lettuce at a grocery store or restaurant unless you can confirm it is not from the Central Coastal growing regions of northern and central California. Package labels with growing region are coming soon. Check label before buying. https://go.usa.gov/xPAy5
		12/6	35	*E. COLI* OUTBREAK UPDATE: now 52 ill people reported from 15 states. Do not eat, serve, or sell ANY romaine lettuce from the Central Coastal growing regions of northern and central California. Some products now have labels with the growing region. Check the label to see where it's from before buying, serving, selling or eating. If you don't know where the romaine lettuce is from, don't eat it. https://go.usa.gov/xPAy5
		12/8	18	Do not buy or eat romaine lettuce at a grocery store or restaurant unless you can confirm it is not from the Central Coastal growing regions of northern and central California. Package labels with growing region are now on some products. Check the label before buying or serving. If you don't know where the romaine lettuce is from, don't eat it. https://go.usa.gov/xPAy5
		12/13	31	*E. COLI* OUTBREAK ADVICE UPDATE: Now 59 ill people reported from 15 states. Do not eat, serve, or sell ANY romaine lettuce from Monterey, San Benito, or Santa Barbara counties in the Central Coastal growing regions of northern and central California. Check the label to see where it's from before buying, serving, selling or eating. If you don't know where the romaine lettuce is from, don't eat it. https://go.usa.gov/xPAy5
		12/15	31	Do not buy or eat romaine lettuce at a grocery store or restaurant unless you can confirm it is not from Monterey, San Benito, or Santa Barbara counties in northern and central California. Check the label before buying or serving. If you don't know where the romaine lettuce is from, don't eat it. https://go.usa.gov/xPAy5
	Pork patty	11/21	29	PORK PATTY ROLL RECALL: Ready to eat pork patty rolls from Long Phung Food Products have been linked to 4 *Listeria* infections in 4 states. Do not eat, serve, or sell pork patty rolls labeled with "EST. 13561," usually found inside the USDA mark of inspection. Return it to the store or throw it away. https://go.usa.gov/xPsEw

TABLE 2. Investigation notice coding chart

Category	Subcategory	Description	Codes	Example quotes
Information sharing	Directive statement	Any statement directing another online user to check for product or share information	Telling to check; telling to share	"Check our turkey"
	Awareness statement	Any statement informing another online user of why they were tagged	Telling why tagged	"I thought of you, since you bake often."
Action	Past	Any mention of a past action relating to outbreak vehicle	Eaten; eaten and sick; purchased	"definitely used it for AJs cake lmao"
	Future	Any mention of a future action resulting from messaging	Food avoidance	"don't buy any"
Questions	Product	Any question asking about the identified outbreak vehicle	Brand; preparation; stores	"Is this Aldi brand?"
Conviction/ beliefs	Food quality	Any mention of food quality of outbreak vehicle	*Salmonella*	"Shouldn't we always assume poultry and eggs have *Salmonella*?"
	Government	Any mention of a belief held about government	Accuracy of information	"CDC is busy covering up something this week"
	Cases	Any mention of a belief held about cases in the outbreak	Poor food safety	"Wow, you actually have to cook chicken properly. Darwin takes care of those that do not."
	Food safety advice	Any mention of recommended food safety advice	Expiration	"thoroughly clean the cooking area and utensils and HANDS after handling raw poultry products."
Emotional response	Negative	Any mention of a negative emotion	Sense of worry; hopelessness; confusion	"there is nothing safe to eat. I give up!"
	Positive	Any mention of a positive emotion	Relief; appreciation	"Thank you for the heads up!"
Promoting another cause	Promoting another cause	Any mention of another cause not related to outbreak messaging	Ad; antivaccination; Lyme disease; local farm; vegetarianism	"Recall, your vaccines are killing and harming as well. You don't seem to care."

about the CDC posting. Questions commonly asked focused on outbreak investigation findings, including information on geographic location of affected areas and specific brand information for foods linked to outbreaks. The convictions and beliefs category included any comments that stated a Facebook user's preconceived notion about the outbreak, the food linked to the outbreak, or food-handling practices and often included speculations about outbreak causes. The emotional responses category included any type of emotional valence; commonly identified emotions were confusion and a sense of worry. The promoting another cause category included comments that were not related to the CDC message but rather supported another effort, such as advertisements for a product or service, vaccine hesitancy, or local food movements.

FSAs

Six multistate foodborne outbreak investigations resulted in an FSA, with a total of 22 (81%) Facebook posts *(Table 1)*. The number of posts for each outbreak investigation ranged from one to eight (five for eggs, two for deli ham, five for ground beef, one for tahini, eight for romaine lettuce, and one for pork patty). These 22 Facebook posts generated 2,454 comments (94% of all comments analyzed), with a range of 4 to 1,646 (median of 31) comments per post. One FSA related to a 2018 outbreak of Shiga toxin-producing *E. coli* infections linked to romaine lettuce was responsible for 1,646 (67%) of the 2,454 comments. Of these 1,646 comments, 362 (22%) were analyzed and coded before data saturation was reached for this post. All other comments (808 comments) for the remaining 21 FSAs were analyzed and coded. A total of 1,170 (48%) of the 2,454 comments were analyzed and coded, resulting in eight categories created from 37 unique codes *(Table 3)*.

The eight categories were information sharing, actions, questions, emotional responses, blame, food specific, promoting another cause, and unrelated. Five of the categories were the same as those identified for INs. The blame category included comments that discussed who was responsible or accountable for the outbreaks and the illnesses related to them. Common discussion topics were the lack of government regulations and/or faults in the food supply chain, including blaming the country of origin or contamination in the manufacturing process. The food-specific category included codes that appeared only for postings associated with the ground beef or romaine lettuce outbreak posts. Comments unique to ground beef posts conveyed users' inability to identify product associated with the outbreak. Multiple Facebook users stated that they stored their ground beef without the original packaging, preventing them from using the lot code information provided in the Facebook post to identify the potentially contaminated ground beef. Topics of comments unique to romaine lettuce posts were focused on in-store product observations (e.g., product still available for sale after the outbreak announcement), packaging labels that identified the region in which the romaine lettuce was grown, and potential sources of contamination (e.g., agricultural water and fecal contamination from farmworkers). The unrelated category included comments that did not relate to the outbreak post, such as jokes and puns.

Comparing categories between INs and FSAs

No meaningful differences were found when comparing the categories from INs with those from FSAs. Five common categories were identified between the two types of posts: (i) information sharing, (ii) actions, (iii) questions, (iv) emotional responses, and (v) promoting another cause.

DISCUSSION

Risk communication is a critical part of the overall public health response effort during a foodborne outbreak. Social media channels such as the CDC's Facebook page provide a convenient and powerful platform for disseminating risk messages to an online following of > 3.8 million users. Given the size of the audience, post creators should know how users react to and use the CDC Facebook posts so that future messaging can be adjusted if needed.

When comparing Facebook users' responses to INs with those to FSAs, many of the same categories of comments emerged. One explanation could be that there were not enough INs to compare with FSAs during the period of interest. More than 4 times as many Facebook posts and 15 times as many comments on Facebook posts resulting from FSAs compared with those from INs; more differences may have been detected if the number of Facebook posts and comments had been similar. Another explanation for this finding could involve the content of the messages for Facebook posts that result from INs and FSAs. Although the two types of Web-based communication tools are distinct, the Facebook posts that result from them sometimes overlap in message content. For example, INs for the outbreaks linked to turkey and cake mix *(Table 1)* both had recall messaging within their corresponding Facebook post; recall messaging is more often associated with an FSA. When to use an IN versus an FSA is determined by health communicators and investigators that are involved in the outbreak. Because the course of each outbreak investigation is unique, the messages in the Facebook posts resulting from them have the potential to overlap, as seen in these examples. Given this overlap, readers exposed to this messaging may not recognize the distinction between FSAs and INs and are likely to focus on message content more than the tool used to create the message.

The goal of risk communication during an outbreak is to inform consumers of actions they can take to protect themselves; success is associated with timely, accurate information being disseminated to the appropriate audience so that the recommended actions can be taken. This evaluation was conducted to evaluate risk communication success with a qualitative approach by (i) uncovering ways in which Facebook users help increase the reach of messaging during

TABLE 3. Food safety alert coding chart

Category	Subcategory	Description	Codes	Example quotes
Information sharing	Directive statement	Any statement directing another online user to check for product or share information	Telling to check; telling to share	"can you check ours?"
	Awareness statement	Any statement informing another online user of why they were tagged	Telling why tagged; reposting information	"I know you love your tahini"
Action	Past	Any mention of a past action relating to outbreak vehicle	Eaten; eaten and sick; purchased; found product; doesn't buy	"maybe this is why we're always sick it's too late we already ate it"
	Future	Any mention of a future action resulting from messaging	Food avoidance	"Or maybe we just never buy or eat romaine again??? It's kinda looking that way!!!"
Questions	Product	Any question asking about the identified outbreak vehicle	Brand; stores; refund	"Where does Aldis buy their ground beef from?"
	Outbreak	Any question asking about the outbreak details	Source; inspection process; states affected; quantity of recalls/ outbreaks	"How does *E. coli* get into the lettuce?"
Emotional response	Negative	Any mention of a negative emotion	Sense of worry; hopelessness; frustration	"Ugh! We just ate tacos tonight made of ground beef! Dang it"
	Positive	Any mention of a positive emotion	Appreciation	"Thank you for this notification."
Promoting another cause	Promoting another cause	Any mention of another cause not related to outbreak messaging	Ad; antivaccination; firearms; local farm; vegetarianism	"Stop eating meat"
Unrelated	Unrelated	Any mention of an unrelated topics not relating to the outbreak	Another outbreak; Jokes/sarcasm/pun	"Lettuce pray"
Blame	Supply chain	Any mention of fault of outbreak to any part of the food supply chain	Origin of product; industry; farm	"This is why U.S. food is not allowed in UK or EU. CDC need to sort out food safety and quality, industry is not doing enough."
	Government	Any mention of fault of outbreak to any part of government law or oversight	Government	"This is the result of cutting regulations. Cut out regulations = cut out safety. Smh."
Food specific	Romaine lettuce	Any codes identified relating to only romaine lettuce postings	Source of problem–water policy, defecation in fields; retailer observations–product availability, new labeling	"The question is, we know the water used on this lettuce is the source..."
	Ground beef	Any codes identified relating to only ground beef postings	Unable to act–freezing without information	"Hard to know when we repack it into freezer bags."

a multistate foodborne outbreak, (ii) identifying commonly sought information during an outbreak, and (iii) validating that recommended actions are being taken.

Message dissemination

Although this evaluation did not include examination of quantitative measures of message dissemination, it did provide qualitative insight into how Facebook users help to increase the reach of CDC foodborne outbreak messages, as revealed by the information sharing code. Users commonly tagged others and shared CDC messaging with specific people they thought the message was relevant to. Through Facebook, the CDC communicates outbreak messages to consumers, regardless of whether they consumed the implicated food. Facebook users helped to further target the message by identifying others who might consume these foods and therefore might need to hear the message the most. When users tagged others, they commonly left a comment justifying why they tagged that individual. These justifications often included situations in which the tagged user may have consumed and/or purchased a contaminated product.

Questions asked by Facebook users

Facebook users responded to foodborne outbreak messages by asking questions to further clarify a message. These questions often concentrated on geographic and brand information and were important because they potentially highlight part of the message that needed further clarification and/or could be indicators of the type of information consumers seek during a foodborne outbreak. The questions asked by users probably were part of an assessment of an individual's own risk so they could determine whether the outbreak affected them. By asking questions about geographic locations of the outbreak and specific brands of food implicated in the outbreak, Facebook users were most likely comparing that information to where they live, where they purchased food, and the brands they commonly bought. The Health Belief Model is a social behavioral science theory that has been widely applied to a variety of public health topics and interventions *(8)*. One major articulation of this model is that perceived susceptibility and perceived seriousness, which together create perceived risk, is a large driver of behavior change *(2, 5, 12)*. Although this theory was not used to develop the qualitative coding scheme in this study, we hypothesize that the answers to these commonly sought questions about the CDC's messaging influence these constructs of perceived risk. The emotional response category comprised multiple codes for negative emotions, including a sense of worry and hopelessness. Negative emotions could be an indicator of perceived risk, although the degree of salience of these emotions could not accurately be determined in this analysis. Further efforts to analyze comments on social media platforms should consider using the Health Belief Model to frame a deductive coding strategy.

Creating messaging that always includes the type of information that consumers seek can be difficult. Outbreak investigators are not always able to identify the source of an outbreak, and even when a source is identified, specific brands of contaminated food and all locations where the contaminated food was distributed and sold may not be known. In this analysis, the source of contaminated romaine lettuce that led to a large outbreak of *E. coli* O157 infections was ultimately narrowed only to a particular growing region, making messaging to consumers challenging *(3)*. Sometimes foods linked to outbreaks are not labeled with brand information, have this information only on small stickers that can easily be missed (e.g., a fresh fruit or vegetable), or the identifying information is on packaging that is thrown away when storing the food (e.g., ground beef repackaged for freezing). These factors can make it difficult for consumers to know whether they have purchased a food linked to an outbreak and whether they need to take an action (e.g., throwing the food away rather than consuming it). To implicate a food as the source of an outbreak, investigators rely on interviews conducted with ill people who report foods they ate before they became ill. Often, ill people do not remember all of the foods they consumed or cannot remember specific information such as brands, making it difficult to narrow the investigation to a specific food *(11)*. Even when a specific food or specific brand of food is linked to an outbreak, identifying all places where it was sold is challenging and takes time. Companies commonly source foods (e.g., chicken) as ingredients for highly processed foods (e.g., chicken salad), requiring regulatory authorities to trace foods through complicated supply chains to identify all foods impacted by an outbreak and where the food was sold *(15)*.

Actions reported by Facebook users

Comments referring to actions that Facebook users took suggested that the CDC's messaging related to multistate foodborne outbreaks was successful for the people they reached. The goal of outbreak messaging is to reach all consumers who purchased a product implicated in an outbreak so that they can make informed choices and take recommended actions to prevent illness. Overall, comments left by Facebook users generally aligned with recommendations from the CDC. Facebook users left comments indicating actions they had taken before reading the message (e.g., purchased or ate outbreak-associated food) and what actions they would take as a result of reading the message (e.g., checking for or throwing away outbreak-associated food and practicing other food safety behaviors). In some instances, Facebook users noted that they had already gotten sick after eating the food.

Although reported actions were consistent with recommendations from the CDC, users also reported recommended actions they could not take. This lack of action was most apparent for comments associated with ground beef-related outbreak posts that were coded and included in the food-specific

category. Multiple Facebook users stated that they stored their ground beef without the original packaging, preventing them from using the lot code information provided in the Facebook post to identify the potentially contaminated ground beef. The inability to identify contaminated food could result in people unknowingly eating it and possibly becoming sick or throwing away food that is not contaminated. These types of comments provide the opportunity to identify outbreak-specific barriers to taking recommended actions. If the CDC could monitor comments in real time, such barriers could be identified, which could inform illness prevention strategies, such as educational campaigns or improvements in product labeling and packaging, and potential adjustments in outbreak messaging.

Although these actions reported in Facebook comments were not observed in an individual's physical environment, reported actions observed on virtual platforms such as Facebook are becoming increasingly credible as social media platforms continue to be integrated into daily life across the globe *(10, 16)*. Findings from this analysis suggest that messaging is successful for the individuals reached; however, it is unclear how many consumers who purchased or consumed foods implicated in each multistate foodborne outbreak are receiving the CDC's outbreak messaging. This determination is important for risk mitigation because taking recommend actions can decrease a person's chances of consuming contaminated food. Further evaluation efforts should focus on examining message dissemination to ensure messaging reaches all consumers of products implicated in outbreaks.

Limitations

This qualitative evaluation was not intended to be generalizable to the overall population. Comments analyzed were from individuals who commented on the CDC's Facebook page; both the content of the comments and Facebook users themselves may differ from the content of comments and Facebook users who do not follow or engage with the CDC's Facebook page. People who follow or engage with the CDC's Facebook page may already be more interested in health information than people who do not. People who commented on the CDC's Facebook page and the perceptions they shared on Facebook may not be representative of the overall population. In addition to lack of generalizability, significant differences were found in the number of outbreaks, Facebook postings, and comments resulting from FSAs compared with INs. For INs, three outbreaks resulted in five Facebook postings and 158 comments (median of 21 comments per post), whereas for FSAs six outbreaks resulted in 22 Facebook postings and 2,454 comments (median of 31 comments per post). Meaningful differences between responses to FSAs and INs may have been found if the number of outbreaks, Facebook postings, and comments had been more different between these communication types. Because we analyzed written comments rather than data from interviews with people, our analysis had two additional limitations: (i) the accuracy and degree of emotions in the emotional category and codes within it might have been misclassified and (ii) themes could not be developed. Additional context around comments would have been needed to interpret emotions (e.g., whether comments were sarcastic) and determine who was responding to the CDC messaging and why they responded.

Public health implications

Qualitative analysis of social media conversations is becoming increasingly relevant as public health entities increase utilization of these platforms to communicate important health messages. Facebook and other social media platforms also provide access to a large volume of data collected from a wide audience, and these data are hard to obtain with traditional data collection methods. Results of these analyses can be used to (i) quickly identify frequently asked questions that need to be addressed, (ii) uncover aspects of critical public health messaging that may be poorly understood or misunderstood by the public, and (iii) identify information that is most important to the public and ultimately drives action. Findings gleaned from these types of analyses can be used to improve future communication efforts and lay a foundation for future risk communication research.

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REFERENCES

1. Aboulhosn, S. 2020. 18 Facebook statistics every marketer should know in 2020. Available at: https://sproutsocial.com/insights/facebook-stats-for-marketers/. Accessed 3 August 2020.
2. Becker, M. H. 1974. The health belief model and personal health behavior. Slack, Thorofare, NJ.
3. Bottichio, L., A. Keaton, D. Thomas, T. Fulton, A. Tiffany, A. Frick, M. Mattioli, A. Kahler, J. Murphy, M. Otto, A. Tesfai, A. Fields, K. Kline, J. Fiddner, J. Higa, A. Barnes, F. Arroyo, A. Salvatierra, A. Holland, W. Taylor, J. Nash, B. M. Morawski, S. Correll, R. Hinnenkamp, J. Havens, K. Patel, M. N. Schroeder, L. Gladney, H. Martin, L. Whitlock, N. Dowell, C. Newhart, L. F. Watkins, V. Hill, S. Lance, S. Harris, M. Wise, I. Williams, C. Basler, and L. Gieraltowski. 2020. Shiga toxin-producing *Escherichia coli* infections associated with romaine lettuce–United States, 2018. *Clin. Infect. Dis.* 71:323–330.
4. Centers for Disease Control and Prevention. 2016. Foodborne outbreaks public communication. Available at: https://www.cdc.gov/foodsafety/outbreaks/investigating-outbreaks/index.html. Accessed 3 August 2020.
5. Champion, V. L., and C. S. Skinner. 2008. Health behavior: theory, research, and practice. Jossey-Bass, San Francisco.

6. Crowe, S. J., B. E. Mahon, A. R. Vieira, and L. H. Gould. 2015. Vital signs: multistate foodborne outbreaks–United States, 2010–2014. *Morb. Mortal. Wkly. Rep.* 43:1221–1225.

7. Erlingsson, C., and P. Brysiewicz. 2017. A hands-on guide to doing content analysis. *Afr. J. Emerg. Med.* 7:93–99.

8. Glanz, K., and D. B. Bishop. 2010. The role of behavioral science theory in development and implementation of public health interventions. *Annu. Rev. Public Health* 31:399–418.

9. Glaser, B. G., and A. L. Strauss. 1967. The discovery of grounded theory: strategies for qualitative research. Aldine, Chicago.

10. Graham, L. T., C. J. Sandy, and S. D. Gosling. 2011. Manifestations of individual differences in physical and virtual environments, p. 773–800. *In* T. Chamorro-Premuzic, S. V. Stumm, and A. Furnham (ed.), Handbook of individual differences. Wiley-Blackwell, New York.

11. Marshall, K. E., T. Nguyen, M. Ablan, M. C. Nichols, M. P. Robyn, P. Sundararaman, L. Whitlock, M. E. Wise, and M. A. Jhung. 2020. Investigations of possible multistate outbreaks of *Salmonella*, Shiga toxin-producing *Escherichia coli*, and *Listeria monocytogenes* infections–United States, 2016. *Morb. Mortal. Wkly. Rep.* 69:1–14.

12. Rosenstock, I. 1974. Historical origins of the health belief model. *Health Edu. Monogr.* 4:328–335.

13. Saunders, B., J. Sim, T. Kingstone, S. Baker, J. Waterfield, B. Bartlam, H. Burroughs, and C. Jinks. 2018. Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual. Quant.* 52:1893–1907.

14. Thomas, D. 2003. A general inductive approach for qualitative data analysis. *Am. J. Eval.* 27:2–11.

15. U.S. Food and Drug Administration. 2016. FDA investigated *Listeria* outbreak linked to frozen vegetables. Available at: https://www.fda.gov/food/outbreaks-foodborne-illness/fda-investigated-listeria-outbreak-linked-frozen-vegetables. Accessed 3 August 2020.

16. Webb, E. J., D. T. Campbell, R. D. Schwartz, L. Sechrest, and J. B. Grove. 1981. Nonreactive measures in the social sciences. Houghton Mifflin, Boston.