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PEER-REVIEWED ARTICLE

Food Protection Trends, Vol 36, No. 2, p. 133-139

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Accuracy and Readability of Information about Human Noroviruses in Food Safety Education Materials Targeting Consumers

ABSTRACT

Human noroviruses (HuNoV) cause an estimated 58% of foodborne disease in the U.S. One widely used approach to preventing foodborne disease is education and training of food handlers from farm to table. Our aim was to determine the accuracy and readability of food safety education materials targeting consumers with information about HuNoV. Our search of the USDA Food Safety Education and Training database yielded 144 artifacts that met our inclusion criteria. Only 9 specifically mentioned HuNoV. Information regarding length of handwashing, type of drying device, and avoidance of bare-hand contact with ready-to-eat foods was missing from 93, 117, and 140 artifacts, respectively. Only two recommended minimizing contact with sick persons, while eight discouraged sick individuals from preparing food for others. None had recommendations for vomit and fecal matter clean-up, nor did any mention a concentration of sodium hypochlorite (bleach) solution to disinfect surfaces contaminated with HuNoV. The mean Flesch Reading Ease score, a measure of readability, was 39.4, indicating that a university degree is needed to read the materials included in our sample. If we are to reduce the burden of illness associated with HuNoV, consumers need easy-to-read written materials on known prevention and control strategies.

INTRODUCTION

Human noroviruses (HuNoV) sicken millions of Americans each year and are the most common cause of foodborne disease *(41)*. A 2013 national survey revealed that fewer than half of U.S. adults have heard of HuNoV, and most have little knowledge of how to prevent and control HuNoV infections *(13)*.

In 2011, the Centers for Disease Control and Prevention (CDC) published guidelines for preventing and controlling HuNoV in semi-closed environments, such as long-term care facilities, hospitals, restaurants, schools, and cruise ships. The guidelines focus on three areas of prevention and control: (1) hand hygiene, (2) exclusion and isolation of sick individuals, and (3) environmental sanitation *(25)*.

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Although these guidelines were not specifically designed for use in home settings, we believe they are at present the best source of science-based information to guide development of consumer education materials.

One publicly accessible database of food safety education materials is the United States Department of Agriculture (USDA) Education and Training Materials Database, where professionals such as Cooperative Extension agents can access food safety education materials targeting consumers *(48)*. It is important to periodically evaluate public resources such as those in the USDA database, to ensure that materials contained therein are accurate and based on the best available scientific evidence. Inaccurate information could lead to the adoption of unsafe practices. The aim of our study was to determine the accuracy and readability of information about HuNoV in food safety materials targeting consumers that were included in the USDA database. We defined accuracy as alignment with the CDC guidelines *(25)*. Readability was determined using the Flesch Reading Ease formula. We believe our findings can guide food safety educators in the improvement of existing materials or the creation of new materials that address HuNoV.

MATERIALS AND METHODS

The USDA Education and Training Materials Database was chosen as a source for our sample because it is a publicly accessible source of food safety education materials. During the summer of 2013, all materials included in this database (n = 1,089) were screened to locate materials that met our eligibility criteria: pertain to food safety in the home, be written in English, target adult consumers, and be formatted in an easily accessible manner. Materials in obsolete or inaccessible formats (e.g., VHS tapes, textbooks, etc.), or that did not meet the eligibility criteria, were excluded. Several eligible materials were comprised of multiple individual items. All individual items included for analysis are hereafter called artifacts. Artifacts available online were downloaded as Portable Document Format (PDF) files. Other artifacts, such as DVD videos, were purchased online or rented from a library.

A coding manual was created comprised of 71 items, divided into four categories: (1) identifying information; (2) format, including Microsoft Word readability statistics; (3) content, including food safety hazards; and (4) prevention and control strategies. A corresponding SurveyMonkey® instrument comprised of all 71 items was used as the coding sheet so that entries were automatically collated. Four trained coders independently conducted a pilot test of the coding manual. Inconsistencies or ambiguities found in the manual during the pilot test were corrected before analysis began.

Two trained coders, who participated in the pilot coding exercise, independently coded each artifact. All responses were exported from the SurveyMonkey® instrument to an Excel spreadsheet. A third, new coder then reconciled discrepancies. The final agreed-upon responses for each artifact became the final dataset for analysis.

In analyzing the content of each artifact, we used the CDC guidelines to assess each artifact's alignment with CDC's published standards. We used the FDA 2013 Food Code (50) to provide guidance on drying devices used after handwashing, as recommendations for drying were not included in the CDC guidelines. To determine alignment, each artifact was given a total score *(Table 1)*. Subscores were also given for each of the three prevention and control strategies — proper hand hygiene, isolation and exclusion of sick persons, and environmental sanitation. The maximum possible scores for these categories were 7, 2, and 5, respectively. Response frequencies for select coding manual items as well as mean score and standard deviation for each of the three areas, were calculated using SAS 9.3 (SAS Institute, Inc., Cary, NC).

Readability was determined using the formula for the Flesch Reading Ease scoring available in Microsoft Word. Another available score for readability is the Flesch-Kincaid Grade Level which "uses mean sentence and word length to determine grade level [between grades 3 and 12]" *(17)*. However, the first metric, the Flesch Reading Ease score, is more widely accepted by government agencies for establishing educational material reading levels, so we only used this metric.

RESULTS AND DISCUSSION

In the summer of 2013, the USDA Education and Training Materials Database contained a total of 1,089 items. Our screening yielded 116 items that met our eligibility criteria. We excluded 27 items because they were duplicates, unavailable, or in an inappropriate format, and/or did not target adult consumers. Of the 89 items reviewed, 6 contained multiple individual items, yielding an additional 82 individual artifacts. Upon close examination of the additional 82 individual artifacts, 21 were excluded because they were duplicates or unavailable, or did not target adult consumers.

A total of 144 artifacts comprised our sample for further content analysis. The mean score for accuracy was 2.4 out of a possible 14 points *(Table 2)*. Public institutions (e.g., universities, government or health agencies) were the source of 101 artifacts, whereas private institutions (e.g., companies, non-profit organizations) were the source of the remaining 43 artifacts. Publication dates ranged from 1995 to 2013. Most artifacts were fact sheets (n = 94), videos (n = 26), or curricula (n = 8).

Presence of information about HuNoV

Seventy-two percent (n = 103) of the artifacts mentioned bacteria, but only 22 percent (n = 31) mentioned the word "virus" or a term that contained the word "virus." Of those, only nine mentioned the word "norovirus." This is not surprising, because bacteria were thought to be the major cause of foodborne disease for many years. HuNoV are in fact the most common cause of foodborne disease worldwide. In the U.S., more than two-thirds of all foodborne gastroenteritis outbreaks are attributed to HuNoV infections

Table 1. Scoring key for determining alignment of infection control strategies with CDC guidelines and/or FDA 2013 Food Code

Coding Manual Question	Accurate Recommendation	Source of Recommendation	Score
Hand Hygiene			
Is handwashing stated?	Yes	CDC Guidelines	1
What is the duration for handwashing?	10–15 seconds *or* 20 secods or greater[a]	FDA 2013 Food Code CDC Guidelines	1
What type of drying device is recommended?	Paper towels	FDA 2013 Food Code	1
	Mechanical dryer	FDA 2013 Food Code	1
Are hand sanitizers mentioned?	Yes	CDC Guidelines	1
Are hand sanitizers stated to be an acceptable alternative for hand-washing?	No	CDC Guidelines	1
Is avoiding bare-hand contact with ready-to-eat foods mentioned?	Yes	CDC Guidelines	1
		Maximum Possible Score	**7**
Isolation and Exclusion of Sick Individuals			
Is minimizing contact with persons when they are sick mentioned?	Yes	CDC Guidelines	1
Are sick persons discouraged from preparing food for others?	Yes	CDC Guidelines	1
		Maximum Possible Score	**2**
Environmental Sanitation			
Are there recommendations for cleaning vomit?	Yes	CDC Guidelines	1
Are there recommendations for cleaning fecal matter?	Yes	CDC Guidelines	1
Is it mentioned that bleach solutions must be freshly prepared for use within 24 hours?	Yes	CDC Guidelines	1
Is a concentration of bleach solution to be used to clean up vomit or fecal matter suggested?	Yes	CDC Guidelines	1
Is a method/procedure for cleaning vomit or fecal matter provided?	Yes	CDC Guidelines	1
		Maximum Possible Score	**5**

[a]If an artifact recommended washing hands for either 10–15 seconds (recommeded by the FDA 2013 Food Code) or 20 seconds or greater (recommended by the CDC Guidelines), the artifact was given a score of 1.

(11), which cause approximately 23 million cases each year *(34)*. Norovirus outbreaks are commonly identified in populations including restaurant patrons *(9, 18)*, children *(19, 37)*, the elderly *(24)*, the immunocompromised *(40)*, military personnel *(27, 43)*, and travelers to developing countries *(1, 30)*, as well as passengers on cruise ships *(51)*, residents of healthcare facilities such as nursing homes *(12, 24)* and hospitals *(29)*, and other populations housed in close quarters *(53)*.

Accuracy of hand hygiene strategies

Although all 144 artifacts mentioned hand hygiene, the mean subscore for hand hygiene was low—2.3 of 7 *(Table 2)*. Most did not include information about length of handwashing or type of drying device. One artifact recommended washing hands for ten to fifteen seconds, and 34% (n = 49) recommended washing for more than twenty seconds. While the CDC recommends more than twenty seconds *(25)*, the FDA Food Code recommends ten to fifteen seconds *(50)*. Moreover, few published studies assessed reduction of viruses by washing hands with soap and water. Three studies demonstrated that one length of washing is not necessarily better than another *(2, 32, 44)* and one reported that handwashing is more effective than alcohol-based hand rubs *(47)*. At present, there is no consensus on how long hands should be washed, so it is not surprising that many

Table 2. Scoring of artifacts by prevention and control strategy

Prevention and Control Strategy	Criteria	Artifacts		Maximum Possible Score	Mean Score	Range (Min-Max)	Standard Deviation
		n	%				
Hand Hygiene	Mention of handwashing, suggested duration, soap and type of soap, drying device, hand sanitizer, hand sanitizer efficacy, or bare-hand contact with ready-to-eat foods	144	100%	7	2.3	1–5	1.1
Isolation and Exclusion of Sick Individuals	Suggestion to minimize contact with persons during infectious periods or discouragement of sick persons from preparing food for others	9	6.3%	2	0.17	0–2	0.28
Environmental Sanitation	Recommendations for cleaning vomit or cleaning fecal matter, preparing fresh sodium hypochlorite solution, preparing correct concentration of sodium hypochlorite solution, or procedures for cleaning vomit or fecal matter	0	0%	5	0	0	0
Total		**144**	**100%**	**14**	**2.4**	**1–6**	**1.2**

consumer education materials do not include statements about length of hand washing.

Drying hands is another important step in proper hand washing. Less than 20% (n = 25) of the artifacts recommended using paper towels to dry hands, while eleven recommended using cloth towels. Studies have shown that paper towels remove pathogens from skin after handwashing *(26, 28, 45)*; the friction created by rubbing hands with paper towels can remove 30–90% of bacteria on hands *(39, 45)*. Cloth towels, which are believed to be commonly used in household settings, could harbor pathogens, including viruses, which could re-contaminate hands if used to dry hands after washing *(5, 33)*. However, presumably few households will have paper towels in bathrooms, so cloth towels are likely to be used in that setting. Therefore, consumer education materials should emphasize that when one is sick, it is best to use paper, not cloth, towels, to dry hands after washing.

In foodservice settings, avoiding all bare-hand contact with ready-to-eat foods, such as sandwiches, salads, and fresh produce, is recommended, as bare hands could be vehicles for transferring pathogens to ready-to-eat foods *(8, 23, 42)*. Only four artifacts mentioned avoiding bare-hand contact with ready-to-eat foods, which is not surprising. In commercial and institutional food settings, use of single-use gloves is recommended. However, it is unrealistic to expect consumers to use single-use gloves when handling ready-to-eat foods in their own home, so emphasis should be placed on how and when to properly wash and dry hands while preparing foods at home rather than on avoiding all bare-hand contact with ready-to-eat foods.

Accuracy of isolation and exclusion strategies

The mean score for isolation and exclusion of sick persons was 0.17 of a possible 2 points *(Table 2)*. It is critical to isolate and exclude sick persons in settings where people congregate, such as long-term care facilities or childcare centers, to prevent the spread of pathogens. Obviously, one cannot exclude sick individuals from their own homes, but sick persons can isolate themselves from other healthy household members. Only eight artifacts discouraged sick individuals from preparing food for others, and only two mentioned minimizing contact with healthy persons while sick. HuNoV can be present at high levels in stool (about 10^{10} particles/mL) and vomitus (about 10^{4} particles/mL) of infected individuals, and even after symptoms have resolved, infected individuals could be shedding high numbers of viral particles in their stool *(3, 4)*. The CDC recommends consumers not prepare food for others while sick and for at least three days after symptoms have stopped *(14)*. Materials targeting consumers should discourage persons experiencing vomiting or diarrhea, two common symptoms of a HuNoV infection, from preparing food for others, and should encourage restriction of contact with healthy individuals.

Accuracy of environmental sanitation strategies

The mean score for environmental sanitation was 0 of a possible 5 points, suggesting a critical gap in current consumer education materials *(Table 2)*. Published outbreak reports have clearly shown that environmental surfaces can be sources of HuNoV *(15, 22, 31, 52)*, so proper disinfection of surfaces (food-contact and nonfood-contact) is important for interrupting transmission and preventing future cases of HuNoV infection.

Because vomit and fecal matter are highly concentrated sources of HuNoV, we focused exclusively on disinfection of surfaces contaminated with HuNoV and not on the routine sanitization/disinfection of surfaces. At present, the only way to eliminate HuNoV from a surface is to disinfect using an U.S. Environmental Protection Agency registered disinfectant with a claim for HuNoV at an appropriate concentration *(49)*. Sanitizers are commonly used to routinely treat food-contact surfaces. However, when a food-contact surface is contaminated with vomit or fecal matter, it must be disinfected, not sanitized, as sanitizers will not eliminate HuNoV *(20, 25)*. Consumer materials must clearly describe the differences between sanitizers and disinfectants and which of the two is appropriate to use after contamination events, so that consumers use the correct products after contamination events.

No artifacts mentioned what to do when a surface is contaminated with HuNoV via vomit or fecal matter. Episodes of vomiting or diarrhea must be handled carefully to limit transmission of the virus to others. General steps for cleaning up vomit or fecal matter include: (1) removing the vomit or diarrhea from the surface immediately, (2) washing the surface with soap and water, (3) rinsing thoroughly, (4) drying with paper towels, (5) disinfecting the surface with an appropriate product for the correct contact time, and (6) rinsing the food-contact surface with water before use *(46)*. Using the appropriate disinfectant at an appropriate concentration is essential for ensuring the elimination of HuNoV. Food safety materials must include detailed information about how to properly disinfect surfaces in the home that have been contaminated by vomit and/or fecal matter.

Bleach can be used as both a sanitizer and a disinfectant, so the concentration needed to clean up surfaces contaminated with vomit and fecal matter must also be included in consumer education materials. According to the CDC, contaminated or potentially contaminated surfaces should be disinfected with a bleach solution having a concentration of 1,000–5,000 ppm *(25)*. It has been well documented that bleach solutions at sufficient concentrations can eliminate HuNoV from contaminated surfaces *(5, 7, 20, 36)*. However, the potency and effectiveness of bleach solutions decrease over time because of evaporation *(16)*, so it is important to use a freshly prepared bleach solution. It is possible that the authors of the materials included in our sample believed that information on cleaning up vomit and fecal matter is not needed because these events would presumably occur in a bathroom rather than in a kitchen. This is a significant oversight, because HuNoV can survive on hard surfaces (food-contact or nonfood-contact) for many weeks *(21)*, serving as a source of HuNoV. Thus, disinfection of all surfaces that are contaminated with vomit and fecal matter should be addressed in consumer education materials.

Readability using Flesch Reading Ease scores

Because of the lack of transcription (no transferable, written narrative) for some materials analyzed, we were able to evaluate only 93 of the 144 materials for the Flesch Reading Ease score. These artifacts had a mean score of 39.4 (SD = 27.5) of a possible 120 points. According to D'Alessandro, Kingsley, and Johnson-West, "The Flesch Reading Ease ranges from 0 to 100, with a lower score being more difficult to read than a higher score. It uses sentence length and polysyllabic words to determine difficulty… A score of 70 or above is described as 'easy' and is written at the grade school level. A score of 60 to 70 is described as 'standard' and is written at the high school level. A score of 60 or below is described as 'difficult'" *(17)*. Thus scores between 60 and 70, considered "standard," are suitable for the average thirteen- to fifteen-year-old. An artifact with a score less than 60 is considered "difficult" to read and suitable only for college graduates *(17)*.

Approximately 58 million individuals in North America are classified as limited-skill readers, who can read but cannot read well *(10)*. Limited-skill readers can read if the material uses familiar vocabulary, logical organization, and an uncluttered layout. Even when information is accurate, if it is not presented in a manner that can be read and understood, it will not be effective. Thus, ensuring ease of reading is paramount in developing educational materials. As many of the materials in our sample currently stand, a reader must have a university education to comprehend them. According to the Federal Plain Language Guidelines, the primary goal is to "write for your audience," suggesting that materials should be tailored to more specific audiences than just the general population *(38)*. For instance, the Federal Plain Language Guidelines recommend writing materials at an 8th grade reading level only if the intended audience is composed of 8th grade students *(38)*. However, the National Institutes of Health recommend writing materials within a 6th to 7th grade reading level *(35)*. Thus, we believe that those materials that are targeting the general population, such as those in our sample, should be written such that anyone, whether a highly educated or a limited-skill reader, can understand. Moreover, we believe additional analyses of the materials should be performed using tools like the CDC Clear Communication Index *(6)* and/or the Federal Plain Language Guidelines *(38)*.

Limitations

Since we gathered our artifacts in the summer of 2013, the items we analyzed might not be representative of what is now included in the USDA Food Safety Education and Training

Database today. To analyze the readability of the artifacts in our sample, we used the statistics available through Microsoft Word. Although this method is generally accepted, it is not comprehensive, as it considers only word and sentence length, and does not consider audience, purpose, or communication characteristics that are known to contribute to clarity and comprehension.

CONCLUSIONS/RECOMMENDATIONS

Food safety education materials need to be improved, particularly as they relate to the prevention and control of HuNoV within homes. Materials should accurately present prevention and control strategies for HuNoV in addition to the more well-known strategies for control of bacteria in consumers' kitchens. The primary gap that we discovered in most materials was the lack of information about how to properly clean and disinfect surfaces contaminated by vomit or fecal matter within the home, particularly in the kitchen and eating areas. Such information is critical to control the spread of HuNoV in the homes of consumers. Also, the materials in our sample were written at a university level, which makes them too difficult for many general consumers to understand. This indicates that with the addition of certain critical pieces of information, most of the educational materials that address food safety for the general consumer within the USDA Education and Training Materials Database could be better suited to educate the public if they were adjusted to a lower-than-college-grade reading level. Therefore, we believe materials need to be revised or new materials created. However, even if materials within the database are improved, most U.S. consumers might not access those materials on their own; their exposure to information might be limited to their interactions with food safety professionals or the media. We believe that such critical information about food safety in the home, particularly as it relates to HuNoV, should be made widely available and more easily accessible. Future research should examine the use of public service announcements (PSAs) to widely disseminate food safety information about HuNoV. Also, because the World Wide Web is accessible to more of the U.S. population than any other information resource, research is needed to evaluate information about HuNoV as it relates to food safety provided to consumers via the World Wide Web.

ACKNOWLEDGMENTS

This work was funded through a grant from the U.S. Department of Agriculture, National Institute of Food and Agriculture, Agriculture and Food Research Initiative, "Building Capacity to Control Viral Foodborne Disease: A Translational, Multidisciplinary Approach," Grant No. 2011-68003-30395.

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