



Norovirus on cruise ships: Motivation for handwashing?

Jeffrey J. Fisher^{a,*}, Barbara A. Almanza^b, Carl Behnke^b, Douglas C. Nelson^b, Jay Neal^c

^a Department of Human Environmental Studies, Central Michigan University, 196 Ojibway Court, Mount Pleasant, MI, 48859, USA

^b Department of Hospitality and Tourism Management, Purdue University, 900 West State Street, West Lafayette, IN, 47907-2059, USA

^c Conrad N. Hilton College of Hotel and Restaurant Management, University of Houston, 4450 University Drive, Houston, TX, 77204-3028, USA

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ABSTRACT

The cruise industry is the fastest growing segment of the travel industry. Concurrent with its growth is the challenge of mitigating the risk associated with illness outbreaks onboard ships. Norovirus is the leading cause of shipboard illnesses. This study examined the efficacy of the protection motivation theory (PMT) for predicting passengers' intentions toward handwashing in the context of norovirus disease incidence. The results of this study indicated that people were willing to engage in protection motivation in order to avoid the communicated threat. The threat appraisal construct and coping appraisal construct were both analyzed. Overall, the protection motivation theory explained 58% of the variability in handwashing intention. The coping appraisal construct significantly predicted handwashing intention. The strongest predictor for handwashing intention was cost. Furthermore, this study revealed a need for continued educational efforts directed at passengers because almost one-third of respondents indicated that they had no prior knowledge of norovirus.

1. Introduction

While norovirus is the leading cause of shipboard disease outbreaks according to the Centers for Disease Control and Prevention (Table 1, Centers for Disease Control and Prevention, 2017), handwashing is one of the best ways to prevent norovirus infections (Centers for Disease Control and Prevention, 2016b). In fact, the World Health Organization (2001) estimates that handwashing could reduce diarrheal disease-associated deaths by up to 50%. Moreover, although most people claim they wash their hands when they should, an observational study of public handwashing indicated that improvement is needed (Borchgrevink et al., 2013).

A great deal of research has been conducted on handwashing of food handlers during norovirus outbreaks (Todd et al., 2010). Less has been done on the handwashing behaviors of consumers during an onboard outbreak. Chimonas et al. (2008) suggested the source of cruise ship outbreaks was embarking asymptomatic passengers. Neri et al. (2008) confirmed this with a study of three outbreaks that determined all ships had passengers embark while ill.

Norovirus outbreaks are most common when people are indoors, from November to April, although they can occur year-round (Centers for Disease Control and Prevention, 2016b). Norovirus outbreaks are prevalent in long-term care and other health-care facilities, restaurants and catered events, schools and institutional settings, as well as cruise ships and other transportation settings (Hall et al., 2011). Once

exposed, infected people are initially asymptomatic even though they are contagious. This period usually lasts between 24 and 48 h; however, symptoms can develop as early as 12 h after exposure. Typical symptoms include nausea, abdominal cramping, headaches, muscle aches, vomiting and diarrhea (Food and Drug Administration, 2014).

Norovirus is easily spread from person-to-person contact with sick passengers, touching contaminated surfaces, and ingesting aerosolized particulates (Centers for Disease Control and Prevention, 2013). While an infected person sheds billions of norovirus particulates from the gastrointestinal tract, ingesting as few as 18 particulates is enough to make someone ill (Teunis et al., 2008). Norovirus may remain in a person's feces for two weeks or more after the initial infection. Transmission can occur with improper handwashing after using the bathroom (Centers for Disease Control and Prevention, 2016c).

Although norovirus was recognized in 1929 by Zahorsky (Zahorsky, 1929) who described it as the winter vomiting disease, only recently has norovirus received significant attention. The genus name *norovirus* is derived from Norwalk virus. In 1968, norovirus received its name after an outbreak at an elementary school in Norwalk, Ohio (Adler and Zickl, 1969). It was not until the 1990s that a detection method called *reverse transcription-polymerase chain reaction* (RT-PCR) was discovered and then used as a diagnostic test for norovirus (Jiang et al., 1992). Very few outbreaks were attributed to norovirus prior to the availability of RT-PCR. In fact, an investigation by the CDC of more than 2500 food-borne outbreaks between 1993 and 1997 attributed less than 1% to

* Corresponding author.

E-mail address: fish2jj@cmich.edu (J.J. Fisher).

Table 1
History of outbreaks on cruise ships.

Year	Norovirus	Unknown	<i>E. Coli</i>	<i>Salmonella</i>	<i>Cyclospora</i>	<i>C. perfringens</i>	Total
2017	8	2				1	11
2016	10	1	1, 1***				13
2015	12						12
2014	7	1	1***				9
2013	8		1				9
2012	15		1***				16
2011	10	2	2				14
2010	8	6					14
2009	10	3	1**		1		15
2008	13		2				15
2007	17	5		1*			23
2006	32	4	1				37
2005	14	4		1			19
2004	17	18	1				36
Total	181	46	12	2*	1	1	243

Note: adapted from “Outbreak updates for international cruise ships” by Centers for Disease Control and Prevention, 2017.

* Tested positive for *Shigella*, *Salmonella*, *Enterobacter* and *Entamoeba histolytica*.

** Tested positive for *E. coli* and *Shigella*.

*** Tested positive for *E. coli* and Norovirus.

norovirus; while 68% were identified as unknown (Olsen et al., 2000). After the discovery of RT-PCR, the percentage of outbreaks attributed to norovirus increased to almost 50% (Widdowson et al., 2005).

Norovirus outbreaks are a concern because of the potentially serious health risks. In the United States norovirus causes an estimated 5.5 million illnesses, 14.5 thousand hospitalizations, and 150 deaths annually (Centers for Disease Control and Prevention, 2016a). Globally, norovirus is the leading cause of acute gastroenteritis with an estimated 685 million illnesses and 50,000 deaths each year (Centers for Disease Control and Prevention, 2016d).

Consequences of an outbreak are economic as well as health related. In the United States, norovirus is one of the top five foodborne pathogens impacting the economy. The Economic Research Service (2014) estimates the following annual cost of illness for healthcare and lost productivity for the top five pathogens in billions: (1) *Salmonella* (nontyphoidal) \$3.7, (2) *Toxoplasma gondii* \$3.3, (3) *Listeria* \$2.8, (4) Norovirus \$2.3, and (5) *Campylobacter* \$1.9. Due to its high-profile nature and the associated health and economic costs, an outbreak on-board a cruise ship is taken very seriously. Both the government and the cruise industry are seeking ways to improve the safety of cruising.

This study examined whether protection motivation theory (PMT) could be applied as a useful framework for investigating the factors that positively influence intention to engage in handwashing practices during a cruise ship outbreak. Protection motivation theory was developed to improve the understanding of fear appeals and their motivating effect on an individual's attitude and behavior change (Rogers, 1975). In PMT, a fear-inducing stimulus (in this study – a norovirus outbreak on a cruise ship) was coupled with a recommended healthy behavior (in this study – handwashing) that may help the individual avoid the danger. The following questions were researched:

RQ1. Is protection motivation theory a useful framework for understanding passengers' handwashing intentions?

RQ2. What is the effect of a simulated norovirus outbreak on passengers' protection motivation?

RQ3. Which activities were most likely avoided during a simulated norovirus outbreak?

2. Protection motivation theory

The protection motivation theory (PMT) first appeared in the Journal of Psychology in 1975. PMT was developed to understand fear appeals and the effect on attitude change (Rogers, 1975). The theory postulated that fear motivates an individual's attitude towards behavior change. The stimulus that induces the fear was often related to a

healthy behavior. A recommended alternative was presented to the individual that communicates a message that the danger associated with the fear may be avoided by a change in behavior. In 1983, the theory was revised to test a combined model of protection motivation theory and self-efficacy theory (Maddux and Rogers, 1983). According to Boer and Seydel (1996), “protection motivation is a mediating variable whose function is to arouse, sustain, and direct protective health behavior” (p. 98). Protection motivation is measured by behavioral intention.

Protection motivation is the combined outcome of the threat appraisal construct and coping appraisal construct. The threat appraisal construct is comprised of *severity* and *susceptibility*: *severity* is related to the amount of harm perceived by an individual in response to a threat; and *susceptibility* is whether an individual perceives that the threat will happen to them (Boer and Seydel, 1996). The coping appraisal construct includes *response-efficacy*, *self-efficacy*, and *cost*: *response-efficacy* is an individual's perception as to the recommended behavior's effectiveness at eliminating the threat; *self-efficacy* is an individual's belief that he/she can comply with the recommended healthy behavior; and *cost* relates to the barriers that prohibit a person from completing the prescribed behavior (Maddux and Rogers, 1983).

PMT has been successfully used in a variety of health communication appeals. Thus, the hypotheses examined the effects of a simulated norovirus outbreak on passengers' protection motivation (see Fig. 1). In accordance with PMT, we hypothesized the following:

Hypothesis 1. When a norovirus outbreak occurs, passengers are likely to have increased perception of *severity* compared to pre-stimulus perceptions.

Hypothesis 2. When a norovirus outbreak occurs, passengers are likely to have increased perception of *susceptibility* compared to pre-stimulus perceptions.

Hypothesis 3. When a norovirus outbreak occurs, passengers are likely to have increased perception of *response-efficacy* towards handwashing compared to pre-stimulus perceptions.

Hypothesis 4. When a norovirus outbreak occurs, passengers are likely to have increased perception of *self-efficacy* towards handwashing compared to pre-stimulus perceptions.

Hypothesis 5. When a norovirus outbreak occurs, passengers will perceive a lower level of handwashing *cost* compared to pre-stimulus perceptions.

Hypothesis 6. Handwashing intention significantly increases during a

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