

Summer 2013

# Hand hygiene: Behavior changes in college students

Claire Evelyn Ballweg  
*James Madison University*

Follow this and additional works at: <https://commons.lib.jmu.edu/honors201019>

---

## Recommended Citation

Ballweg, Claire Evelyn, "Hand hygiene: Behavior changes in college students" (2013). *Senior Honors Projects, 2010-current*. 383.  
<https://commons.lib.jmu.edu/honors201019/383>

This Thesis is brought to you for free and open access by the Honors College at JMU Scholarly Commons. It has been accepted for inclusion in Senior Honors Projects, 2010-current by an authorized administrator of JMU Scholarly Commons. For more information, please contact [dc\\_admin@jmu.edu](mailto:dc_admin@jmu.edu).

Hand Hygiene: Behavior Changes in College Students

---

A Project Presented to  
the Faculty of the Undergraduate  
College of Health and Behavioral Studies  
James Madison University

---

in Partial Fulfillment of the Requirements  
for the Degree of Bachelor of Science

---

by Claire Evelyn Ballweg

August 2013

---

---

Accepted by the faculty of the Department of Health Sciences, James Madison University, in partial fulfillment of the requirements for the Degree of Bachelor of Science.

FACULTY COMMITTEE:

HONORS PROGRAM APPROVAL:

---

Project Advisor: Georgia NLJ Polacek,  
Ph.D.,  
Associate Professor, General Education and  
Health Sciences

---

Barry Falk, Ph.D.,  
Director, Honors Program

---

Reader: Stephanie Baller, Ph.D.,  
Assistant Professor, Health Sciences

---

Reader: Sharon Babcock, Ph.D.,  
Associate Professor, Biology

## Table of Contents

List of Figures	3
Acknowledgments	4
Introduction	5
Literature Cited	8
Methods	17
Results	22
Discussion	27
Conclusion	31
Appendix A.	32
References	34

## List of Figures

### Tables

1	Dorm information and assignments	17
2	Demographics for control students	18
3	Demographics for intervention students	18
4	Significant attitude and behavior data	22
5	Significant knowledge data	23
6	Free response pre-test data	25
7	Free response post-test 1 data	25
8	Free response post-test 2 data	26

## **Acknowledgments**

I would like to express a sincere appreciation to my advisor, Dr. Georgia Polacek, she continually encouraged and supported me throughout this thesis. Without her guidance, vast knowledge of health, and continual help, this thesis would not have been possible.

I would like to thank my readers, Dr. Stephanie Baller and Dr. Sharon Babcock, whose comments and advice on this work have helped me greatly improve the quality of my thesis.

I thank James Madison University's Honors Program and Dr. Barry Falk for a small grant as financial support towards implementing the interventions required for this study.

## Introduction

Maintaining good hand washing habits has the capability to save more lives than any single vaccine (Centers for Disease Control and Prevention [CDC], 2011). The FDA states unwashed hands are critical modes of disease transmission (Nadakavukaren, 2011). Hand washing is one of the easiest and best ways to prevent diarrheal diseases and pneumonia. Public health authorities recommend a thorough washing and scrubbing of the hands before meals, during meal preparations, and after using the toilet (Nadakavukaren, 2011). Washing should last for at least twenty seconds, using soap and water (CDC, 2011). Scrubbing under the fingernails, between the fingers, and the wrists is the most important. The small steps of hand washing may not seem important, but these methods greatly contribute to cleanliness and disease prevention.

For the purpose of comprehension of this study, hand washing habits will be defined as the rituals and consistencies a person has when and if they wash their hands. Improved hand washing habits include an increase in the duration of hand washing and/or an increase in the frequency of hand washing after or before appropriate activities (like after using the restroom or before eating). Movements their ritual contains, use of soap and water, as well as the point in time of washing (after certain activities or before certain activities) were included. Hand hygiene habits were considered more encompassing, taking hand sanitizer into account. A hand washing intervention was defined as a session and/or series of events attempting to alter and improve a student's hygiene habits. Knowing the specific definitions of these terms clarified the purposes and uses in this study.

Hand washing becomes a major issue in dense living quarters and food preparation (Nadakavukaren, 2011). When people are together and share many objects, germs can spread even faster, such as in a college dorm. Hand hygiene is a simple way to prevent the spread of disease, but unfortunately many people choose to not comply. During outbreaks of infectious diseases, hand washing habits improve and frequency increases (Fung & Cairncross, 2007). During the severe acute

respiratory syndrome (SARS) outbreak, people in outbreak cities had a significantly higher frequency of hand washing, compared to those cities that were not affected (Fung & Cairncross, 2007).

Though the outbreak of SARS ended and hand washing habits slowly returned to the previous rate, the initial improvement is promising. Well being is always at risk when people do not wash their hands, not just during a disease outbreak. This is one type of approach to an intervention to try to improve hand washing habits.

While some interventions have proven to be somewhat successful, the effects of multi-faceted research on hand hygiene is in need of further investigation. Some methods of intervention have been thoroughly researched. One study utilized glowing hand gel given to subjects, which fluoresced germs on their hands under a black light (Fishbein, Tellez, Lin, Sullivan, & Groll, 2011). Trying to frighten people with the amount of germs on their hands is an attempt at a moderate scare tactic. Another study used a gross factor approach which focused on sharing with the volunteers all of the 'gross' germs and filth that can be on a person's hands (Botta, Dunker, Fenson-Hood, Maltarich, & McDonald, 2008). Neither of these two studies provided the subjects with any extra factual information, beyond the basic scare/gross factors. Both of the studies saw only a portion of participants changed their hand washing habits. Using multiple intervention strategies may influence more subjects to change their habits, as these would appeal to a wider audience. For example, those who are visual might enjoy and learn from a video and change their behavior while those who are conceptual may learn more from facts and diagrams.

In order to prevent disease, it is important that the general population improves hand hygiene habits, however this behavior change will require the right motivation. Further research on improving hand washing hygiene is needed. Therefore the present study will attempt to determine if a multi-faceted approach to improving hand hygiene has an effect on college students' behavior at James Madison University.

To properly determine if a multi-faceted method to advance hand washing will affect college student habits, the existing knowledge about hand washing hygiene must be understood. Greater pre-existing knowledge could influence a student's resulting habit change. Therefore an initial survey was administered and taken into consideration during the statistical analysis. Furthermore, to eliminate any extraneous variables, it was important to ascertain if students exposed to the intervention improved their hand washing habits significantly compared to those students who were not exposed to any intervention. Half of the subjects were kept as controls, only exposing them to a pre and post survey. To have the ability to control extraneous variables, the research was limited to freshman dorms at James Madison University.

Interventions are performed to assist and influence student behavior so as to improve their hand hygiene habits. Reinforcement is a vital in maintaining hand washing habits; just one intervention may only temporarily improve those habits (Farrell, Savage, & O'Leary, 2008). This study was unable to incorporate multiple interventions, and this factor should be taken into consideration when comparing the pre and post survey statistics. In an ideal study, multiple interventions/reminders would take place over time in order to continue the reinforcement of the importance of hand hygiene. Hypothetically, there may be an intervention or factor that could permanently improve a person's hygiene habits, and ultimately that is the goal of all studies on hand washing. Since this is unrealistic, the most practical goal for researchers is to strive for increasing awareness and initiation of the behavior change. Therefore the main purpose of this study was to determine if a multi-faceted hand washing intervention would improve college student's hand hygiene habits.



## Literature Review

Hand washing behavior is important on college campuses because of the close living quarters and the ease with which germs can be spread in the community. To influence or facilitate a change in hand washing habits, a structured plan with a theory of behavior change should be utilized. The Health Belief Model (HBM) is a psychological model used to explain and predict behaviors (Rosenstock, 1974). The HBM is based on six constructs describing perceived threats, benefits, and the subject's confidence (Rosenstock, 1974). Constructs include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Rosenstock, 1974). The HBM is an appropriate theory to use on hand washing because it focuses on value and expectancy (Sharma & Romas, 2012). The model is predictive, it is used to tell what people are expected to do and as a guide for interventions (Sharma & Romas, 2012).

The first construct is perceived susceptibility and is defined as the belief a person has about their chances of acquiring a disease or other health related harmful state due to a certain behavior (Sharma & Romas, 2012). Perceived susceptibility is highly dependent on the knowledge the individual has, the more they know about the behavior, the more realistic their perceived susceptibility is. With hand washing, individuals need to know the true risks of not performing this behavior. One research article discusses knowledge and practice of hand washing in hospitals (Farrell et al., 2008). Healthcare associated illness is a problem but can be prevented through interventions aimed at increasing knowledge and improving habits of healthcare professionals (Farrell et al., 2008). However, knowledge and awareness require reinforcement, it does not necessarily last (Farrell et al., 2008). Reinforcement poses a substantial limitation for studies designed as one-time interventions. Initial effectiveness of the intervention may diminish over time due to individuals who believe their susceptibility has decreased; they therefore need to be reminded of the reality.

Ott and French (2009) reviewed past interventions and concluded improvements need to be made in hand hygiene for health care staff and student nurses. The researchers concluded that, in addition to interventions that presented educational material on hygiene, interventions with other approaches were also successful, like using media or including participation (Ott & French, 2009). Multifaceted and repeated interventions were found to be more effective, thus utilizing the perception of threat and cues to action. The effectiveness of this method provides useful information on what kind of intervention to perform for further studies, a multi-faceted one.

The hand hygiene habits of college students were assessed, through a survey, in a group who had *Streptococcus* (Thumma, Aiello, & Foxman, 2009). Typical results showed that more females than males washed their hands frequently (6 or more times) during the day (Thumma et al., 2009). However only a small portion of both males and females reported washing their hands before eating (Thumma et al., 2009). Even when a student is sick, they still do not necessarily understand their susceptibility to disease and the harmful health consequences when they do not wash their hands and keep good hygiene habits.

The attitudes and responses of students and faculty towards a pandemic were obtained, since universities are more susceptible for outbreaks (Van et al., 2010). The researchers concluded students and faculty are not worried about pandemics until the disease takes a turn for the worst (Van et al., 2010). They also concluded health education is needed for students and faculty to learn to isolate themselves during infections (Van et al., 2010). If students are more knowledgeable about health habits from general health education, they will benefit more from an intervention. Those who are being exposed to the information for the first time in an intervention may not fully understand the truth about their susceptibility to diseases as consequences from not maintaining good hygiene habits.

The second construct of the HBM is perceived severity, which is the belief a person has about the harshness of the harmful consequences a person can experience due to the behavior (Sharma & Romas, 2012). Perceived severity is dependent on the knowledge the individual has and obtains. To ensure realistic expectations, it is important to be specific with the consequences that are taught to college students so it is more difficult to exaggerate or diminish them. An intervention was conducted at three chiropractic schools to assess whether or not the students changed their hand hygiene habits and whether or not those changes were due to the intervention (Marion et al., 2009). The intervention concentrated on five areas of health education: intrapersonal, interpersonal, community, institutional policies, and laws (Marion et al., 2009). The conclusion was that the intervention increased the student's habits and knowledge level (Marion et al., 2009). Part of this positive impact was most likely due to students learning the truth about the severity of the consequences that they could experience due to not washing their hands.

Hand washing behaviors of students were observed at a university and conclusions on the variance in their behaviors by race, gender, and having an observer present, were made (Monk-Turner et al., 2005). More women (85%) than men (69%) washed their hands and more women tended to use soap (Monk-Turner et al., 2005). Women may have more knowledge about the severity of the consequences of not using soap. However men who did wash their hands, washed them for longer than women (Monk-Turner et al., 2005). These factors should be taken into consideration when forming future surveys for a study; it indicates that demographic questions should be included.

Taylor, Basco, Zaied, and Ward (2010) attempted to raise awareness and increase frequency of hand washing. To conduct this study, students were observed in the restroom and observations were made whether they washed their hands (water or water and soap). They were asked to complete a survey on exiting the restroom and many students who did not wash their hands gave

the wrong answers to the knowledge questions (Taylor et al., 2010). The association shows students who do not know the severity of the consequences of not washing their hands are less inclined do so.

In an alternative study, new student nurses were out in a simulated health scenario and were evaluated on their safety behavior with a checklist (Gantt & Webb-Corbett, 2010). Some of the behaviors that were observed include hand hygiene, introductions, informed consent signed, professional attire, etc. (Gantt & Webb-Corbett, 2010). Most students omitted typical patient safety behaviors including hand hygiene showing students will not practice good hygiene habits if they do not have enough knowledge on the severity of bad hygiene.

The third construct is perceived benefits, the belief a person retains of the positive outcomes or usefulness of the recommendations regarding a behavior (Sharma & Romas, 2012). False perceptions of benefits can be fought with specificity in hand washing instructions demonstrating the exact benefit. Previous knowledge an individual has about the correct hand washing methods and benefits will affect their behavior. A study was conducted on the Simons College campus to relate upper respiratory infections with hand washing habits (Scott & Vanick, 2007). Residential students were less likely to wash their hands after activities and more likely to have an upper respiratory infection (Scott & Vanick, 2007). Residential students may not understand or value the benefits of washing their hands. Surgeoner, Chapman, and Powell (2009) conducted a study on whether or not students in a residence hall followed the recommended hand hygiene strategies during a norovirus outbreak. Only 17.4% of the students followed the strategies but 83.0% reported in a survey that they were following the hand hygiene technique (Surgeoner et al., 2009). Surgeoner et al. (2009) concluded the effect and acceptance of health promotion methods depends on whether the nature of the message is truly compelling and convincing. Sometimes students do not perceive

that there is a great benefit from participating in hand hygiene methods unless there is a persuasive message.

The first purpose of the Tousman et al. (2007) study was to determine if second graders would improve their hand washing habits with a learner-centered program, and the second was to determine the overall success of the program. The program utilized “Glitterbug”® where the children could see, under a blacklight, the germs that were left on their hands (Tousman et al., 2007). Seventy-nine percent of parents said they did not have to remind their children to wash their hands (Tousman et al., 2007). Being able to see the physical germs and the results after washing allowed children to see direct benefits of washing hands, which was effective in improving their hand hygiene.

The fourth construct is perceived barriers, or the belief an individual carries about the actual and false obstacles they will encounter with the specified behavior (Sharma & Romas, 2012). While knowledge is a factor in this construct, attitude also contributes to the perception. The more an individual knows about a behavior, the more they will be able to accurately predict barriers of that behavior. But if they are not interested or inclined toward this behavior, they may try to find more barriers and excuses to deter them from participating in the behavior. With hand washing, students may say there was no soap in the bathroom or that they were running late, both are not true barriers but contributions of their attitudes of not being interested in changing their hand washing habits.

According to a study by Devnani, Kumar, Sharma, and Gupta (2012), one obstacle to good hand washing is inadequate facilities. In order to assess these claims, the study gave a checklist to patients to assess the facilities and 26.80 % of the sinks did not have a soap dispenser or the soap dispenser was broken (Devnani et al., 2011). If a study is to be done on how much students wash their hands or whether they use soap or not, it may be helpful to make sure the soap dispensers are working and filled with soap! In overcoming barriers, it is important to assess attitude and

knowledge. One article reflects and describes an intervention strategy known as the “5<sup>th</sup> guy” where a student carried around a fake urinal to represent that one in five guys does not wash their hands after going to the bathroom (Sander, 2008). Thirty hand-sanitizer stations were set up around the campus at the same time, but according to the faculty, it did not seem like the students were utilizing the stations (Sander, 2008). The method demonstrates that scare tactics do not necessarily result in improved hand hygiene in young adults and adults without a knowledge base. Maybe if the hand sanitizers displayed facts about hand washing and disease students would be more compelled to use them.

Sevim and Sema (2008) provided educational material to nursing students and observed how the information was applied through a survey. According to the survey, nursing students washed their hands at a lower frequency than the number of patients they saw (Sevim & Sema, 2008). Many of the students reported the reason for not washing their hands with as much frequency was due to unsuitable conditions (Sevim & Sema, 2008). Adequate hygiene facilities are necessary to improve on hand washing habits, but students may perceive them as a bigger barrier than they actually are. Limiting factors need to be taken into consideration when performing future interventions, surveys, and studies on hand washing. Another article describes a study conducted in residence halls, four dorms were chosen for an experimental group and four for a control group (White, Kolble, & Carlson, 2005). The experimental groups received an intervention on the importance of hand hygiene and also received Purell hand sanitizer (White et al., 2005). The survey data asked about the subjects’ behaviors regarding hand hygiene, exercise, nutrition, sleep behavior, stress, and exercise (White et al., 2005). These questions allow for other factors to be taken into consideration, and barriers to be revealed students are experiencing based on other factors in their life.

The fifth construct is cues to action, which are the internal or external forces that trigger the individual to start (or stop) the behavior (Sharma & Romas, 2012). This construct is based on an

individual's behaviors. Some students need a reminder about the importance of washing their hands, and that will keep them participating in the behavior. In a study conducted by Anderson et al. (2008), college students were observed in different settings, one setting included hand washing visual prompts. Visual prompts improved hand washing only in students in the "other" ethnic category (Anderson et al., 2008). The visual prompts/cues to action could help to improve some hand washing habits in future interventions. A different type of cue to action was researched by Botta et al. (2008). In a college student focus group, students responded more to gross factors (such as urine on hands) than facts about germs and becoming sick (Botta et al., 2008). The information was utilized to create an intervention that focused on these gross factors. Both females and males improved hand washing after the intervention, while control dorms stayed the same for females and decreased for males (Botta et al., 2008).

Social pressures are another type of potential influence on a person's hand washing habits. Edwards et al. (2002) secretly observed subjects in a restroom, but revealed himself at times to determine whether having an observer present would influence habits. Women being observed were more likely to wash their hands (Edwards et al., 2002). Knowing gender can affect a response is useful in forming survey questions and determining observation techniques. Different age groups can also be more responsive to different cues to action. Researchers performed an intervention in the pediatric waiting room of the emergency room department (Fishbein et al., 2011). Subjects were randomly administered glow gel hand sanitizer and shown the germs on their hands under a blacklight (Fishbein et al., 2011). They were administered a survey and then were called back 2-4 weeks later to repeat the demonstration (Fishbein et al., 2011). A significant amount of the children improved in their hand washing habits, however there was no significant change in the parents' habits (Fishbein et al., 2011). Interventions need to be directed towards the subjects at hand. Adults

may not be as affected by the glow technology as children, but more affected by facts about illness and germs.

Miller, Yardley, and Little (2012) implemented a program that utilized the Internet to promote hand washing and good hygiene behaviors to reduce transmission of upper respiratory infections. There was a 'low-threat' group that only learned some of the effects of pandemics and a 'high-threat' group that received education on all the negative effects of a pandemic (Miller et al., 2012). The 'high-threat' group became more serious about hand washing and intended to improve their hygiene more than the 'low-threat' group (Miller et al., 2012). Some extent of scare tactics may encourage better hand hygiene habits and act as cues to action. One very important cue to action is disease. In order to determine attitudes, behaviors, and motivation for university students during a pandemic, a survey was administered to students asking about the attitudes and behaviors of interest (Park, Cheong, Son, Kim, & Ha, 2010). The study concluded that during the H1N1 pandemic, the students increased and improved their hand washing habits (Park et al., 2010). Future studies can utilize this information; the results could be skewed if an intervention was unknowingly carried out during a pandemic.

The final construct is self-efficacy, or an individual's confidence in themselves in having the ability to perform a certain behavior (Sharma & Romas, 2012). There are many ways to improve and increase self-efficacy in an individual, including training and demonstrations, setting progressive goals, verbal reinforcement, and anxiety reduction (Sharma & Romas, 2012). While most students will not have low self-efficacy about hand washing, others may not be sure they can perform the actions correctly or believe they will forget to wash their hands. By performing a set of questionnaires and home interviews, one study analyzed the connection between college selectivity and student health (Fletcher & Frisvold, 2011). The study was longitudinal and continued with questionnaires and interviews after the subjects had graduated college (Fletcher & Frisvold, 2011).



Fletcher & Frisvold 2011 found a connection between more selective colleges and better health in the students, as well as a general correlation between higher education and healthier habits. Students in better colleges having a higher self-efficacy about being able to perform tasks in general, including hand washing. While this study focused on smoking and obesity, the same idea could be applied to hand washing health.

Students at a nursing school attended an infection control lecture with information on how to properly wash hands (Magaldi & Molloy, 2010). They were named “ambassadors” and were required to observe health professionals and educate the professionals if they were washing their hands wrong (Magaldi & Molloy, 2010). Many doctors were offended and did not want to be corrected by the students, the student’s self-efficacy increased while the doctor’s decreased (Magaldi & Molloy, 2010). All individuals in a community need to be trained in order to improve their self-efficacy and disease prevention.

The Health Belief Model is an appropriate theory to apply to hand hygiene because it refers to and demonstrates how to resolve the myths and misperceptions people have about this behavior change (Rosenstock, 1974). Extensive research has been performed on hand washing, and if not directly, has indirectly utilized the constructs of the Health Belief Model. Most research, however, has found it difficult to influence the subjects for an extended period of time, or at all. The vast range of research that has been conducted on hand washing behaviors conclusively demonstrates there needs to be further investigation on which specific combination of intervention strategies best influence college students to change their hygiene behaviors.

## Methods

The participants in this research were freshman and sophomore students living in James Madison University residence halls. Resident halls were randomly selected and contact was made with Resident Advisors [RA] of the selected dorms. The intervention was considered as one of the educational activities that the RA's must host throughout the year. Once approval was obtained to solicit participants at the dorms, control and experimental dorms were randomly assigned (Table 1). The intervention was completely voluntary and students were able to attend the intervention without having to complete the surveys.

Random selection for dorms and for assigning a treatment (control or experimental) was done by first assigning the dorms a number (when they were in alphabetical order) and then a random number generator was used from the Internet to select a number. Five dorms were selected for both the control and intervention groups. Demographic information was obtained through the surveys and is displayed in Tables 2 and 3.

Flyers were posted in the experimental dorms advertising the intervention and incentives. The RA's of the experimental dorms were asked to voluntarily tell the students about the event.

**Table 1.** This table displays participating dorm information and assignments.

<i>Dorm</i>	<i>Assignment</i>	<i># students in attendance</i>	<i>Pre-Test Date</i>	<i>Post-Test Date (1)</i>	<i>Post-Test Date (2)</i>
Potomac	Control	9	2/14/2013	-	3/26/2013
Shorts	Control	9	2/18/2013	-	3/26/2013
Willow	Control	9	2/13/2013	-	3/26/2013
Wayland	Control	9	3/1/2013	-	3/26/2013
Garber	Control	9	2/19/2013	-	3/26/2013
Spruce	Intervention	4	2/13/2013	2/13/2013	3/26/2013
Dogwood	Intervention	7	2/13/2013	2/13/2013	3/26/2013
Huffman	Intervention	11	2/20/2013	2/20/2013	3/26/2013
McGraw-Long	Intervention	15	2/20/2013	2/20/2013	3/26/2013
Weaver	Intervention	8	2/27/2013	2/27/2013	3/26/2013

**Table 2.** Demographics for control students.

<i>Demographic</i>	<i>Response</i>	<i>Number of Students</i>
Age	18	24
	19	20
	20	1
Gender	Male	18
	Female	27
Year	Freshman	44
	Sophomore	1
Major	Arts and Letters	7
	Business	4
	Education	1
	Health and Behavioral Studies	7
	Integrated Science and Engineering	2
	Science and Mathematics	7
	Visual and Performing Arts	16
	Undecided	1

**Table 3.** Demographics for intervention students.

<i>Demographic</i>	<i>Response</i>	<i>Number of Students</i>
Age	18	20
	19	22
	20	3
Gender	Male	17
	Female	28
Year	Freshman	36
	Sophomore	9
Major	Arts and Letters	7
	Business	12
	Education	1
	Health and Behavioral Studies	9
	Integrated Science and Engineering	2
	Science and Mathematics	8
	Visual and Performing Arts	3
	Undecided	3

The control dorms were given the pre-test survey to complete between February 13th and March 1st of 2013. The intervention dorms were given an immediate post-test survey. All

participating dorms were given a post-test survey (same survey) after Spring Break on March 26th 2013 (Table 1). The post-test was emailed to them and contained a URL to the Qualtrics survey online. The participants were asked to provide their email when they took the pre-test (on a separate list so it was not identifiable with their survey).

The intervention was performed in the experimental dorms in February of 2013 (Table 1). As the students in the experimental dorms walked into the room where the intervention was held, the principal investigator greeted them and shook all of their hands. The students were unaware that the investigator's hand had glitter on it. Later during the PowerPoint presentation portion, it was pointed out to them that their hands, faces, and clothes has glitter on them, representing germs. After shaking hands and being greeted, they were asked to sign-in with their email and identification number so that they could be sent the post-test survey URL. After they sat down, they were given the survey as the pre-test.

The intervention then officially began and consisted of six facets. These facets were: the entertaining feature, the informative feature, the increasing awareness component, assessment of information, incentives, and reinforcement. The participants were shown the entertaining aspect of the presentation, the video, followed by the informative PowerPoint presentation (including bringing up the glitter as the increasing awareness component). At the end of the PowerPoint, quiz questions (assessment) were presented and those who answered them correctly received a prize (incentive), such as hand sanitizers, stickers, and hand washing timers. After the questions, the students completed an immediate post-test (same survey). After the intervention was concluded, hand hygiene posters (reinforcement) were posted in the bathrooms (only for hall-style bathroom dorms), in the kitchen, in the TV rooms, and hallways.

Finally the experimental students took the second post-test survey at the same time as the control students (after Spring Break). The post-test survey was sent electronically via Qualtrics, participants were emailed with the link for the survey.

### *Data Analysis*

SPSS (IBM 20) was used to analyze the survey data to determine any significant data between pre and post-tests within the experimental group, and between the experimental and control groups. To be able to match specific pre-tests with post-tests, unidentifiable codes were obtained on the survey (birth month and last three digits on JACcard #). The same code was asked for on the post-test survey so there was a comparison of individuals before and after the intervention.

To assess the constructs of the HBM, each question on the survey pertained to a certain construct. Perceived susceptibility was evaluated through questions 5, 12, 13, 18, and 19 (Appendix A). The five questions asked the subject about how often they wash their hands and to determine whether statements about the spread of disease were true or false. The student's answers demonstrated what they understood about how easily they could catch a cold or disease by not washing their hands. Perceived severity was assessed through questions 9, 14, and 15 (Appendix A). The three questions asked the subjects about increasing their habits during a disease outbreak, and to determine whether statements about specific diseases or methods of contamination were true or false. The student's opinion of how serious they think diseases are that could spread by not washing their hands is portrayed in these questions. Perceived benefits were evaluated using questions 10, 16, and 17 (Appendix A). The three questions asked the students about their opinion on the importance of washing their hands, and to determine if statements about where to wash your hands are true or false. The student's opinion on how valuable they think washing their hands will be is portrayed in these questions. The perceived barriers construct was assessed through question 6 and the written

answers to question 7 (Appendix A). Question six asked the students about their opinion on how often college students wash their hands, which showed their estimation of the costs of washing their hands depending on how many other students wash their hands. For example if a student thinks most college students do not wash their hands, they may see washing their own hands as pointless since they will be touching things all the other students touch. Question seven asks them to explain the choice they made on rating their own hand washing habits, which brought up any barriers they believed existed, like no soap available or in a hurry. Cues to action were represented by questions 8 and 11 (Appendix A). The two questions asked the student about their opinion of others who do not wash their hands and about how often they themselves are sick. The actual questions are strategies to activate students to wash their hands more because of how they feel about those who do not or to wash their hands more because they realize that they are often sick. Finally self-efficacy was evaluated through their rating of how well they wash their hands in question number 7 (Appendix A). Students can evaluate themselves through the question and determine if they have the ability to better their habits by explaining their choice. The purpose of this report is to bring awareness to health professionals, health students, college students, and University employees about the importance of washing your hands and the current habits of college students through the HBM.

## Results

Data collected from the intervention and control groups were analyzed to determine significance with paired T-Tests. Tables 4 and 5 represent the significant frequency of answers from the intervention group, separated by pre-test and the first post-test. The four questions in Table 4 evaluated a student's attitude and behavior towards hand washing. Fewer students agreed that college students have good hand washing habits, and more students disagreed ( $t(44) = 2.701, p = 0.01$ ). After the intervention, even more students disagreed. When students evaluated themselves, most agreed they had good hand washing habits. But after the intervention, more students felt neutral about their hand washing habits ( $t(44) = 2.461, p = 0.018$ ). Seven students, who had said they would not on the pre-test, said they would increase their hand washing habits during an outbreak ( $t(44) = 2.847, p = 0.007$ ). Last, more students decided hand washing was important in preventing illness after the intervention was performed ( $t(44) = 4.458, p < 0.001$ ).

**Table 4.** Significant Paired T-Test output for attitude (A) and behavior (B) questions.

Survey Question	Response	Pre-Test	Post-Test 1	<i>p</i> value
(A) 6. Most (more than 75% of) college freshman/sophomores have good hand washing habits.	Strongly Disagree	1	4	0.01
	Disagree	26	26	
	Neutral	11	10	
	Agree	7	5	
	Strongly Agree	0	0	
(B) 7. I have good hand washing habits.	Strongly Disagree	1	1	0.018
	Disagree	2	1	
	Neutral	10	17	
	Agree	25	21	
	Strongly Agree	7	5	
(B) 9. Do you increase your hand washing habits during a disease outbreak, or when a roommate is ill?	Yes	36	43	0.007
	No	9	2	
(A) 10. How important do you believe hand washing is in preventing illness?	Important	30	42	0.001
	Somewhat Important	13	3	
	Not Important	2	0	

The three questions in Table 5 evaluated student’s knowledge about hand washing. Question 13 asked the students to determine if a statement about common infections was true or false. Eight students who thought the statement was false during the pre-test learned it was true during the intervention and responded accordingly during the post-test ( $t(44) = 3.084, p = 0.004$ ). After students were presented with the information about more serious infections, such as Hepatitis A, only three students still thought these infections could not be prevented by proper hand washing ( $t(44) = 6.205, p < 0.001$ ). Only one student thought hand-sanitizer is a better way of washing hands on the post-test ( $t(44) = -2.602, p = 0.013$ ).

**Table 5.** Significant Paired T-Test output for knowledge questions.

Survey Question	Response	Pre-Test	Post-Test 1	<i>p</i> value
13. Common infections caused by germs passed from one person to another include diarrhea, vomiting, and viruses.	True	35	43	0.004
	False	10	2	
14. More serious infections, such as Hepatitis A and viral meningitis, can be prevented by proper hand washing.	True	21	42	0.001
	False	24	3	
19. Using hand-sanitizer is a better and more effective way of washing your hands.	True	7	1	0.013
	False	38	44	

The survey asked two open-ended questions. The first asked the students to “Please explain the reasoning for your choice for the statement, I have good hand washing habits.” For the previous question they were given five options ranging from strongly agree to strongly disagree. The responses to the question ranged from washing their hands after using the bathroom and before eating, to just washing their hands when they deem necessary, to not washing their hand. The codes used for the answers included, I wash after using the bathroom, I wash my hands a lot/well, I wash my hands when necessary, I wash my hands after the bathroom AND before I eat, I do not always wash my hands, I do not wash for 20 seconds, I do not know/because, I could wash them better.



The themes used were when a student washed their hands (I wash after using the bathroom, I wash my hands after the bathroom AND before I eat, I do not always wash my hands) and how a student washed their hands (I wash my hands a lot/well, I wash my hands when necessary, I do not wash for 20 seconds, I do not know/because, I could wash them better). For the pre-test, most intervention students (16 out of 45) said they just wash their hands after using the bathroom while most control students (10 out of 45) said they wash their hands a lot/well (Table 6). The answers to the post-test seemed to be more evenly spread with 5 out of 19 intervention saying they wash their hands after using the bathroom and 6 out of 16 controls saying the same. Very few students said they wash their hands before eating a meal (7 intervention and 4 control for the pre-test, 4 intervention and 1 control for the post-test). And if they reported they did wash their hands before eating a meal it was always paired with washing after using the restroom (Tables 6-8).

The second question asked the students “If you are in the restroom and see someone not wash their hands, what is your reaction?” The responses to the open-ended question ranged from disgust to anger to indifference. The codes used for the answers were disgust/horrified, ew/gross, indifferent, assume they are in a hurry, anger, good (glad/happy). The themes were indifference (indifferent, assume they are in a hurry, and good) and gross (disgust/horrified, ew/gross, and anger). In both the intervention and the control groups, most students said they would have an ew/gross reaction to this situation (Tables 6 & 8). Otherwise most answers were evenly spread and about the same amount between control and intervention except for indifference. On the pre-test survey, more students in the intervention group (13 versus 6) said they would be indifferent to this situation than the control group. The same results occurred in the post-test survey, but to a much smaller degree (3 intervention versus 1 control) (Table 8).

**Table 6.** Free response code and number of answers for survey questions four and five, Pre-Test.

7. Please explain the reasoning for your choice for the statement “I have good hand washing habits.”	Intervention	Control	8. If you are in the restroom and see someone not wash their hands, what is your reaction?	Intervention	Control
I wash after using the bathroom	16	6	Disgust/Horrified	10	10
I wash my hands a lot/well	10	17	Ew/Gross	20	23
I wash my hands when necessary	6	10	Indifferent	13	6
I wash my hands after the bathroom AND before I eat	7	4	Assume they are in a hurry	2	0
I do not always wash my hands	4	2	Anger	0	5
I do not wash for 20 seconds	1	5	Good (glad/happy)	0	1
I do not know/because	1	1			
I could wash them better	0	0			

**Table 7.** Free response code and number of answers for survey questions four and five, Post-Test 1.

7. Please explain the reasoning for your choice for the statement “I have good hand washing habits.”	Intervention	8. If you are in the restroom and see someone not wash their hands, what is your reaction?	Intervention
I wash after using the bathroom	16	Disgust/Horrified	10
I wash my hands a lot/well	11	Ew/Gross	24
I wash my hands when necessary	5	Indifferent	10
I wash my hands after the bathroom AND before I eat	5	Assume they are in a hurry	1
I do not always wash my hands	1	Anger	0
I do not wash for 20 seconds	1	Good (glad/happy)	0
I do not know/because	1		
I could wash them better	5		

**Table 8.** Free response code and number of answers for survey questions four and five, Post-Test 2.

7. Please explain the reasoning for your choice for the statement “I have good hand washing habits.”	Intervention	Control	8. If you are in the restroom and see someone not wash their hands, what is your reaction?	Intervention	Control
I wash after using the bathroom	5	6	Disgust/Horrified	3	4
I wash my hands a lot/well	5	2	Ew/Gross	11	11
I wash my hands when necessary	2	3	Indifferent	3	1
I wash my hands after the bathroom AND before I eat	4	1	Assume they are in a hurry	1	0
I do not always wash my hands	1	2	Anger	1	0
I do not wash for 20 seconds	0	1	Good	0	0
I do not know/because	2	1			

To answer the research question about multi-faceted interventions, T-Tests were performed and themes were created for the survey data. There were seven significant results from the T-Test. Results from the two open-ended questions were analyzed by hand and themes were compared between the intervention and control groups. Since there were significant data in frequency changes, some conclusions can be made about multi-faceted interventions.

## Discussion

Each survey question evaluated a certain construct of the HBM. When T-Tests were performed between the pre-test and first post-test of the intervention group, seven of the questions showed significant results. The only construct without any significant results was cues to action.

Questions 13 and 19 had significant results and evaluated the perceived susceptibility construct (Table 5). On the post-test, more students understood they were susceptible to common infections if they did not wash their hands. They also understood hand-sanitizer is not more effective than washing one's hands with soap and water, and using hand-sanitizer can actually increase susceptibility to disease. The PowerPoint presentation included this information, demonstrating the informational aspect of the intervention affected the students and they learned from it.

Students learned the true severity of not washing hands from questions 9 and 14, which also had significant results (Tables 4 and 5). After the intervention, more students said they washed their hands during an outbreak. The entertaining aspect of the intervention (short movie) influenced them by demonstrating an extreme example of what happens during an outbreak. In addition, more students understood serious infections could be prevented by not washing one's hands, which again emphasizes the importance of the informational aspect of the intervention. Marion et al. (2009) reported student knowledge gained via an intervention had positive impacts on the student's habits and education. The questions in this survey allowed the students to learn or understand the severity of consequences they could experience when not washing their hands. Perceived severity is the second construct of the HBM.

Question 10 evaluated the student's attitude towards the importance of hand washing. More students thought hand washing was important during the first post-test, demonstrating their perceived benefits increased (Table 4). Changing a student's attitude on how beneficial hand washing

is to them includes the entire intervention. Each aspect of the intervention was designed to show them the importance of hand washing and its benefits. Surgeoner et al. (2009) achieved similar results, where the students were affected by compelling messages to change their hand washing habits and realized the true benefits of doing so.

Students thought fewer college students wash their hands during the post-test compared to the pre-test (Table 4). In combination with their answers to open-ended question 8 (stating what their reaction is to someone who does not wash their hands in the bathroom), the students seem to think that other JMU students not washing their hands is a barrier. Some students said they felt anger and disgust at others for not washing their hands and did not want to touch anything in the bathroom. If one student washes his/her hands and the other does not, but both touch the door, then what was the use of washing hands in the first place? Unlike the study by Devnani et al. (2011) where patients did not have access to acceptable facilities, students at JMU do have access to adequate facilities and this did not seem to be a barrier. One solution to the perceived barrier students do have is to have trash cans placed at the exit of the bathroom so students can open the door with a paper towel and throw it away without having to touch the door handle.

The proposed cues to action (questions 8 and 11) did not have significant results. Over a longer period of time, more students could have changed their habits and noticed they were sick less often, resulting in a significant result for question 11 on the survey. So it seems that in a short time period, individual changes in how often one is sick will not influence a change in hand washing habits. Instead, Botta et al. (2008) found college students have a better response to 'gross' factors than to facts about hand washing in a short period of time. Cues to action in a shorter time span may be better for improving hand washing habits.

Question 7 asked students to rate their hand washing habits, assessing their self-efficacy and how much confidence they have in their ability to wash their hands well (Table 4). Interestingly,

their self-ratings significantly decreased after the intervention, indicating after learning the appropriate way to wash their hands they realized they were not doing a very good job. The students learned how to appropriately wash their hands through the intervention and applied it to their own habits. The intervention increased the confidence they have in themselves to change their habits using their new knowledge. Similarly, Magaldi and Molloy (2010) found demonstrations were useful and did improve hand washing habits.

The survey the students completed consisted of two open-ended questions, which were hand-analyzed. In the intervention group, there was not a large difference between the pre-test and first post-test answers. Most students reported washing their hands after using the restroom and said they would have an “ew” or “gross” reaction if they saw someone not wash their hands in the restroom. Both answers are not extreme compared to not washing their hands at all or being angry with someone for not washing their hands, which both had fewer answers.

Few students reported washing their hands before eating a meal. If they reported they did wash their hands before eating a meal it was always paired with washing after using the restroom (Tables 6-8). Other researchers also found only a small portion of college students reported washing their hands before eating (Thumma, Aiello, & Foxman, 2009). Not enough emphasis is put on encouraging or teaching students to wash their hands before eating at a young age. But it is just as important to wash your hands before eating as it is to wash them after using the bathroom, although slightly more inconvenient. Student’s perceived susceptibility include thinking they are not vulnerable to germs while they eat. Perceived susceptibility was the only construct of the HBM was impacted by the open-ended questions.

There are a few reasons why there was not a significant difference between the intervention and control groups during the post-test. Students may have forgotten what the right answers were to the knowledge questions, therefore on average getting the same answers as the control group. The

intervention group may have changed their hand washing habits for the first week or so and then reverted back to their old habits, again giving them the same average on behavior questions as the control group. Finally for the opinion questions, it is possible the intervention did not help them to care more about washing their hands or help them to understand that it is important to do so. So on the first pre and the second pre-test, the students in the intervention group had the same opinion (or not a significantly different one) on the importance of hand washing.

The lack of significant data between the intervention and control groups could have also been due to the small sample size. The study was limited to the number of college freshman and sophomores who decided to attend the interventions and participate in the surveys. If it could be opened up campus wide, possibly in a few campus events, not only could be a larger sample size with more diverse demographics. Freshmen are still getting used to college and may not be focused on hand hygiene, while upperclassman may have realized the importance of not missing class from being ill. The small sample size also clarifies the largely significant data from what seem small frequency changes (Tables 4 and 5).

The study was also limited as a one-time intervention with a minor reinforcement. Interventions can greatly increase knowledge, but this knowledge and awareness requires reinforcement, it does not automatically last (Farrell et al., 2008). Students may have forgotten what they learned in the intervention, and would have benefited more if they had been exposed to the information one, two, or even three more times. Repetition seems to be the key to sustaining change in knowledge or behavior resulting from that knowledge. Finally, some of the survey questions were unclear or confusing to the students, indicating a need of revisions. Fewer straightforward questions the students can read and answer quickly would be better and incline them to take the survey.

## **Conclusion**

The purpose of this study was to determine if a multi-faceted intervention could improve college student's hand washing habits. The Health Belief Model (Rosenstock, 1974) was used as a guide to establish specific areas and methods to improving these habits. After analysis, there were significant data differences between the pre-test and first post-test frequencies within the intervention group. So the intervention was successful, with an improvement in knowledge and an increase in frequency of hand washing (Tables 4 and 5). The lack of significant data between the pre-test and second post-test suggest students require repetition, which was lacking here, for a change to become permanent.

The Health Belief Model (Rosenstock, 1974) was a good tool to assess and improve college student's hand washing habits. The six constructs were a proper guide to the intervention, survey questions, and analysis of the data. While there is room for improvement, overall this study was a good attempt at trying to figure out if a multi-faceted intervention could help students change their hand washing habits, but there could be many improvements to make the study more impactful. The results of this study do not mean that a multi-faceted intervention does not work. More data, with improved techniques, needs to be collected to determine if a multi-faceted intervention helps students gain better hand washing habits over a longer period of time or if a completely new approach needs to be explored.



## Appendix A.

Pre-Test Survey:

ID #: \_\_\_\_\_ (birth month, last three digits of JACcard number) ex: 06489

I understand that this survey is confidential and anonymous and I am voluntarily answering this survey.

Hand washing habits can be defined as the rituals and consistencies a person has, when and if they wash their hands.

1. Age: \_\_\_\_\_

2. Gender:        Male    Female

3. Year at JMU: Freshman        Sophomore

4. What is your major? \_\_\_\_\_

5. How often do you wash your hands in a day?

7+ times                      4-6 times                      2-3 times                      None - once a day

6. Most (more than 75% of) college freshman/sophomores have good hand washing habits.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

7. I have good hand washing habits.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Please explain the reasoning for your choice to number 7:

---

8. If you are in the restroom and see someone not wash their hands, what is your reaction?

---

9. Do you increase your hand washing habits during a disease outbreak, or when a roommate is ill?    Yes    No

10. How important do you believe hand washing is in preventing illness?

                    Important                                      Somewhat important                                      Not important

11. How often are you sick?

Almost always    1 or 2 times a month    Once every 3 months    Once every 6 months    Rarely

12. \*The common cold can be passed from one person to another.        True    False

13. \*Common infections caused by germs passed from one person to another include diarrhea, vomiting, and viruses.    True    False

14. \*More serious infections such as Hepatitis A and viral meningitis can be prevented by proper hand washing.    True    False

15. \*Germs on door handles, toilet handles, and bathroom tap-handles are harmless and cannot cause sickness.                      True    False

---

\* Taylor, J., Basco, R., Zaied, A., & Ward, C. (2010). Hand hygiene knowledge of college students. *Clinical Laboratory Science*, 23(2), 89-93.

16. \*You should particularly wash your palms and between your fingers since this is where most germs are.                    True    False
17. \*Germs rarely get underneath the fingernails, and when they do, just running water on your hands gets rid of them.                    True    False
18. You do not have to always wash your hands with soap, only after using the bathroom and before eating.    True    False
19. \*Using hand-sanitizer is a better and more effective way of washing your hands.                    True    False

Good habits can be defined as washing for at least 20 seconds with soap and water, after using the bathroom and before coming into contact with food.

Post-Test Survey link:

[http://jmu.qualtrics.com/SE/?SID=SV\\_3x6QijnKnPTUvD7](http://jmu.qualtrics.com/SE/?SID=SV_3x6QijnKnPTUvD7)

## References

- Anderson, J., Warren, C., Perez, E., Louis, R., Phillips, S., Wheeler, J., Cole, M., & Ranjita, M. (2008). Major article: Gender and ethnic differences in hand hygiene practices among college students. *Hand Hygiene and Infection*, 36(5), 361-368.
- Botta, R., Dunker, K., Fenson-Hood, K., Maltarich, S., & McDonald, L. (2008). Using relevant threat, EEPM and interpersonal communication to change hand washing behaviours on campus. *Journal of Communication in Healthcare*, 1(4), 373-381.
- Centers for Disease Control and Prevention (2011). Celebrate global handwashing day October 15<sup>th</sup>. Retrieved February 5, 2012 from <http://www.cdc.gov/features/handwashing/>
- Devnani, M., Kumar, R., Sharma, R., & Gupta, A. (2011). A survey of hand washing facilities in the outpatient department of a tertiary care teaching hospital in India. *Journal of Infection in Developing Countries*, 5(2), 114-118.
- Edwards, D., Monk-Turner, E., Poorman, S., Rushing, M., Warren, S., & Willie, J. (2002). Predictors of hand washing behavior. *Social Behavior & Personality: An International Journal*, 30(8), 751-756.
- Evans, M., & Breshears, J. (2012). Attitudes and behaviors of chiropractic college students on hand sanitizing and treatment table disinfection: Results of initial survey and focus group. *Journal of Chiropractic*, 44(4), 13-23.
- Farrell, D., Savage, E., & O'Leary, A. (2008). Handwashing practices: Implications for nursing students. *Irish Journal of Anaesthetics & Recovery Nursing*, 4(4), 5-8.
- Fishbein, A., Tellez, I., Lin, H., Sullivan, C., & Groll, M. (2011). Glow gel hand washing in the waiting room: A novel approach to improving hand hygiene education. *Infection Control & Hospital Epidemiology* 32(7), 661-666.

- Fletcher, J., & Frisvold, D. (2011). College selectivity and young adult health behaviors. *Economics of Education Review*, 30(5), 826-837.
- Fung, I., & Cairncross, S. (2007). How often do you wash your hands? A review of studies of hand washing practices in the community during and after the SARS outbreak in 2003. *International Journal of Environmental Health Research*, 17(3), 161-183.
- Gantt, L., & Webb-Corbett, R. (2010). Using simulation to teach patient safety behaviors in undergraduate nursing education. *Journal of Nursing Education*, 49(1), 48-51.
- Magaldi, M., & Molloy, J. (2010). Spotlight on: Using student nurses as hand washing ambassadors: A model to promote advocacy and enhance infection control practice. *Nurse Educator*, 35(5), 183-185.
- Marion, W., Ramcharan, M., Ndetan, H., Floyd, R., Globe, G., Pfefer, M., & Brantingham, J. (2009). Hand hygiene and treatment table sanitizing in chiropractic teaching institutions: Results of an education intervention to increase compliance. *Journal of Manipulative and Physiological Therapeutics*, 32(6), 469-476.
- Miller, S., Yardley, L., & Little, P. (2012) Development of an intervention to reduce transmission of respiratory infections and pandemic flu: Measuring and predicting hand washing techniques. *Psychology, Health & Medicine* 17(7), 59-82.
- Monk-Turner, E., Edwards, D., Broadstone, J., Hummel, R., Lewis, S., & Wilson, D. (2005). Another look at hand washing behavior. *Social Behavior & Personality: An International Journal*, 33(7), 629-674.
- Nadakavukaren, A. (2011). Food quality. *Our global environment: A health perspective*. (pp. 215-241). Long Grove, IL: Waveland Press.
- Ott, M., & French, R. (2009). Hand hygiene compliance among health care staff and student nurses in a mental health setting. *Issues in Mental Health Nursing*, 30(11), 702-704.

- Park, J., Cheong, H., Son, D., Kim, S., & Ha, C. (2010). Perceptions and behaviors related to hand hygiene for the prevention of H1N1 influenza transmission among Korean university students during the peak pandemic period. *BMC Infectious Diseases*, 10(1), 222-229.
- Rosenstock, I. (1974). Historical origins of the Health Belief Model. *Health Education Monographs*, 2(4).
- Sander, L. (2008). Colleges put the squeeze on germs. *Chronicle of Higher Education*, 54(25), A1-A7.
- Scott, E., & Vanick, K. (2007). A survey of hand hygiene practices on a residential college campus. *American Journal of Infection Control*, 35(10), 694-696.
- Sevim, C., & Sema, K. (2008). Hygienic hand washing among nursing students in Turkey. *Applied Nursing Research* 21 (4), 207-211.
- Sharma, M. & Romas, J. (2012). The Health Belief Model. *Theoretical foundations of health education and health promotion*. (74-94). Massachusetts: Jones & Bartlett Learning.
- Surgeoner, B., Chapman, B., & Powell, D. (2009). University students' hand hygiene practice during gastrointestinal outbreak in residence: What they say they do and what they actually do. *Journal of Environmental Health*, 72(2), 24-28.
- Taylor, J., Basco, R., Zaied, A., & Ward, C. (2010). Hand hygiene knowledge of college students. *Clinical Laboratory Science*, 23(2), 89-93.
- Thumma, J., Aiello, A., & Foxman, B. (2009). Brief reports: The association between handwashing practices and illness symptoms among college students living in a university dormitory. *American Journal of Infection Control*, 37(1), 70-72.
- Tousman, S., Arnold, D., Helland, W., Roth, R., Heshelman, N., Castaneda, O., Fischer, E., O'Neil, K., & Bileto, S. (2007). Evaluation of hand washing program for 2<sup>nd</sup> -graders. *Journal of School Nursing*, 23(6), 342-348.

- Van, D., McLaws, M., Crimmins, J., MacIntyre, R., & Seale, H. (2010). University life and pandemic influenza: Attitudes and intended behaviour of staff and students towards pandemic (H1N1) 2009. *BMC Public Health*, 10(1), 130-138.
- Vessey, J., Sherwod, J., Warner, D., & Clark, D. (2007). Comparing hand washing to hand sanitizers in reducing elementary school student's absenteeism. *Pediatric Nursing*, 33(4), 368-372.
- White, C., Kolble, R., & Carlson, R. (2005). The impact of health campaign on hand hygiene and upper respiratory illness among college students living in residence halls. *Journal of American College Health* 53(4), 175-181.