Hand Hygiene Promotion: An Essential Strategy for Preventing Foodborne Disease in Elementary Schools

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HAND HYGIENE PROMOTION: AN ESSENTIAL STRATEGY FOR PREVENTING
FOODBORNE DISEASE IN ELEMENTARY SCHOOLS

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Food, Nutrition, and Culinary Science

by
Zhangqi Wang
December 2014

Accepted by:
Angela M. Fraser, Ph.D., Committee Chair
Julia L. Sharp, Ph.D.
Felix H. Barron, Ph.D.
**ABSTRACT**

Student absenteeism is a pervasive problem in the United States, causing a number of educational, economic, and institutional problems. Hand-hygiene interventions have been reported to be a method for reducing illness-associated student absenteeism. As an increasing number of schools offer self-service, including salad bars and bowls of whole fresh fruit, opportunities for the transmission of foodborne pathogens via hands could possibly increase illness-associated student absenteeism. To address this problem, we conducted a two-phase study. First, we conducted a systematic literature review to evaluate peer-reviewed studies (N=24) that reported an association between hand hygiene interventions and illness-associated absenteeism reduction in elementary schools. We concluded that hand-hygiene interventions were associated with reducing illness-related absenteeism reduction in elementary schools. Secondly, we administered a web-based survey to SC school foodservice managers (N=1231) to assess their perceptions and behaviors about hand hygiene in the school foodservice environment. Findings from the 403 eligible responses showed that school foodservice managers perceived a low level of susceptibility to gastrointestinal diseases, a high level of perceived efficacy to protect self and others from getting gastrointestinal diseases, a high level of agreement with proper food-safety behaviors. Furthermore, there was an insignificant relationship between foodservice manger risk perceptions and food-safety behaviors. Our results will inform the development of a hand-hygiene intervention to be delivered in elementary schools in upstate South Carolina.
I would like to dedicate this thesis work to my parents, Futian Wang and Yunxia Zhang, who have been a constant source of support and always loved me unconditionally. I also would like to dedicate this thesis to my boyfriend Zhongjing Guo who has been a constant encouragement and support during the challenges of graduate school and life. I am truly thankful for having you all in my life.
I would like to thank my advisor, Dr. Angela Fraser, for her excellent guidance, patience, and providing me with an excellent atmosphere for doing research. I would like to thank my committee members, Dr. Julia Sharp and Dr. Felix Barron, who guided my research for the past several semesters and helped me to develop my background in statistics and food science. I also would like to thank Dr. William Bridges for helping me analyze survey results and teaching me two statistics classes.

This work would not have been possible without the contributions of Dr. Maria Lapinski and Dr. Elizabeth Quilliam at the Michigan State University and Dr. LeeAnn Jaykus at the North Carolina State University. I thank the members of our team who have helped me in my study design and writing process: Cortney Leone, Morgan Getty, Suzan Simmons, Mary Carney, Lauren Foster, Hillary Evans, Leslie Salley, Roman Sturgis and Matthew Zeller. I also thank others members of our team who have been nice and friendly to me and always supported me: Lalani Jayasekara, Joanna Smyers, Ana Romero, Omar Almamoud, and Chaoyi Tang.

I would also like to thank my roommates, Hongye Wang, Chen Liu, Hui Dong, and Yanting Xing, who have cared a lot about me and always supported me with their best wishes.
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CHAPTER ONE

INTRODUCTION

Hand hygiene is a well-recognized strategy for reducing exposure to pathogens that cause infectious disease. For example, handwashing programs can reduce diarrheal and respiratory disease rates (Michaels et al., 2003), as well as sickness and absenteeism, by as much as 30%-40%. The importance of hand washing is evident by the fact it is cited as a Method of Control for nearly 30% of the 136 communicable diseases documented in the American Public Health Association (APHA) Control of Communicable Diseases Manual (Heymann, 2008).

The U.S. Centers for Disease Control and Prevention (CDC) estimated that more than 25% (15 million) school-aged children (aged 5–17) missed school day(s) in 2011 (CDC 2011). Many of these absences were presumably associated with infectious disease. Crowded settings, shared objects, and inadequate self-care all contribute to the transfer of infectious disease agents in the school environment. Food handling practices in schools can also increase opportunities for the transfer of pathogens spread via hands. During the past ten years, 276 foodborne disease outbreaks were reported causing 11,741 student illnesses (Table 1.1).

Many schools now offer self-service, including salad bars and bowls of whole fresh fruit, as part of the National School Lunch Program. Experts believe that if children can self-select their foods, they are more likely to choose healthier foods. Some schools are even offering family-style dining inside the classroom so all students can serve
themselves. These self-service practices can undoubtedly increase the risk of transmission of foodborne pathogens if proper controls are not in place.

One way the USDA Food and Nutrition Services has addressed food safety concerns in general is to require all school foodservice operations that participate in the National School Lunch Program to have a food safety plan based on HACCP principles. School districts all over the U.S. have invested millions of dollars on the development of these HACCP Plans. However, it needs to be noted that even when properly implemented, these HACCP Plans only control food safety up to the point of service. Once consumers (such as students) have direct access to exposed food, control is lost and the risk for foodborne disease increases. Thus, self-service practices, while possibly increasing the selection of healthy foods, could also result in increased cases of foodborne disease because these practices allow children to have direct contact with food.

One way to decrease risk of illness is for children to engage in good hand hygiene practices prior to eating. The challenge to hand hygiene is that schools have such busy curricula with insufficient time for children to wash their hands prior to eating. Environmental obstacles also impede compliance. There are often too few hand sinks available. Even if one sink were available in a classroom, it could take approximately 30 minutes for 30 students to properly wash their hands. Furthermore, some are too high for easy access and many are located outside the classroom where supervision is limited. Soap and paper towels are frequently in short supply and hot water is often not available in many school bathrooms.
The aim of this study is to decrease foodborne illness in elementary schools attributed to improper hand-hygiene practices. The specific pre-intervention objectives to meet this goal were:

1. Determine the effect of hand-hygiene interventions on infectious disease-associated absenteeism.

2. Determine what types of educational materials are available to teach elementary school children about hand hygiene.

3. Identify individual factors that influence hand-hygiene practices of South Carolina school foodservice managers.

Our findings will be used to inform the development of a hand-hygiene intervention to be delivered in elementary schools in upstate South Carolina.
Table 1.1: Foodborne Disease Outbreaks Attributed to Schools from 2003–2012 (CDC OutbreakNet, 2014).

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<th>Reporting Year</th>
<th>Total number of outbreaks</th>
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<th>Vehicle for illness</th>
<th>Number Ill</th>
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<td>15</td>
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<td>2006</td>
<td>42</td>
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REFERENCES


CHAPTER TWO

THE RELATIONSHIP BETWEEN HAND-HYGIENE INTERVENTIONS AND INFECTIOUS DISEASE-ASSOCIATED ABSENTEEISM IN ELEMENTARY SCHOOLS: A SYSTEMATIC LITERATURE REVIEW

INTRODUCTION

Student absenteeism is a persistent problem that results in substantial consequences. For example, academic performance can suffer when students miss class and assignments (Wadesango & Machingambi, 2011; Carroll, 2010; Ready, 2010; Reid, 2012). Because performance can continue to decline as absenteeism increases, the overall academic standards of a school can also be lowered (Reid, 2012; Levy et al., 2011; Belachew et al., 2011). Increased effort may be required from teachers because they have to re-teach missed content for absent students (Epstein & Sheldon, 2002). Student absenteeism can also result in increased school administrative costs (i.e., student tracking) (Epstein & Sheldon, 2002). Moreover, because public school funding formulas in the U.S. are based on attendance records, increased absenteeism directly leads to less federal and state funding for schools (Epstein & Sheldon, 2002; Meng et al., 2012; Urrieta & Martinez, 2011). Another consequence of absenteeism that is external to the school environment is parents might have to miss work or hire a babysitter, which can be costly, when a child is too sick to attend school (Saps, et al., 2009; Master et al., 1997; Vessey et al., 2007). Given the wide range of consequences, student absenteeism and its prevention warrants further study.

Infectious diseases, such as acute gastrointestinal illness (AGI) and respiratory illness (RI), are frequently associated with student absenteeism. The most current
statistics (1997) from the U.S. Centers for Disease Control and Prevention (CDC) show that students missed 22 million days of school due to colds alone; 38 million days of school were missed due to the influenza virus. In addition, many of the 48 million cases of foodborne disease are classified as an AGI. Between 1998 and 2008, state and local health departments reported 286 foodborne disease outbreaks (17,266 cases of illness) within U.S. schools, which presumably resulted in many sick students missing school (Gould et al., 2013).

Hand washing is one method of control for many infectious diseases (Heymann et al., 2008). As a result, many hand hygiene interventions have been designed for and delivered in schools, some with the specific goal of reducing absenteeism or illness. Hand-hygiene interventions have been reported to be strongly associated with the reduction of infectious disease but to our knowledge, no systematic review has examined the relationship between the implementation of a hand hygiene intervention and absenteeism rates in schools despite the existence of many interventions designed with this goal as central to the study design (Curtis & Cairncross, 2003; Rabie & Curtis, 2006). As such, the aim of this review is to evaluate studies published between 1980 and 2012 that reported the association between hand hygiene interventions and illness-associated absenteeism reduction in elementary schools. The results of this study can serve as a guide for the development of future, and perhaps more effective, hand hygiene interventions.
METHODS

Search Strategy

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guide to create a transparent, valid review of published studies that tested the relationship between hand-hygiene interventions and absenteeism reduction (Figure 2.1). PRISMA is an evidence-based, minimum set of items used to conduct systematic reviews and meta-analyses and is considered to be an international standard (Liberati et al., 2009). A comprehensive literature search was conducted to identify eligible studies published in English-language journals. We performed the search using the following databases: Science Direct (1980-2012), Academic Search Complete (1980-2012), Academic OneFile (1980-2012), AgEco Search (1980-2012), Web of Science (1980-2012), and Google Scholar (1980-2012). Academic Search Complete is managed by EBSCO, and allows for simultaneous searches through multiple databases, such as MEDLINE® and CINAHL®. We conducted our electronic search using the terms hand hygiene, hand washing, children, student, education, campaign, training, information, and intervention. After running a search query, an e-mail alert was created, as well as a Really Simple Syndication (RSS) feed that continued to direct us to relevant literature. We also reviewed the reference lists of all relevant articles to locate additional published studies.
Selection

In order to select the study sample, the title and abstract of each citation was reviewed using our eligibility criteria. Articles were then sorted to remove duplicates. Ambiguous titles or abstracts were included and reviewed. Hard copies of all potentially relevant citations were retrieved for additional review.

We evaluated studies for inclusion on the basis of five eligibility criteria: 1) nature of intervention, 2) target population, 3) outcome, 4) study design, and 5) publication type. The intervention under study had to include education or behavior change communication to promote hand hygiene or had to encourage the use of hand sanitizer or soap in schools. To be classified as an educational intervention, the publication had to indicate that educational (e.g., curricula) or communication activities were included in the intervention. Only studies conducted in elementary schools were included in our review; in some jurisdictions elementary schools may include up to grade 8. In order to be included in the review, student absenteeism had to be measured as a study outcome. Randomized control trials and quasi-experimental trials were included. Crossover studies, designs without control groups, and designs with control groups (pretest or non-pretest) were classified as quasi-experimental designs. In some studies, it was not possible to determine if randomization was used; therefore, these studies were classified as nonrandomized (Guinan et al., 2002). Only peer-reviewed publications written in English were included.
Quality Assessment

The Downs and Black Checklist (1998) was used to assess quality of studies as it has been identified as one of the best quality evaluation systems (Appendix A) (Deeks et al., 2003). It can be used to conduct systematic reviews of both randomized and non-randomized trials and can adequately identify sources of potential bias. The checklist consists of 27 items categorized into five sections: 1) reporting (10 items); 2) external validity (3 items); 3) internal validity – bias (7 items); 4) internal validity – confounding (selection bias) (6 items); and 5) power (1 item); the highest possible score is a 28 (Item 5 can earn up to 2 points). Two trained reviewers independently assessed the quality of all eligible studies using the checklist. Initially, studies were evaluated qualitatively (yes/no/unable to determine); the ratings were then converted to a quantitative score (2/1/0). The reviewers discussed any disagreements in scoring and reached a consensus. Reviewer ratings were averaged to create a quality score for each study.

RESULTS

Search strategy

We identified 706 records within the electronic databases (Figure 2.1). We included 69 potentially eligible studies for full text review after removing duplicates and screening titles and abstracts for inclusion criteria. Hand searching the reference list of relevant articles resulted in 14 additional articles; these were also reviewed for eligibility. After screening the full text, 60 studies were excluded for the following reasons: inappropriate type of interventions (n=14), did not target elementary schools (n=23), did
not measure absenteeism (n=10), did not use an appropriate study design (n=16), and were not peer-reviewed publications (n=3). Based on our inclusion criteria, we identified 17 eligible studies; 9 of 17 included educational interventions.

Study Characteristics

Of the 17 eligible studies, 12 were conducted in the United States and the remaining 5 in Canada (n=2), Egypt (n=1), and Denmark (n=2); all were published between 1992 and 2012. Studies with two types of design were included: randomized control (n=5) and quasi-experimental (n=12). The range of sample sizes was 13 to 44,451 students and 1 to 60 elementary schools. One study did not report the number of elementary schools involved, and three did not report the number of study subjects. The length of studies ranged from 4 weeks to 18 months. In most studies (15), the age of the subjects was 4 to 11 years of age. In two studies conducted in Denmark the age of the sample subjects was 5 to 15 years old.

Quality Assessment

The median quality assessment score was 16 (range 8-20), which Prince et al. (2008) and Connor et al. (2009) suggest using to classify the study as “higher” or “lower” quality. Randomized control studies had higher scores (range 18-20). Compared with lower quality studies, all higher quality studies clearly reported the confounders, and some (4 of 9) adjusted confounders during data analyses (Table 2.1) (Nandrup-Bus, 2011; Sandora, 2008; Stebins et al., 2011; Nandrup-Bus, 2009). Most higher quality studies (5
Figure 2.1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
Flow Chart Describing the Literature Search Procedure
of 9) randomly assigned subjects to groups, while none of the lower quality studies randomized subjects. Power analysis, which is necessary to determine proper sample size to show effect, was reported in some higher quality studies (5 of 9), but not in lower quality studies (Vessey et al., 2007; Sandora, 2008; Stebbins et al., 2011; Nandrup-Bus, 2009; Talaat et al., 2011). Although higher quality studies avoided more biases than lower quality studies, both had flaws. The characteristics of students who did not complete the intervention were described in 15 studies and several studies reported significant attrition. For example, Lau et al. (2012) reported a large number of dropouts, with 208 of 981 students not completing the study. Of 17 studies, 16 were unrepresentative of larger populations because they did not use proper randomization in their study design. Lack of blinding for subject or investigators was another common weakness in most studies (n=15). Some studies may also have undergone data dredging; however, no studies included reported doing so. Only 3 studies used an intervention, whose protocol could be repeated (Vessey et al., 2007; Day et al., 1993; Lau et al., 2012).
Table 2.1: Quality Assessment Results Based on Downs and Black’s Checklist for Measuring Quality

<table>
<thead>
<tr>
<th>Questions</th>
<th>Total (n=17)</th>
<th>High(^a) (n=9)</th>
<th>Low(^b) (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reporting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1: Is the hypothesis clearly described?</td>
<td>17</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Q2: Are outcomes described in Introduction &amp; Methods?</td>
<td>16</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Q3: Are inclusion/exclusion criteria clearly described?</td>
<td>16</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Q4: Are interventions clearly described?</td>
<td>17</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Q5: Are confounders clearly described?</td>
<td>12</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Q6: Are the main findings clearly described?</td>
<td>14</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Q7: Does the study provide estimates of the random variability in the data for the main outcomes?</td>
<td>13</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Q8: Have all important adverse events been reported?</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Q9: Have the characteristics of patients lost to follow-up been described?</td>
<td>15</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Q10: Have actual p-values been reported?</td>
<td>10</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td><strong>External validity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q11: Were the subjects asked to participate representative of the source population?</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Q12: Were those subjects who were prepared to participate representative of the source population?</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Q13: Intervention was representative of that in use in the source population?</td>
<td>16</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td><strong>Internal validity – bias</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q14: Did study blind subjects?</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Q15: Did study blind investigators?</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Q16: Was “data dredging” clearly reported?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q17: Was follow-up period the same for all subjects?</td>
<td>14</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Q18: Were the statistical tests appropriate?</td>
<td>15</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Q19: Was compliance with intervention reliable?</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Q20: Were the main outcome measures used accurate?</td>
<td>17</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td><strong>Internal validity – confounding (selection bias)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q21: Were the subjects in different intervention groups recruited from the same population?</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Q22: Were subjects in different intervention groups recruited over the same period of time?</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Q23: Were subjects randomized to intervention group?</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Q24: Was the randomized assignment concealed from both subjects and investigators?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q25: Was there adequate adjustment for confounding in the analyses?</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Q26: Were losses of subjects to follow-up taken into account?</td>
<td>13</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q27: Did the study conduct power analysis to calculate the sample size?</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^a\)High: Higher quality studies with quality scores \(\geq 16\).
Key Findings

Absenteeism was measured in 7 ways (Table 2.2): absence episode (one absence episode was one or more contiguous absent days during the study period; 2 studies), absence period (one absence period was number of days absent because of a single cause; 2 studies) absence incidence (on study), days absent per student (days of absences divided by number of different students absent; 5 studies), absent days (days of absence; two studies), percentage of total absent days (absent days divided by total participating days; two studies), and percentage of students absent per day (number of absent students divided by number of total participating students; one study). Two studies did not report how they measured absenteeism.

Of the 17 studies, 5 specifically measured both AGI-associated absenteeism and RI-associated absenteeism (Master et al., 1997; Sandora et al., 2008; Dyer et al., 2000; White et al., 2001; Talaat et al., 2011), two studies only measured RI-associated absenteeism (Stebbins et al., 2011; Kimel et al., 1996), and 10 measured combined illness-associated absenteeism (absenteeism caused by either AGI or RI without differentiation) (Vessey et al., 2007; Guinan et al., 2002; Nandrup-Bus, 2011; Nandrup-Bus, 2009; Monsma et al., 1992; Tousman et al., 2007; Hammond et al., 2000; Day et al., 1993; Lau et al., 2012; Morton & Schultz, 2004; Dyer et al., 2000). Study authors used symptoms, such as abdominal pain, diarrhea, and vomiting, to classify students as having AGI. RI was defined as a student having symptoms such as cough, sneezing, sinus trouble, bronchitis, fever, pink eye, headache, acute asthma, and/or mononucleosis.
Respiratory infectious symptom-related absenteeism (e.g. flu and cold) was categorized into RI-associated absenteeism.

**AGI-associated absenteeism.** Of the 5 studies that measured AGI-associated absenteeism, four were higher quality (range 18-20) (Sandora et al., 2008; Dyer et al., 2000; White et al, 2001; Talaat et al., 2011), with one classified as lower quality (Master et al., 1997). Interventions used in these 5 studies included use of hand sanitizer, use of soap, and instructions. All five reported a significant reduction in absenteeism in the intervention group as compared to the control group. Three of the studies reported a 30%-40% reduction (p<.01) in AGI-associated absenteeism in the intervention group as compared to the control group (Master et al., 1997; Dyer et al., 2000; White et al., 2001); while one reported a 3.2% (p<.01) reduction in absenteeism (Sandora et al., 2008). Talaat et al. reported that absence incidence due to diarrhea symptoms decreased by 33.3% (p<.0001) in the intervention group (Talaat et al., 2011).

**RI-associated absenteeism.** Of the 7 studies that reported RI-associated absenteeism, 5 also reported AGI-associated absenteeism (the same 5 studies as reported above) besides RI-associated absenteeism (Sandora et al., 2008; Dyer et al., 2000; White et al, 2001; Talaat et al., 2011; Master et al., 1997), and 2 studies only reported RI-associated absenteeism (Stebbins et al., 2011; Kimel et al., 1996). Five studies (Sandora et al., 2008; Stebbins et al., 2011; Dyer et al., 2000; White et al, 2001; Talaat et al., 2011) were higher quality (quality score: 18-20), while 2 (Master et al., 1997; Kimel et al., 1996) were lower quality studies (quality score: 13-14). Three of the 7 studies did not
<table>
<thead>
<tr>
<th>Author</th>
<th>Intervention</th>
<th>Related Illness</th>
<th>Quality Score</th>
<th>Unit of Measurement</th>
<th>Absenteeism Control</th>
<th>Absenteeism Intervention</th>
<th>Absenteeism Reduction</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammond et al.</td>
<td>Alcohol-based hand sanitizer</td>
<td>RI or AGI</td>
<td>13</td>
<td>Days absent per student&lt;sup&gt;d&lt;/sup&gt;</td>
<td>3.0</td>
<td>2.4</td>
<td>19.8%</td>
<td>Illness-related absenteeism significantly reduced*.</td>
</tr>
<tr>
<td>Nandrup-Bus</td>
<td>Alcohol-based hand sanitizer</td>
<td>RI or AGI</td>
<td>16</td>
<td>Absence period&lt;sup&gt;e&lt;/sup&gt;</td>
<td>449 periods</td>
<td>306 periods</td>
<td>31.8%</td>
<td>Combined illness-related absenteeism significantly reduced*.</td>
</tr>
<tr>
<td>Sandora et al.</td>
<td>Alcohol-based hand sanitizer</td>
<td>RI or AGI</td>
<td>20</td>
<td>Days absent per student&lt;sup&gt;d&lt;/sup&gt;</td>
<td>GI-: 1.6</td>
<td>R-: 1.7</td>
<td>GI-: 3.2%</td>
<td>GI associated absenteeism significantly reduced***; No significant reduction in R associated absenteeism*.</td>
</tr>
<tr>
<td>Guinan et al.</td>
<td>Alcohol-based hand sanitizer; Hand-hygiene education</td>
<td>Cold, flu or AGI</td>
<td>11</td>
<td>Absence episodes&lt;sup&gt;f&lt;/sup&gt;</td>
<td>277</td>
<td>140</td>
<td>50.6%</td>
<td>Reduction in number of absences was significant**.</td>
</tr>
<tr>
<td>Morton and Schultz</td>
<td>Alcohol-based hand sanitizer; Hand-hygiene education</td>
<td>RI or AGI</td>
<td>18</td>
<td>AB rate: not defined</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Absenteeism rate was reduced 43%&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Stebbins et al.</td>
<td>Alcohol-based hand sanitizer; Respiratory hygiene education</td>
<td>Influenza A or B</td>
<td>18</td>
<td>Absence episode&lt;sup&gt;f&lt;/sup&gt;</td>
<td>ILI A: 34</td>
<td>ILI A: 20</td>
<td>ILI A: 41.2%</td>
<td>No significant reduction on all lab-confirmed influenza&lt;sup&gt;c&lt;/sup&gt;;</td>
</tr>
<tr>
<td>Dyer et al.</td>
<td>Alcohol-free hand sanitizer</td>
<td>RI or AGI</td>
<td>18</td>
<td>Days absent per student&lt;sup&gt;d&lt;/sup&gt;</td>
<td>GI-: 1.8</td>
<td>R-: 2.3</td>
<td>GI-: 28.9%</td>
<td>GI associated*** and R associated** absenteeism were significantly reduced.</td>
</tr>
<tr>
<td>Author</td>
<td>Intervention</td>
<td>Related Illness</td>
<td>Quality Score</td>
<td>Unit of Measurement</td>
<td>Absenteeism Control</td>
<td>Absenteeism Intervention</td>
<td>Absenteeism Reduction</td>
<td>Key Findings</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------</td>
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<td>---------------</td>
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<td>--------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>White et al. (2001)</td>
<td>Alcohol-free hand sanitizer</td>
<td>RI or AGI</td>
<td>19</td>
<td>Days absent per student(^d)</td>
<td>GI-: 3.1 R-: 2.4</td>
<td>GI-: 1.9 R-: 2.2</td>
<td>GI-: 38.7% R-: 8.3%</td>
<td>GI related** and R related*** absenteeism significantly reduced.</td>
</tr>
<tr>
<td>Master et al. (1997)</td>
<td>Non-antimicrobial soap</td>
<td>RI or AGI</td>
<td>14</td>
<td>Days absent per student(^d)</td>
<td>GI-: 1.8 R-: 2.4</td>
<td>GI-: 1.2 R-: 2.0</td>
<td>GI-: 32.0% R-: 15.7%</td>
<td>GI related** absenteeism significantly reduced. R-absenteeism was not significantly reduced(^c).</td>
</tr>
<tr>
<td>Nandrup-Bus (2009)</td>
<td>Non-antimicrobial soap</td>
<td>RI or AGI</td>
<td>19</td>
<td>Absence period(^a)</td>
<td>449 periods</td>
<td>280 periods</td>
<td>37.6%</td>
<td>Combined illness-related absenteeism significantly reduced**.</td>
</tr>
<tr>
<td>Talaat et al. (2011)</td>
<td>Non-antimicrobial soap; Hand-hygiene education</td>
<td>ILI, diarrhea, conjunctivitis</td>
<td>18</td>
<td>Number of absences per 100 student-weeks</td>
<td>ILI: 0.5 Diarrhea: 0.3</td>
<td>ILI: 0.3 Diarrhea: 0.2</td>
<td>ILI: 40.0% Diarrhea: 33.3%</td>
<td>Combined illness-related absenteeism significantly reduced***.</td>
</tr>
<tr>
<td>Vessey et al. (2007)</td>
<td>Soap; Hand sanitizer</td>
<td>Infectious diseases</td>
<td>17</td>
<td>Absent days</td>
<td>25.4</td>
<td>26.8</td>
<td>-5.2%</td>
<td>No significant difference in absenteeism(^b).</td>
</tr>
<tr>
<td>Day et al. (1993)</td>
<td>Hand-hygiene education</td>
<td>Infectious illnesses</td>
<td>14</td>
<td>Absent days</td>
<td>76</td>
<td>60</td>
<td>21%</td>
<td>Illness-related absenteeism significantly reduced(^d).</td>
</tr>
<tr>
<td>Kimel (1996)</td>
<td>Hand-hygiene education</td>
<td>RI</td>
<td>13</td>
<td>Percentage of students absent per day(^g)</td>
<td>Pre-: 1.6% Post-: 3.8% 3 month post: 5.1%</td>
<td>Pre-: 1.6% Post-: 1.8% 3 month post: 3.9%</td>
<td>Pre-: 0% Post: 52.6% 3 month post:</td>
<td>Flu related absenteeism significantly reduced***.</td>
</tr>
</tbody>
</table>
Table 2.2: Continued

<table>
<thead>
<tr>
<th>Author</th>
<th>Intervention</th>
<th>Related Illness</th>
<th>Quality Score</th>
<th>Unit of Measurement</th>
<th>Absenteeism Control</th>
<th>Absenteeism Intervention</th>
<th>Absenteeism Reduction$^a$</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monsma et al. (1992)</td>
<td>Hand-hygiene education</td>
<td>Infectious illnesses</td>
<td>8</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>Total absenteeism was 22% less than the previous year$^b$.</td>
</tr>
<tr>
<td>Tousman et al. (2007)</td>
<td>Hand-hygiene education</td>
<td>...</td>
<td>12</td>
<td>Percentage of absent days$^h$</td>
<td>...</td>
<td>...</td>
<td></td>
<td>Absenteeism rates were 34% lower during weeks 3 and 4 of the intervention$^d$.</td>
</tr>
</tbody>
</table>

**NOTE:** IS= intervention study; CS= control study; ILI=influenza like illness; AGI=gastrointestinal-associated; RI= respiratory-associated;

$^a$ Reduction =$\frac{(\text{Control} - \text{Intervention})}{\text{Control}}$ x 100%

$^b$ P-values were more than 0.05, which indicates no significant difference was observed.

$^c$ P-values were not reported in the original studies.

$^d$ Days absent per student=days of absences divided by number of different students absent.

$^e$ One absence period: the number of days absent because of a single cause.

$^f$ One absence episode: one or more contiguous absent days during the study period.

$^g$ Percentage of students absent per day=number of absent students divided by total participating students.

$^h$ Percentage of absent days=days of absence divided by total participating days.

$^*P<.05$; $^{**}P<.01$; $^{***}P<.001$.  

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21
detect a significant reduction of RI-associated absenteeism after the intervention (including use of hand sanitizer and use of soap) (Master et al., 1997; Sandora et al., 2008; Stebbins et al., 2011). The remaining 4 studies reported a significant reduction in absenteeism after the intervention (including use of hand sanitizer, use of soap, and educational intervention) (Dyer et al., 2000; White et al, 2001; Talaat et al., 2011; Kimel et al., 1996). Kimel (1996) designed a powered quality study and observed decreased absenteeism of 52.6% (p=.001) in the intervention group immediately following the intervention; however, he did not observe any significant difference during the flu season (p>.05). Two studies examined absent days corresponding with each absent student, and both reported a significant reduction of RI-associated absenteeism (8.3%, p<.001; 49.7%, p<.01) in the intervention group compared with control group (Dyer et al., 2000; White et al., 2001). Talaat et al. (2011) detected a 40% (p<.0001) reduction in student absences within the intervention group.

**Combined illness-associated absenteeism.** Ten studies measured absenteeism caused by either AGI or RI (Vessey et al., 2007; Guinan et al., 2002; Nandrup-Bus, 2011; Nandrup-Bus, 2009; Monsma et al., 1992; Tousman et al., 2007; Hammond et al., 2000; Day et al., 1993; Lau et al., 2012; Morton et al., 2004). Of the 10 studies, 4 (Guinan et al., 2002; Monsma et al., 1992; Tousman et al., 2007; Hammond et al., 2000) were considered lower quality studies (range 9-13) and 6 (Vessey et al., 2007; Nandrup-Bus, 2011; Nandrup-Bus, 2009; Hammond et al., 2000; Day et al., 1993; Lau et al., 2012; Morton et al., 2004) were considered higher quality study design (range 15-19). Three of the ten measured infectious disease-associated absenteeism (Vessey et al., 2007; Monsma
et al., 1992; Day et al., 1993); however, we still considered it caused by AGI or RI, because AGI and RI are the two leading infectious diseases causing school illness-associated absenteeism (Sandora et al., 2008). Nine of ten studies observed a difference in absenteeism in the intervention group as compared to the control group (Guinan et al., 2002; Nandrup-Bus, 2011; Nandrup-Bus, 2009; Monsma et al., 1992; Tousman et al., 2007; Hammond et al., 2000; Day et al., 1993; Lau et al., 2012; Morton et al., 2004). Only 4 of the 9 studies did not report a significant difference between intervention and control groups (Monsma et al., 1992; Tousman et al., 2007; Day et al., 1993; Morton et al., 2004). Of these 4 studies, 1 reported significant absence reduction (21%, respectively) (Day et al., 1993); however, they did not provide corresponding p-values to support their findings. Three studies did not present how they measured absenteeism; however, they reported a 22-43% reduction within the intervention group (Monsma et al., 1992; Tousman et al., 2007; Morton et al., 2004). Another 5 studies detected a 19.8%-50.6% (p<.05) reduction of combined illness-associated absenteeism (Guinan et al., 2002; Nandrup-Bus, 2011; Nandrup-Bus, 2009; Hammond et al., 2000; Lau et al., 2012).

**Interventions using hand sanitizer.** Each intervention was assigned to a mutually exclusive category. The type of hand hygiene interventions administered included: use of alcohol-based hand sanitizer, use of alcohol-free hand sanitizer, and use of hand sanitizer combined with education (Table 2.2). In 9 studies, hand sanitizer was offered by teachers in the classroom to elementary students (Vessey et al., 2007; Guinan et al., 2002; Nandrup-Bus, 2011; Sandora et al., 2008; Stebbins et al., 2011; Hammond et al., 2000; Morton & Schultz, 2004; Dyer et al., 2000; White et al., 2001). Seven of the nine studies
that used hand sanitizers had a higher quality design with assessment scores ranging from 16 to 20 (Vessey et al., 2007; Nandrup-Bus, 2011; Sandora et al., 2008; Stebbins et al., 2011; Morton & Schultz, 2004; Dyer et al., 2000; White et al., 2001). Two studies scored under 16, so were classified as low quality (Guinan et al., 2002; Hammond et al., 2000). Of the 3 studies that examined the effects of alcohol-based hand sanitizer use, 2 reported a 19.8%-31.8% (p<.05) reduction of combined illness-associated absenteeism within the intervention group (Nandrup-Bus, 2011; Hammond et al., 2000). Another one of these three studies detected a 3.2% (p<.01) reduction of AGI-associated absenteeism within the intervention group; however, no significant reduction in RI-associated absenteeism (Nandrup-Bus, 2011; Sandora et al., 2008; Hammond et al., 2000). Three studies reported the effect of combining the use of alcohol-based hand sanitizer with education (Guinan et al., 2002; Stebbins et al., 2011; Morton & Schultz, 2004); two of the three studies reported a 43%-50.6% (p<.001) reduction of combined illness-associated absenteeism in the intervention group compared to the control group (Guinan et al., 2002; Morton & Schultz, 2004). Another one did not detect significant reduction in RI-associated absenteeism between the intervention and control group (Stebbins et al., 2011). Dyer et al. (2000) and White et al. (2001) tested the effect of alcohol-free hand sanitizers independently and detected a 28.9%-38.7% (p<.01) reduction in AGI-associated absenteeism and a 8.3%-49.7% (p<.01) reduction in RI-associated absenteeism in the intervention groups.

*Interventions using soap.* Four studies required students to use hand soap alone or in conjunction with education or hand sanitizer (Master et al., 1997; Vessey et al., 2007;
Nandrup-Bus, 2009; Talaat et al., 2011). Three of the four studies were high quality (range 17-19) (Vessey et al., 2007; Nandrup-Bus, 2009; Talaat et al., 2011), with one classified as low quality (quality score=14) (Master et al., 1997). Two studies reported a 33% (p<.01) reduction in AGI-associated absenteeism within the intervention group (Master et al., 1997; Talaat et al., 2011); while another reported 37.6% (p<.01) reduction of combined illness-associated absenteeism (Nandrup-Bus, 2009). Vessey et al. (2007) reported use of alcohol-based hand sanitizer and use of soap produced had nearly identical outcomes.

*Educational intervention.* Of the 5 studies that chose to only offer education to subjects, 4 studies exhibited numerous flaws in study design (quality scores ranged from 8 to 14), thus the results should be interpreted with caution (Monsma et al., 1992; Tousman et al., 2007; Day et al., 1993; Kimel, 1996). Educational interventions included curricula, songs, games, picture stories, and posters. One study detected significant reduction (p<.001) in RI-associated absenteeism in the intervention group (Kimel, 1996); while another reported 26.8% (p<.001) reduction in combined illness-associated absenteeism (Lau et al., 2012). The remaining three studies observed reductions, but did not report the statistical significance of their findings (Monsma et al., 1992; Tousman et al., 2007; Day et al., 1993; Kimel, 1996).

**DISCUSSION**

The aim of our literature review was to evaluate studies that reported the relationship between hand hygiene interventions and infectious disease-associated
absenteeism in elementary schools. Our results suggest there is a relationship between hand-hygiene interventions and infectious disease-associated absenteeism reduction, especially absenteeism related to AGI. Our results also suggest the relationship between interventions using hand sanitizer or soap and AGI-associated and combined illness-associated absenteeism reduction.

**AGI-Associated Absenteeism**

Our review showed a relationship (p<0.01) between good quality studies that used hand sanitizer and/or soap and an AGI-associated absenteeism reduction of 30%-40% (Master et al., 1997; Sandora et al., 2008; Dyer et al., 2000; White et al., 2001; Talaat et al., 2011). These results are not surprising as soap and possibly hand sanitizers are essential tools for proper hand hygiene. For example, Talaat and colleagues (2011) designed a series of educational activities, including games, theater plays, drawing, and songs, to encourage students to wash hands with soap and water before and after meals and after using the bathroom and requested students to wash hands at least twice during the school day for about 45 seconds, followed by proper rinsing and drying with a clean cloth towel (Talaat et al., 2011). These investigators detected a 33.3% (p<.001) reduction of AGI-associated absenteeism in the intervention group compared to the control group. White and colleagues (2001) offered hand sanitizer to the intervention group and instructed students to use hand sanitizer at the following events: 1) upon arriving at school; 2) before and after eating, and 3) before leaving class at the end of the school day (White et al., 2001). In their study, AGI-associated absenteeism was reduced by 38.7%
(p<.01) in the intervention group. Our findings are also in agreement with the findings in the Curtis and Cairncross systematic literature review that showed hand-hygiene interventions in community-based settings could reduce diarrheal disease by 47% (Curtis & Cairncross, 2003).

**RI-Associated Absenteeism**

The relationship between hand-hygiene interventions and RI-associated absenteeism reduction is inconclusive. Our review revealed that some hand-hygiene interventions—including use of hand sanitizer (with/without education), use of soap, and hand-hygiene education hand-hygiene education—were not associated with RI-associated absenteeism reduction (Master et al., 1997; Sandora et al., 2008; Stebbins et al., 2011; Kimel, 1996); 2 of these 4 studies were low quality studies. Two studies offered hand sanitizer to students and did not detect significant reduction of RI-associated absenteeism in the intervention group (Sandora et al., 2008; Stebbins et al., 2011). One possible reason is that the amount of hand sanitizer used may not be sufficient to reduce the transmission of pathogens that cause respiratory infections. Another possible contribution to this finding is the fact that pathogens that cause GI are ingested, while those that cause RI are inhaled (Fabian et al., 2008). Master and colleagues (1997) encouraged students to wash hands with soap and did not report a significant reduction of RI-associated absenteeism in the intervention group (Master et al., 1997). The study had a lot of design flaws (quality score: 14), including not report confounding variables, not report power calculation to determine the sample size, lack of randomization, and lack of blinding,
which may have contributed to the failure of the study. Kimel (1996) provided an educational intervention to students and detected significant reduction of RI-associated absenteeism in the intervention group one month after the intervention; however, no significant reduction was reported during flu season (two months after the intervention). Lack of paper towel and soap refilling and time may have contributed to this result. Another likely reason for the above findings is the difference in the frequency and timing of hand-hygiene; for example, hand-hygiene practices after coughing or sneezing may not be as frequent as hand-hygiene practices after defecation because the hands are not visibly soiled, yet they are equally essential for controlling the spread of pathogens.

Aiello (2008) conducted a meta-analysis to evaluate the effectiveness of hand-hygiene interventions on infectious disease risk in the community setting and also reached the same conclusion as we did in this systematic literature review: some hand-hygiene interventions were not associated with respiratory illness prevention, but Aiello (2008) stated that it is essential to consistently apply hand-hygiene during critical points in the chain of transmission. In addition, Warren-Gash (2013) suggested the effectiveness of hand-hygiene in reducing transmission of influenza and acute respiratory tract infections varies depending on setting, context, and compliance.

**Relationship between Use of Hand Sanitizer and Absenteeism**

As expected, the use of alcohol-based hand sanitizer was associated with the reduction in combined illness-associated absenteeism and AGI-associated absenteeism;
however, it was not associated with the reduction of RI-associated absenteeism. Our findings are conclusive because most studies (4 of 6) were classified as high quality.

The use of alcohol-free hand sanitizers containing benzalkonium chloride (SAB formulation) (Guinan et al., 1997), which is a less commonly used active ingredient in hand sanitizers, led to significant reductions in AGI-associated, RI-associated, and combined illness-associated absenteeism. Higher quality scores (range 18-19) of those two studies (Dyer et al., 2000; White et al., 2001) make our conclusions more reliable. One possible reason why there was no relationship between the use of alcohol-based hand sanitizers and RI-associated absenteeism reduction is that no active agent remains on the skin after alcohol dries, allowing skin to be recolonized by pathogens; however, the SAB-based hand sanitizer does not dry (Dyer et al., 2000; Dyer et al., 1998). Furthermore, it has been observed that hands can be more susceptible to microbial contamination after frequent use of the alcohol-based sanitizers, because alcohol strips away the sebum that prevents skin from bacterial infections (Dyer et al., 1998).

**Relationship between Using Soap and Absenteeism**

Three studies provided evidence that interventions using non-antibacterial soap were associated with AGI-associated and combined illness-associated absenteeism reduction (Master et al., 1997; Nandrup-Bus, 2009; Talaat et al., 2011). Only one of the three studies had a lower quality study design (quality score: 14). No matter interventions requiring only the use of soap or interventions combining the use of soap and hand-hygiene education (Master et al., 1997; Nandrup-Bus, 2009; Talaat et al., 2011), all
reported a statistically significant (p < .01) reduction in AGI-associated and combined illness-associated absenteeism in the intervention group as compared to the control group. The most likely reason is that interventions offering soap to students solve the problem that lack of consistently available soap, and paper lead to poor hand hygiene practices in schools. It also has been reported hand washing with soap can reduce the risk of gastrointestinal disease by 42-47% (Curtis & Cairncross, 2003). The CDC (2013) also recommended hand washing with soap because it is one of the most effective ways to prevent the spread of many types of illnesses in various settings including elementary schools.

**Relationship between Educational Interventions and Absenteeism Reduction**

Education-only interventions may be associated with RI-associated absenteeism reduction or combined illness-associated absenteeism reduction because all five studies observed a reduction within the intervention groups; however, numerous design flaws, as well as the lack of inferential statistics, made it difficult to conclude the relationship between education-only interventions and illness-associated absenteeism reduction. Therefore, our findings are suggestive, rather than conclusive. One possible reason why hand hygiene is not consistently practiced is ambivalence toward hand washing and misunderstanding about the importance and benefits of hand washing in the school environment (White et al., 2001). Hand-hygiene education may improve this situation and have been shown to be effective on increasing handwashing frequency (Harkavy 2002). Because other obstacles still exist, e.g. lack of handwashing facilities and time,
educational intervention may work better, if combined with other interventions, such as use of hand sanitizer and use of soap.

**Quality Assessment**

Through the use of the quality assessment checklist, our review reveals common flaws in many of the studies; however, some of these flaws were caused by the nature of the intervention and could not be avoided. For example, study results cannot be generalized due to non-randomization; schools often decline to participate in studies, so using a convenience sample is typically more appropriate for this type of study. Studies may also experience non-compliance from participants within the intervention group, which could be resulted in addition of experimental bias; this was a common problem for 12 of the 17 studies measuring absenteeism. The implementation of strict hand-hygiene directives is problematic and only feasible in environments where there is high motivation, such as hospitals; however, even in that environment hand-hygiene compliance is low (Jefferson et al., 2009). Most included studies had the problem of inadequate blinding (n=15) or insufficient adjustments (n=13) for confounding variables, which are well-known causes of exaggerated results. Therefore, their results should be interpreted with caution.

**Suggestions for Future Studies**

Based on our results, we suggest that future studies of hand hygiene interventions address randomization, blinding, and attrition, as these are major sources of bias (Higgins
& Green, 2006). Because participant compliance was low and rarely reported, evaluation of future hand-hygiene interventions should also investigate the frequency, duration, quality, and motivators of hand-hygiene practices. There is a strong association between sample size and statistical power, which enables one to detect a statistically significant difference between intervention and control groups. A trade-off exists between a feasible sample size and adequate statistical power (Eng, 2003). Future studies should consider calculating a proper sample size using power analysis.

**Limitations**

As with most other systematic literature reviews there were limitations because the classification of the intervention was not clear due to multiple components being included in the study. For example, in Stebbins’s study, the hand-hygiene intervention (use of hand sanitizer) was combined with respiratory-hygiene intervention (Stebbins et al., 2011).

The variability of study quality is another limitation of this review. Most studies had flaws common to field research and bias, such as lack of randomization, lack of blinding, large proportion of dropouts, and low participant compliance with the intervention. Therefore, the results of the studies must be interpreted with reasonable caution.

While the quality assessment tool was the most suitable tool for study evaluation in this review, it had its own limitations. The tool was comprehensive; however, no items relating to baseline comparisons were included. The validity and reliability of the tool
were deemed suitable; however, three items were deemed unsuitable based on external validity (Downs & Black, 1998).

The relationship between each type of intervention and absenteeism reduction should also be interpreted with caution. A meta-analysis is necessary to compare association between individual interventions and absenteeism reduction in the review; however, its strict inclusion criteria made it impractical to use for the currently available studies regarding hand-hygiene interventions in elementary schools. Because only 7 of the 17 studies used the same unit of measurement, the analyses necessary for significant comparison between studies were not feasible.

Language also serves as a limitation in this review. We only included studies published in English; whereas, contrasting negative results may be published in non-English journals, so the results in this review may overestimate relation between the interventions and the reduction of the absenteeism.

CONCLUSION

Hand-hygiene is an effective control method for communicable disease (Heymann et al., 2008; Curtis et al., 2000; Michaels et al., 2003). There is not adequate evidence to prove that hand-hygiene interventions are strongly associated with the reduction of RI-associated absenteeism; however, our review concludes that hand-hygiene interventions are associated with AGI-associated absenteeism reduction in elementary schools. Based on our quality assessment of each reviewed study, we suggest that future studies develop protocols that minimize bias. Special attention should be given
to the following protocols: randomization, blinding, and the evaluation of participants’ intervention compliance.
REFERENCES


CHAPTER THREE
HAND HYGIENE PERCEPTIONS, BELIEFS, AND PRACTICES OF SOUTH CAROLINA SCHOOL FOODSERVICE MANAGERS

INTRODUCTION

Most cases of foodborne disease are attributed to improper hand hygiene of infected food workers (Gould et al., 2013). The poor personal hygiene practices of workers have been well documented in many published studies (Giampaoli et al., 2002; Burt et al., 2003; Allwood et al., 2004; Green et al., 2005; Green et al., 2006; Staskel et al., 2007). Few studies, however, have investigated foodservice workers’ hand-hygiene behaviors and perceptions. Strohbehn et al. (2008) observed foodservice workers’ hand-hygiene behaviors in four school districts (K-12) in Kansas for a total of 60 hours and reported that handwashing was only performed 22% of the time in accordance with 2005 Food Code guidelines. No studies were located in which U.S. school foodservice workers’ hand-hygiene perceptions, beliefs, and practices were studied. Therefore, the aim of this study was to determine the hand hygiene perceptions, beliefs, and practices of school foodservice managers in South Carolina.

METHODS

The research protocol for this study was reviewed and approved by the Human Subjects Committee of the Clemson University and Michigan State University Institutional Review Board before data collection began.
Theoretical Framework

Two theoretical frameworks were used to guide design of the survey instrument. The first was the Extended Parallel Process Model (EPPM), a framework for effective communication of health and risk-related information. The EPPM places responses into three categories: 1) non-responses, 2) danger control, and 3) fear control responses (Maloney, Lapinski, & Witte, 2011; Witte et al., 1996; Witte, 1997). The second was the Risk Perception Attitude (RPA) framework, derived from the EPPM, which posits that the relationship between risk perception and self-protective motivations and behaviors is moderated by perceived efficacy, and classifies people into one of four attitude groups (Figure 3.1): 1) responsive attitude (high risk perception, high efficacy beliefs), 2) indifference attitude (low risk perception, low efficacy beliefs), 3) avoidance attitude (high risk perception, low efficacy beliefs), and 4) proactive attitude (low risk perceptions, high efficacy beliefs) (Maloney, Lapinski, & Witte, 2011; Rimal & Real, 2003; Rimal et al., 2009; Rimal & Juon, 2010; Mead et al., 2012).

![Figure 3.1: Risk Perception Attitude Framework](image_url)
The following research questions and hypotheses guided our work:

R1: What are school foodservice managers’ existing food-safety-related practices?
R2: What are school foodservice managers’ perceived risks and efficacy beliefs associated with preventing foodborne disease outbreaks among children?
R3: In which of the RPA quadrants do foodservice managers fall?

H1: After controlling for known predictors, the relationship between risk perception and food safety practices will be stronger at higher levels of efficacy than at lower levels of efficacy.

H2: After controlling for known predictors, the interactive effects of perceived risk and efficacy beliefs on practices will be stronger when the benefit is for self versus others.

**Target Population and Sample**

Our target population was foodservice managers in all public schools in South Carolina (N=1231). All South Carolina Child Nutrition Directors (N=82) were emailed an invitation, which included a description of our study. The directors were asked to forward the email to all school foodservice managers within their district. The link to the web-based survey was included in the e-mail. Instructions were given to the participants on how to access and complete the online survey. After completing the survey, as an incentive, participants could enter a drawing for one of five $50.00 VISA gift cards.
**Instrument Development**

A 35-item web-based survey instrument was developed to assess school foodservice managers’ hygiene-related perceptions, beliefs, and practices. The instrument included closed- and open-ended items in five sections: school characteristics (n=13), self-service practices (n=5), attitudes and opinions (n=8), training (n=4), and demographic information (n=5). All risk perceptions, efficacy beliefs, and practices scales were measured using a 5-point scale ranging from -2 (strongly disagree) to 2 (strongly agree). The number of items used to measure perceptions, beliefs, and practices was limited to minimize respondent fatigue.

Three items measured participant perceptions for risk of gastrointestinal illness (GI); two of three items measured perceived risk to self, and the other one measured perceived risk to children. Two items assessed foodservice managers’ perceived efficacy to protect self, while another one item assessed perceived efficacy to protect children. One item measured foodservice managers’ food-safety-related practices; two of four sub-items specifically measured foodservice manager handwashing practices, including washing hands and wearing gloves.

Twenty-minute cognitive interviews were conducted with six foodservice managers who did not participate in our study. The survey was revised accordingly.

**Data Collection**

The survey was administered through Survey Monkey® between May 14, 2014 and June 23, 2014. Information provided by participants was uploaded to an Excel
spreadsheet without any identifying information attached to completed surveys. Follow-up contacts (telephone calls) were made for each undeliverable email. The survey invitation was then sent to this list of corrected email addresses. Two reminder emails were sent over a two-week period to each district. All districts from which no responses were received were contacted by telephone.

**Data Analysis**

Statistical analyses were performed using SAS 9.4. Frequencies, relative frequencies, and means were calculated for all descriptive data and were used to answer the research questions. Prior to testing our two hypotheses, t-test or one-way analyses of variance (ANOVA) were performed to examine the effects of demographic factors on both independent and dependent variables in order to determine the covariates. According to Tabachinick and Fidell’s (1996) recommendations, included covariates should be correlated with independent variables and dependent variables, but not correlated with another covariate. After conducting one-way ANOVA (Analysis of Variance) analysis and t-test among categorical variables and running the correlations among the continuous variables, no demographic variables were included for future analysis. Hierarchical regression analyses were conducted to test our two hypotheses with self-reported handwashing and food safety-related practices as the outcome variables. Hypotheses tests were done by evaluating the significance of the incremental change in explained variance.
RESULTS

Respondent Characteristics

A total of 416 surveys were completed, 5 were excluded due to duplicate responses; those answered by Child Nutrition Directors (n=8) were also excluded. In total, a 32.7% (403/1231) response rate was achieved. Respondent characteristics are in Table 3.1. Most respondents were female (82.4%), White (59.3%) or Black (25.8%), and had a high school diploma (50.4%). On average, foodservice managers were 51 years old (range 26-73 years) and had worked for 15 years (range 1-42) in school foodservice. Most (75.9%) were certified foodservice managers and had received formal training in hand hygiene (85.6%). Among those who received formal training in hand hygiene, 66.4% received no training on types of soap and nearly 13.0% received no training on drying techniques. Over 20.8% received no training on hand sanitizers, and only 19.1% received training on washing children’s hands. Respondents reported their Child Nutrition Director (42.2%) was their most trusted source for getting information about hand hygiene.
<table>
<thead>
<tr>
<th>Table 3.1: Foodservice Manager Characteristics (N=403)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
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</tr>
<tr>
<td>Race/Ethnicity</td>
</tr>
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<td>Black, Non-Hispanic</td>
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<tr>
<td>American Indian or Alaskan Native</td>
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<tr>
<td>Asian/Pacific Islander</td>
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<tr>
<td>Other</td>
</tr>
<tr>
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</tr>
<tr>
<td>Highest Education Level</td>
</tr>
<tr>
<td>Associate’s degree</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
</tr>
<tr>
<td>Culinary school/technical school</td>
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<tr>
<td>Graduate degree</td>
</tr>
<tr>
<td>High school diploma or GED</td>
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<tr>
<td>Some culinary school or technical school</td>
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<tr>
<td>Some high school, but no diploma</td>
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<tr>
<td>No response</td>
</tr>
<tr>
<td>Hand-hygiene training content (n=345)a</td>
</tr>
<tr>
<td>When to wash hands</td>
</tr>
<tr>
<td>How to wash hands</td>
</tr>
<tr>
<td>How to wash children’s hands</td>
</tr>
<tr>
<td>Types of soap to use</td>
</tr>
<tr>
<td>Drying techniques</td>
</tr>
<tr>
<td>Hand sanitizers</td>
</tr>
<tr>
<td>Water temperatures</td>
</tr>
<tr>
<td>Length of handwashing</td>
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<td>Other</td>
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Table 3.1: Continued

<table>
<thead>
<tr>
<th>Most trusted source for getting information about hand hygiene</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Co-workers</td>
<td>14</td>
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</tr>
<tr>
<td>School administrator</td>
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</tr>
<tr>
<td>District Nutrition Director</td>
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<tr>
<td>Parent Teacher Association</td>
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<tr>
<td>Local health department</td>
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<td>20.8</td>
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<tr>
<td>Federal government</td>
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<td>16.1</td>
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<tr>
<td>Other</td>
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<td>6.0</td>
</tr>
<tr>
<td>No response</td>
<td>42</td>
<td>10.4</td>
</tr>
</tbody>
</table>

*a Hand-hygiene training content: Only respondents who answered yes to the logic question “Have you ever received formal training specifically about hand hygiene” were exposed to this question. Therefore, there were 345 responses to this question.

School Characteristics

Most respondents worked at elementary/primary schools (46.4%, Table 3.2).

Most schools (79.4%) reported that between 0 and 400 students participate in the School Breakfast Program; while 72.9% of schools reported that between 200 and 600 students participate in the School Lunch Program (Table 3.3 & 3.4). Among schools serving meals to students (n=393), most served meals in the cafeteria (95.8%). On average, seven (range 1-39) foodservice workers worked each day for 6.53 hours (range 4-8.5). Hand sanitizer dispensers/bottles were not in 21.3% (n=86) schools. Written policies that required students to wash their hands before entering the cafeteria were only posted in 13.9% (n=56) schools. Of those who reported posted written policies, most respondents identified signage in the cafeterias (n=30), bathrooms (n=36) and classrooms (n=29)
Table 3.2: Participating Schools’ Characteristics (N=403)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td><strong>School type</strong></td>
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<td></td>
</tr>
<tr>
<td>Elementary/primary school</td>
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</tr>
<tr>
<td>Elementary/middle school</td>
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<td>7.0</td>
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</tr>
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<td>High school</td>
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<td>2.0</td>
</tr>
<tr>
<td><strong>Serve meals to students</strong></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>393</td>
<td>97.5</td>
</tr>
<tr>
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<tr>
<td>No response</td>
<td>8</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Places where meals were served</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cafeteria</td>
<td>386</td>
<td>95.8</td>
</tr>
<tr>
<td>Classroom</td>
<td>87</td>
<td>21.6</td>
</tr>
<tr>
<td>Gymnasium</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Hand sanitizers/bottles in school</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>317</td>
<td>78.7</td>
</tr>
<tr>
<td>No</td>
<td>52</td>
<td>12.9</td>
</tr>
<tr>
<td>I do not recall.</td>
<td>18</td>
<td>4.5</td>
</tr>
<tr>
<td>No response</td>
<td>16</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Written policy that requires students to wash their hands before entering the cafeteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>56</td>
<td>13.9</td>
</tr>
<tr>
<td>No</td>
<td>144</td>
<td>35.7</td>
</tr>
<tr>
<td>I do not recall.</td>
<td>182</td>
<td>45.2</td>
</tr>
<tr>
<td>No response</td>
<td>21</td>
<td>5.2</td>
</tr>
</tbody>
</table>
Table 3.2: Continued

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Places where the written policy posted (N=56)(^a)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cafeteria</td>
<td>30</td>
<td>7.4</td>
</tr>
<tr>
<td>Hallway</td>
<td>19</td>
<td>4.7</td>
</tr>
<tr>
<td>Bathroom</td>
<td>35</td>
<td>8.7</td>
</tr>
<tr>
<td>Classroom</td>
<td>29</td>
<td>7.2</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Whether allow self-service practices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>303</td>
<td>75.2</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>20.1</td>
</tr>
<tr>
<td>No response</td>
<td>19</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Self-service opportunities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepackaged foods at the serving line</td>
<td>247</td>
<td>61.3</td>
</tr>
<tr>
<td>Salad bar</td>
<td>47</td>
<td>11.7</td>
</tr>
<tr>
<td>Hot bar</td>
<td>84</td>
<td>20.8</td>
</tr>
<tr>
<td>Open bowls of fresh, whole fruit</td>
<td>231</td>
<td>57.3</td>
</tr>
<tr>
<td>Open vegetable tray</td>
<td>94</td>
<td>23.3</td>
</tr>
<tr>
<td>Other</td>
<td>28</td>
<td>7.0</td>
</tr>
<tr>
<td><strong>Whether observed a student touching exposed food that was available to other students</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>245</td>
<td>60.8</td>
</tr>
<tr>
<td>No</td>
<td>109</td>
<td>27.1</td>
</tr>
<tr>
<td>I do not recall.</td>
<td>24</td>
<td>6.0</td>
</tr>
<tr>
<td>No response</td>
<td>25</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>What foodservice workers do when they observed a student touching exposing food</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set the touched food aside for staff to</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Took out, washed, and put back the touched food touched food</td>
<td>27</td>
<td>6.7</td>
</tr>
<tr>
<td>Required students to take the touched food</td>
<td>126</td>
<td>31.3</td>
</tr>
<tr>
<td>Discarded the touched food</td>
<td>197</td>
<td>48.9</td>
</tr>
<tr>
<td>Nothing</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Other</td>
<td>22</td>
<td>5.5</td>
</tr>
</tbody>
</table>

\(^a\) Places where the written policy posted (N=56): Only respondents who answered yes to the logic question “Written policy that requires students to wash their hands before entering the cafeteria” were exposed to this question. Therefore, there were 56 responses to this question.
Table 3.3: School Types and Numbers of Students Participating in the Breakfast Program

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Number of Schools</th>
<th>Elementary/Primary</th>
<th>Elementary/Middle</th>
<th>Middle</th>
<th>Middle/High</th>
<th>High</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-200</td>
<td>185</td>
<td>79</td>
<td>11</td>
<td>33</td>
<td>11</td>
<td>43</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>201-400</td>
<td>123</td>
<td>62</td>
<td>12</td>
<td>17</td>
<td>5</td>
<td>21</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>401-600</td>
<td>45</td>
<td>25</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>601-800</td>
<td>18</td>
<td>11</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>801-1000</td>
<td>11</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>388</td>
<td>183</td>
<td>28</td>
<td>62</td>
<td>19</td>
<td>73</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 0 was included because it was included in the 0-25 range on the survey instrument.

Table 3.4: School Types and Numbers of Students Participating in the Lunch Program

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Number of Schools</th>
<th>Elementary/Primary</th>
<th>Elementary/Middle</th>
<th>Middle</th>
<th>Middle/High</th>
<th>High</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-200</td>
<td>34</td>
<td>12</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>201-400</td>
<td>139</td>
<td>78</td>
<td>8</td>
<td>17</td>
<td>8</td>
<td>22</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>401-600</td>
<td>143</td>
<td>70</td>
<td>9</td>
<td>32</td>
<td>2</td>
<td>25</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>601-800</td>
<td>50</td>
<td>18</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>15</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>801-1000</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>387</td>
<td>183</td>
<td>28</td>
<td>62</td>
<td>19</td>
<td>72</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 0 was included because it was included in the 0-25 range on the survey instrument.

Student self-service practices were allowed in 75.2% of schools (Table 3.2).

Prepackaged foods at the serving line (61.3%) and open bowls of fresh, whole fruit (57.3%) were the two most common self-service opportunities in schools. Most
respondents (60.8%) reported that they had ever observed a student touching exposed food that was available to other students. When observing this event, most respondents (48.9%) reported they discarded the touched food. Only 2 reported doing nothing when observing students touching exposed food.

**Foodservice Manager Food-Safety Practices**

Four item choices were used to describe foodservice manager food-safety practices (Table 3.5). Foodservice managers indicated high levels of agreement with both handwashing practices (mean=1.7) and food-safety-related practices (mean=1.7).

**Foodservice Manager Perceptions and Beliefs about Children**

Mean scores of items about managers’ perceived risk of GI for children ranged from 0.7 to 1.1 on a scale of -2 to 2 (Table 3.5). Manager mean risk perception of GI for children increased as children’s age decreased. The mean score of foodservice manager efficacy beliefs to protect children from illness was 1.6; only 13 respondents disagreed or strongly disagreed that they could reduce illness-associated absenteeism if they implemented food-safety-related practices.
Table 3.5: Foodservice Manager Perceptions, Beliefs, and Practices

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Item</th>
<th>Frequency (%)</th>
<th>Mean&lt;sup&gt;a&lt;/sup&gt;</th>
<th>SD</th>
<th>D</th>
<th>U</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk perception</td>
<td>Because of my job, I am:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>At risk for experiencing GI</td>
<td>73 (18.1)</td>
<td>98 (24.3)</td>
<td>52 (12.9)</td>
<td>115 (28.5)</td>
<td>25 (6.2)</td>
<td>-0.2 ± 1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Likely to experience GI</td>
<td>65 (16.1)</td>
<td>110 (27.3)</td>
<td>56 (13.9)</td>
<td>67 (16.6)</td>
<td>13 (3.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal illness is:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serious</td>
<td>12 (3.0)</td>
<td>14 (3.5)</td>
<td>39 (9.7)</td>
<td>216 (53.6)</td>
<td>80 (19.9)</td>
<td>0.8 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>13 (3.2)</td>
<td>28 (7.2)</td>
<td>64 (15.9)</td>
<td>134 (33.3)</td>
<td>58 (14.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal illness causes serious complications for:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preschool students</td>
<td>11 (2.7)</td>
<td>10 (2.5)</td>
<td>28 (7.0)</td>
<td>184 (45.7)</td>
<td>119 (29.5)</td>
<td>1.1 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elementary school students</td>
<td>9 (2.2)</td>
<td>12 (3.0)</td>
<td>31 (7.7)</td>
<td>189 (46.9)</td>
<td>96 (23.8)</td>
<td>1.0 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle school students</td>
<td>6 (1.5)</td>
<td>22 (5.5)</td>
<td>59 (14.6)</td>
<td>179 (44.4)</td>
<td>50 (12.4)</td>
<td>0.8 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High school students</td>
<td>7 (1.7)</td>
<td>27 (6.7)</td>
<td>59 (14.6)</td>
<td>175 (43.4)</td>
<td>43 (10.7)</td>
<td>0.7 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adults</td>
<td>7 (1.7)</td>
<td>28 (7.0)</td>
<td>60 (14.9)</td>
<td>177 (43.9)</td>
<td>44 (10.9)</td>
<td>0.7 ± 0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Older adults</td>
<td>7 (1.7)</td>
<td>9 (2.2)</td>
<td>31 (7.7)</td>
<td>165 (40.9)</td>
<td>116 (28.8)</td>
<td>1.2 ± 0.8</td>
<td></td>
</tr>
<tr>
<td>Efficacy belief</td>
<td>I can protect myself from gastrointestinal illness if:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I frequently wash my hands while at work.</td>
<td>11 (2.7)</td>
<td>0 (0)</td>
<td>1 (0.3)</td>
<td>61 (15.1)</td>
<td>291 (72.2)</td>
<td>1.7 ± 0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I use gloves when handling ready-to-eat food.</td>
<td>10 (2.5)</td>
<td>1 (0.3)</td>
<td>0 (0)</td>
<td>56 (13.9)</td>
<td>290 (72.0)</td>
<td>1.7 ± 0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I sanitize serving areas regularly during meal times.</td>
<td>10 (2.5)</td>
<td>2 (0.5)</td>
<td>1 (0.3)</td>
<td>61 (15.1)</td>
<td>283 (70.2)</td>
<td>1.7 ± 0.8</td>
<td></td>
</tr>
<tr>
<td>It is easy for me to:</td>
<td>Frequently wash my hands while at work.</td>
<td>12 (3.0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>58 (14.4)</td>
<td>293 (72.7)</td>
<td>1.7 ± 0.8</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3.5: Continued

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Item</th>
<th>Frequency (%)</th>
<th>Mean&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy beliefs</td>
<td>It is easy for me to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use gloves when handling ready-to-eat food.</td>
<td>9 (2.2)</td>
<td>1.7 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>Sanitize serving areas regularly during meal times</td>
<td>11 (2.7)</td>
<td>1.6 ± 0.8</td>
</tr>
<tr>
<td></td>
<td>I can reduce absenteeism caused by illness among students in my school by:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequently washing my hands while at work</td>
<td>9 (2.2)</td>
<td>1.6 ± 0.8</td>
</tr>
<tr>
<td></td>
<td>Using gloves when handling ready-to-eat food</td>
<td>8 (2.0)</td>
<td>1.6 ± 0.8</td>
</tr>
<tr>
<td></td>
<td>Sanitizing serving areas regularly during meal times</td>
<td>9 (2.2)</td>
<td>1.6 ± 0.8</td>
</tr>
<tr>
<td>Practices</td>
<td>In the last 2 weeks, I typically:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Washed my hands thoroughly before preparing food</td>
<td>8 (2.0)</td>
<td>1.8 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>Wore gloves when I handled ready-to-eat food</td>
<td>7 (1.7)</td>
<td>1.7 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>Sanitized serving areas regularly during meal times</td>
<td>7 (1.7)</td>
<td>1.7 ± 0.8</td>
</tr>
<tr>
<td></td>
<td>Changed serving pieces if I saw a student sneeze on them</td>
<td>7 (1.7)</td>
<td>1.7 ± 0.7</td>
</tr>
</tbody>
</table>

**NOTE:** SD = strongly disagree. D = disagree. U = undecided. A = agree. SA = strongly agree.
<sup>a</sup> Mean: All risk perception, efficacy belief, and behavior scales measured on 5-point scales ranging from -2 (strongly disagree) to 2 (strongly agree), in which higher scores indicated greater agreement or higher levels of the variable.
Risk Perception Attitude Quadrants

Risk perception scores below 0 were classified as lower perceived risk; scores above 0 were classified as higher perceived risk. Efficacy belief scores below 0 were classified as lower efficacy belief; scores above 0 were classified as higher efficacy belief. Most respondents (85.8%) fell in the quadrant “high risk perception, high efficacy beliefs” (Figure 3.2).

Effect of Risk Perception on Food-safety Practices

The beta coefficient corresponding to risk perception × efficacy belief was not significant ($\beta=0.03, t=1.3, p>0.05$) and the addition of this term did not yield a significant change in $R^2$ ($R^2=0.8, \Delta R^2=0.001, p>0.05$) (Table 3.6). The Beta coefficient can be explained as when the independent variable (e.g. risk perception) changes 1 unit, the dependent variable (e.g. food-safety practices) will change $\beta$ units. Significance of the change in $R^2$ indicated the significant effect of the added variable on the outcome.

Furthermore, data analysis revealed there was no relation between risk perception and foodservice managers’ food-safety-related practices ($\beta=-0.03, t=-1.3, p>0.05$). In addition to testing the effect of independent variables on food safety practices, we also tested the effect of independent variables on foodservice manager handwashing practices. There was not a significant relationship between risk perception and handwashing practices ($\beta=-0.04, t=-1.3, p>0.05$).
NOTE: Attgroup=attitude group.

Figure 3.2: Risk Perception Attitude Framework Quadrants
Table 3.6: Effect of Risk Perceptions on Handwashing/Food-safety Practices

<table>
<thead>
<tr>
<th></th>
<th>β^a</th>
<th>t</th>
<th>Block ΔR^2</th>
<th>Total R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DV: handwashing behaviors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td></td>
<td></td>
<td>0.7^b</td>
<td>0.7</td>
</tr>
<tr>
<td>Riskall</td>
<td>-0.04</td>
<td>-1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effall</td>
<td>0.9</td>
<td>30.0**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riskall*Effall</td>
<td>0.03</td>
<td>1.1</td>
<td>0.001^b</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>β^a</th>
<th>t</th>
<th>Block ΔR^2</th>
<th>Total R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DV: food-safety behaviors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td></td>
<td></td>
<td>0.8^b</td>
<td>0.8</td>
</tr>
<tr>
<td>Riskall</td>
<td>-0.03</td>
<td>-1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effall</td>
<td>0.9</td>
<td>36.3**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riskall*Effall</td>
<td>0.03</td>
<td>1.3</td>
<td>0.001^b</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**NOTE:** Riskall=overall risk perception. Effall=overall efficacy beliefs.
^a Unstandardized β from regression equations.
^b p-value>0.05, which indicates no significant difference was observed. **p<0.01.

Interactive Effect of Perceived Risk and Efficacy Beliefs on Practices

We tested the interactive effects that perceived risk and efficacy beliefs could each have on handwashing practices and food safety-related practices. The data indicated that the addition of risk perception to others × efficacy beliefs to other interactions yielded a nonsignificant change in R^2 in the test on either handwashing practices (R^2=0.7, ΔR^2=0.004, p>0.05) or food safety-related practices (R^2=0.8, ΔR^2=0.004, p>0.05) (Table 3.7).
Table 3.7: Interactive Effect of Risk Perceptions and Efficacy Beliefs on Handwashing/Food-safety Practices

<table>
<thead>
<tr>
<th>DV: handwashing behaviors</th>
<th>Block ΔR²</th>
<th>Total R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>0.7b</td>
<td>0.7</td>
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<tr>
<td>Riskself</td>
<td>-0.02</td>
<td>-0.9</td>
</tr>
<tr>
<td>Effself</td>
<td>0.6</td>
<td>13.5**</td>
</tr>
<tr>
<td>Riskothers</td>
<td>-0.006</td>
<td>-0.2</td>
</tr>
<tr>
<td>Effothers</td>
<td>0.2</td>
<td>5.5**</td>
</tr>
</tbody>
</table>

Model 1
Riskself*Effself 0.007 0.3 0.0001b 0.7

Model 2
Riskothers*Effothers 0.02 0.7 0.0004b 0.7

DV: food-safety behaviors

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<th>Block ΔR²</th>
<th>Total R²</th>
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<tbody>
<tr>
<td>Block</td>
<td>0.8b</td>
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<tr>
<td>Riskself</td>
<td>-0.03</td>
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<tr>
<td>Effself</td>
<td>0.6</td>
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<tr>
<td>Riskothers</td>
<td>0.006</td>
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<tr>
<td>Effothers</td>
<td>0.3</td>
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</tbody>
</table>

Model 1
Riskself*Effself 0.005 0.2 0.00002b 0.8

Model 2
Riskothers*Effothers 0.02 0.8 0.0004b 0.8

NOTE: Riskself=perceived risk to self. Riskothers=perceived risk to others. Effself=perceived efficacy to protect self. Effother=perceived efficacy to protect others. HW=handwashing behaviors. FS=food-safety behaviors.

a Unstandardized β from regression equations.
b P-value>0.05, which indicates no significant difference was observed. **p<0.01.

DISCUSSION

The aim of this study was to assess school foodservice manager food-safety practices, risk perceptions, and efficacy beliefs. Using the Extended Parallel Process Model (EPPM) and the Risk Perception Attitude (RPA) framework as guides, we sought to better understand the effects of risk perceptions and efficacy beliefs on food-safety
behaviors. The following is a discussion of our findings in relation to our research questions and hypotheses.

R1: Foodservice Managers’ Existing Food-safety Practices

The survey findings indicated high level of agreement with proper food-safety practices and handwashing practices. It is well known that improper hand-hygiene can lead to cross-contamination and is one of the most common improper practices among food workers (Green et al., 2005; Green et al., 2006; Mitchell et al., 2007). Food worker bare-hand contact with food is also the most common contamination factor that contributes to foodborne disease outbreaks (Painter et al., 2006; Gould et al., 2013). In our study, 87.4% of respondents agreed or strongly agreed that they washed their hands thoroughly before preparing food; while 89.1% of the foodservice managers agreed or strongly agreed that they wore gloves when handling ready-to-eat food. One plausible reason is that these practices are required by the South Carolina HACCP (Hazard Analysis & Critical Control Point) plan. Moreover, most (75.9%) respondents were certified managers and 85.6% had received formal training about hand hygiene.

Therefore, they were required and trained to follow proper hand-hygiene practices. In addition, the average age of our sample was 51 years old and had worked for 15 years in school foodservice. Given this, we believe they were familiar with school food-safety guidelines and had developed good hand-hygiene practices.

R2: School Foodservice Managers’ Perceived Risks and Efficacy Beliefs Associated with Preventing Foodborne Disease Outbreaks among Children
Respondents perceived moderate levels of risk among children and high levels of efficacy beliefs concerning preventing GI among children. It has been reported that food worker hand-hygiene knowledge is increased after corresponding training (Hertzman, et al., 2011; Lin and Sneed, 2005; Yarrow, 2006). School foodservice manager’s moderate level of risk perception among children might have been influenced by a lack of risk presented in their training. However, their agreement that younger children were more at risk than older children is presumably because many food safety trainings clearly identify highly susceptible audiences, such as very young children. Age may also contribute to the moderate level of perceived risk, as previous studies observed that people perceive less risk when getting older (Lobb et al., 2007; Millstein & Halpern-Felsher, 2002; Rhodes & Pivik, 2011).

**R3: Risk Perception Attitude Quadrants**

Most respondents classified as either having a *responsive* attitude (85.76%) or a *proactive* attitude (10.47%) toward preventing GI. Previous studies showed that food safety training had a positive impact on foodservice employee knowledge of food safety (Hertzman, et al., 2011; Lin and Sneed, 2005; Yarrow, 2006). The food safety training that these managers previously received likely contributed to their perception of the severity of GI. Although respondents seemed knowledgeable about the severity of GI, some did not consider themselves susceptible to it. Their confidence in their hand-hygiene practices and food safety-related practices might have caused the decrease in their of perceived susceptibility of getting GI. Ultimately, we found that managers
reported good food safety-related and hand-hygiene practices (and high efficacy beliefs) regardless of their motivation for doing so—whether it be related to perceived risk or not.

**H1: Relationship between risk perception and food safety behavior will be stronger at higher levels of efficacy than at lower levels of efficacy.**

We expected that foodservice managers with higher levels of efficacy beliefs would also exhibit risk perceptions that more strongly influenced their food safety-related practices. However, a lack of effect of risk perceptions on both handwashing practices and food-safety practices indicated that practices were not motivated by school foodservice managers’ own perceptions of risk. School foodservice is highly regulated and is required to have an active school HACCP (Hazard Analysis Critical Control Point) plan, which has clearly defined hand hygiene and safe food handling standards. Such regulations likely have a greater influence on foodservice manager practices than their own perceptions of risk.

**H2: The interactive effects of risk and efficacy on behavior will be stronger when the benefit is for self vs. others.**

We expected that managers’ risk perception in conjunction with their efficacy beliefs would influence their food-safety practices, as the RPA framework posits that the relationship between risk perception and self-protective motivations and practices is moderated by efficacy beliefs (Maloney, Lapinski, & Witte, 2011; Rimal & Real, 2003; Mead et al., 2012). However, a lack of interactive effect of risk perception and efficacy
beliefs on both handwashing practices and food-safety practices indicated that practices were not motivated by the perceived risk combined with efficacy. Regulations and control of school foodservice environments combined with the proper training that most school foodservice workers had received likely had a greater influence on their food safety behaviors than did their individual beliefs or perceptions.

**Limitations**

The results of this study were limited to school foodservice managers in the state of South Carolina and cannot be generalized to all school food handlers throughout United States without further study. Therefore, a future national study is suggested to identify regional differences. Furthermore, behaviors, perceptions, and beliefs were self-reported and may not truly reflect the actual behaviors, perceptions, and beliefs of the participants, which are prone to response bias by the participants.

**CONCLUSION**

Foodservice workers have been involved in multiple foodborne diseases, making assessment of foodservice workers’ food-safety-related practices, perceptions, and beliefs a necessity. Our findings identified school foodservice managers’ low susceptibility to gastrointestinal diseases, high level of perceived efficacy to protect self and others from getting gastrointestinal diseases, high level of agreement with proper food-safety practices and revealed there was little effect of foodservice managers’ risk perceptions on
their food-safety behaviors. As our study only targeted the state of South Carolina, a further national study is suggested to identify regional differences.
REFERENCES


Yarrow, L. K. (2006). Food safety attitudes, beliefs, knowledge and self-reported practices of college students before and after educational intervention (Doctorial Dissertation). Kansas State University.
Appendix A

Downs and Black’s Checklist

Reporting

1. *Is the hypothesis / aim / objective of the study clearly described?*

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2. *Are the main outcomes to be measured clearly described in the Introduction or Methods section?*

If the main outcomes are first mentioned in the Results section, the question should be answered no.

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3. *Are the characteristics of the patients included in the study clearly described?*

In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given.

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4. *Are the interventions of interest clearly described?*

Treatments and placebo (where relevant) that are to be compared should be clearly described.

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5. *Are the distributions of principal confounders in each group of subjects to be compared clearly described?*

A list of principal confounders is provided.

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6. *Are the main findings of the study clearly described?*

Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and
conclusions. (This question does not cover statistical tests which are considered below).

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7. **Does the study provide estimates of the random variability in the data for the main outcomes?**

In non normally distributed data the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes.

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8. **Have all important adverse events that may be a consequence of the intervention been reported?**

This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided).

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9. **Have the characteristics of patients lost to follow-up been described?**

This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no where a study does not report the number of patients lost to follow-up.

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10. **Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?**

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**External validity**
All the following criteria attempt to address the representativeness of the findings of the study and whether they may be generalized to the population from which the study subjects were derived.

11. *Were the subjects asked to participate in the study representative of the entire population from which they were recruited?*

The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine.

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12. *Were those subjects who were prepared to participate representative of the entire population from which they were recruited?*

The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.

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13. *Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?*

For the question to be answered yes the study should demonstrate that the intervention was representative of that in use in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre unrepresentative of the hospitals most of the source population would attend.

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<th>answer</th>
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**Internal validity - bias**

14. **Was an attempt made to blind study subjects to the intervention they have received?**

For studies where the patients would have no way of knowing which intervention they received, this should be answered yes.

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15. **Was an attempt made to blind those measuring the main outcomes of the intervention?**

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16. **If any of the results of the study were based on "data dredging", was this made clear?** Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes.

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17. **In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?**

Where follow-up was the same for all study patients the answer should yes. If different lengths of follow-up were adjusted for by, for example, survival analysis the answer should be yes. Studies where differences in follow-up are ignored should be answered no.

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18. **Were the statistical tests used to assess the main outcomes appropriate?**

The statistical techniques used must be appropriate to the data. For example non parametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not
described it must be assumed that the estimates used were appropriate and the question should be answered yes.

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19. Was compliance with the intervention/s reliable?

Where there was non compliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes.

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20. Were the main outcome measures used accurate (valid and reliable)?

For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.

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Internal validity - confounding (selection bias)

21. Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?

For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.

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22. Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?

For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine.

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23. Were study subjects randomized to intervention groups?

Studies which state that subjects were randomized should be answered yes except where method of randomization would not ensure random allocation. For example alternate allocation would score no because it is predictable.

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24. Was the randomized intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?

All non-randomized studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no.

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25. Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?

This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In non randomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.

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26. Were losses of patients to follow-up taken into account?

If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.

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**Power**

27. Did the study have sufficient power to detect a clinically important effect?

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Appendix B

School Self-Service Practices Survey

Clemson University, Michigan State University, and North Carolina State University are working together on a U.S. Department of Agriculture (USDA) project to improve hand hygiene practices in South Carolina schools. We need your help to better understand hand hygiene practices in schools. Please help us by answering approximately 35 questions about the school where you work. We estimate it will take 10 minutes to complete the survey. We will use the information gathered to develop an intervention to improve hand hygiene practices in schools.

Participation in this survey is voluntary. If you decide to participate, you can enter a drawing for one of five $50.00 VISA gift cards by clicking the link at the end of the survey and filling in your name and e-mail address. The five winners will be contacted by late June 2014. All information collected will be kept strictly confidential. After the drawing is complete, all names and contact information will be destroyed. We will share the aggregated data with Dr. Bowens-Seabrook and her group as well as with you.

We appreciate your time. If you have any questions or concerns about this study, please contact Dr. Angela Fraser (Clemson University) at afraser@clemson.edu. If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Office of Research Compliance at 864.656.6460. Thank you in advance for your participation in this survey.

PART I. SCHOOL CHARACTERISTICS

1. In which county is your school located?

   County

   Please select: [ ]

2. What is the name of your school?

3. Which BEST describes your school?

   ○ Elementary/Primary School
   ○ Elementary/Middle School
   ○ Middle School
   ○ Middle/High School
   ○ High School
   ○ Other, please specify

4. Does your school provide meals to students?

   ○ Yes
   ○ No
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5. Approximately how many students participate in the School Breakfast Program EACH day at your school?
   Please select: No. of Students

6. Approximately how many students participate in the School Lunch Program EACH day at your school?
   Please select: No. of Students

7. Where are meals served to students? Select all that apply.
   - Cafeteria
   - Classroom
   - Gymnasium
   - Other; please specify

8. On average, how many hours do the foodservice workers work EACH day?
   Please select: Work Hours

9. Approximately how many TOTAL foodservice workers are employed at your school?
   Please select: No. of Food Workers

10. Approximately how many foodservice workers work EACH day?
    Please select: No. of Food Workers
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11. Are hand sanitizer dispensers/bottles available to students in your school?

☐ Yes
☐ No
☐ I do not recall.

12. Does your school have a WRITTEN policy that requires students to wash their hands before entering the cafeteria to eat breakfast or lunch?

☐ Yes
☐ No
☐ I do not recall.

13. Where are notices referring to this policy posted? Select all that apply.

☐ Cafeteria
☐ Hallway
☐ Bathroom
☐ Classroom
☐ Other, please specify ________________

PART II. SELF-SERVICE PRACTICES

We will ask you 5 questions about self-service practices in your school. We are defining "self-service" as students serving themselves food provided by the school.
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14. Does your school allow students to serve food to themselves (such as prepackaged food and whole fruit)?
   - Yes
   - No

15. Select ALL the self-service opportunities that are available to students in your school.
   - Prepackaged foods at the serving line
   - Salad bar
   - Hot bar
   - Open bowls of fresh, whole fruit
   - Open vegetable tray

   Please select:

   Other, please specify

16. In my school, there are procedures for:
   - How to keep self-service areas clean
   - When to clean utensils used in self-service areas
   - When to replace utensils used in self-service areas
   - When to sanitize surfaces of self-service areas
   - How to manage food at the serving line that has been touched by bare hands

   Yes  No  I do not know.

17. Have you ever observed a student touching exposed food that was available to other students?
   - Yes
   - No
   - I do not recall.
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18. What did you do when you observed a student touching exposed food that was available to other students? Select all that apply.

- Set the touched food aside for staff to eat/take home
- Took out, washed, and put back the touched food
- Required students to take the touched food
- Discarded the touched food
- Nothing
- Other, please specify

PART III. ATTITUDES AND OPINIONS

The next 8 questions are regarding your attitudes and opinions about hand hygiene. There are no right or wrong answers. For the purpose of this survey, we define "gastrointestinal illness" as a short-term illness with any of the following symptoms: diarrhea, vomiting, and/or stomach cramps.

19. When someone vomits in your facility, what do you believe is the MOST likely cause?

- Virus
- Flu
- Food poisoning
- Food Intolerance
- Food allergies
- Psychological conditions (such as anxiety)
- Other, please specify

For the following questions, please indicate your level of agreement.

20. Because of my job, I am:

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>At risk for experiencing gastrointestinal illness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likely to experience gastrointestinal illness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# School Self-Service Practices Survey

## 21. Gastrointestinal illness is:

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
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</tr>
</tbody>
</table>

## 22. Gastrointestinal illness causes serious complications for:

<table>
<thead>
<tr>
<th>Group</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school students</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Middle school students</td>
<td></td>
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<tr>
<td>High school students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Older adults</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## 23. I can protect myself from gastrointestinal illness if:

<table>
<thead>
<tr>
<th>Action</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I frequently wash my hands while at work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I use gloves when handling ready-to-eat food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I sanitize serving areas regularly during meal times</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

## 24. It is easy for me to:

<table>
<thead>
<tr>
<th>Action</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequently wash my hands while at work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use gloves when handling ready-to-eat food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitize serving areas regularly during meal times</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## 25. I can reduce absenteeism caused by illness among students in my school by:

<table>
<thead>
<tr>
<th>Action</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequently washing my hands while at work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using gloves when handling ready-to-eat food</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitizing serving areas regularly during meal times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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26. In the last 2 weeks, I typically:

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washed my hands thoroughly before preparing food</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wore gloves when I handled ready-to-eat food</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sanitized serving areas regularly during meal times</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Changed serving pieces if I saw a student sneeze on them</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

PART IV. Training

27. Are you a certified foodservice manager?
   ○ Yes
   ○ No

28. Have you ever received formal training specifically about hand hygiene?
   ○ Yes
   ○ No
   ○ I do not recall.

29. What did the training cover? Select all that apply.
   ○ When to wash hands
   ○ How to wash hands
   ○ How to wash children’s hands
   ○ Types of soap to use
   ○ Drying techniques
   ○ Hand sanitizers
   ○ Water temperatures
   ○ Length of handwashing
   ○ Other, please specify
30. When it comes to getting information about hand hygiene at your job, who is your MOST trusted source?
- Co-workers
- School administrator
- District Nutrition Director
- Parent Teacher Association (PTA/PTO)
- Local health department
- Federal government (e.g., FDA, CDC, USDA)
- Other, please specify

PART V. DEMOGRAPHIC INFORMATION

31. I am:
- Male
- Female
- Other

32. What year were you born?

33. What is your racial background? Select all that apply.
- White, Non-Hispanic
- Black, Non-Hispanic
- Hispanic
- American Indian or Alaskan Native
- Asian/Pacific Islander
- Other, please specify
34. What is the HIGHEST level of education you have completed?

- Some high school, but no diploma
- High school diploma or GED
- Some culinary school or technical school/college
- Finished culinary school or technical school with certificate(s)/diploma
- Associate's degree
- Bachelor's degree
- Graduate degree

35. How many years have you worked in school foodservice?

Please select:

36. Feel free to leave any comments, suggestions, or feedback here.

Thank you very much for your time.

You have completed the survey.

If you choose to participate in the VISA gift card drawing, please click here.
## Appendix C

### Duration of Education/Data Collection

<table>
<thead>
<tr>
<th>Citation</th>
<th>Intervention</th>
<th>Duration of education</th>
<th>Duration of data collection</th>
<th>Intervention details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammond (2000)</td>
<td>ABHR</td>
<td>NA</td>
<td>36 weeks</td>
<td>Students were instructed to use ABHR when entering and leaving the classroom, first thing in the morning, before and after lunch, after recesses, after use of the restroom, and before going home.</td>
</tr>
<tr>
<td>Nandrup-Bus (2011)</td>
<td>ABHR</td>
<td>NA</td>
<td>12 weeks</td>
<td>Students were required to use ABHR before the first less, before lunch, and before leaving school for home.</td>
</tr>
<tr>
<td>Sandora (2008)</td>
<td>ABHR</td>
<td>NA</td>
<td>32 weeks</td>
<td>Students were required to use ABHR before and after lunch, after use of the restroom, and after any contact with potentially infectious secretions.</td>
</tr>
<tr>
<td>Guinan (2002)</td>
<td>ABHR; Education</td>
<td>1 hour</td>
<td>12 weeks</td>
<td>1 hour educational activities; students were directed to the hand sanitizer</td>
</tr>
<tr>
<td>Morton &amp; Schultz  (2004)</td>
<td>ABHR; Education</td>
<td>45 min</td>
<td>15 weeks</td>
<td>Students could access to ABHR in first 46 days and last 47 days; 45-min “Germ Unit” to each class prior to the start of the experiment phase.</td>
</tr>
<tr>
<td>Stebbins (2011)</td>
<td>ABHR; Education</td>
<td>45-min</td>
<td>25 weeks</td>
<td>A set of “WHACK the Flu” were used from November 1, 2007 to April 24, 2008</td>
</tr>
<tr>
<td>Dyer (2000)</td>
<td>Alcohol-free hand rub</td>
<td>NA</td>
<td>10 weeks</td>
<td>Students were instructed to use AFHR in first 4 weeks and last 4 weeks</td>
</tr>
<tr>
<td>White (2001)</td>
<td>Alcohol-free hand rub</td>
<td>NA</td>
<td>5 weeks</td>
<td>Students were instructed to use AFHR upon entering the classroom, before and after eating, and before leaving class at the end of the school day.</td>
</tr>
<tr>
<td>Master (1997)</td>
<td>Soap</td>
<td>NA</td>
<td>7 weeks</td>
<td>Children were required to wash hands after arrival at school, before eating lunch, after lunch recess, and before going home.</td>
</tr>
<tr>
<td>Nandrup-Bus (2009)</td>
<td>Soap</td>
<td>NA</td>
<td>12 weeks</td>
<td>Students were required to wash hands before beginning the first less, before lunch, and before leaving school for home.</td>
</tr>
<tr>
<td>Talaat (2011)</td>
<td>Soap; Education</td>
<td>NA</td>
<td>12 weeks</td>
<td>Students were required to wash hands at least twice during the school day; Educational activities include games, theater plays, drawings and songs.</td>
</tr>
<tr>
<td>Citation</td>
<td>Intervention</td>
<td>Duration of education</td>
<td>Duration of data collection</td>
<td>Intervention details</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>-----------------------</td>
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<td>----------------------</td>
</tr>
<tr>
<td>Vessey (2007)</td>
<td>Soap; Hand rub</td>
<td>NA</td>
<td>16 weeks</td>
<td>Half of the classes used hand sanitizer while the other half used soap and water.</td>
</tr>
<tr>
<td>Day (1993)</td>
<td>Education</td>
<td>NA</td>
<td>26 weeks</td>
<td>A special teaching program for students with disability</td>
</tr>
<tr>
<td>Kimel (1996)</td>
<td>Education</td>
<td>50 min</td>
<td>18 weeks</td>
<td>½-hour presentation and 20-min discussion</td>
</tr>
<tr>
<td>Lau (2012)</td>
<td>Education</td>
<td>1 hour</td>
<td>35 weeks</td>
<td>An initial 30-min interactive session and three 10-min review sessions every two months.</td>
</tr>
<tr>
<td>Monsma (1992)</td>
<td>Education</td>
<td>NA</td>
<td>4 weeks</td>
<td>A set of activities every week</td>
</tr>
<tr>
<td>Touman (2007)</td>
<td>Education</td>
<td>NA</td>
<td>4 weeks</td>
<td>A learner-centered activity each week</td>
</tr>
</tbody>
</table>