PREVENTING RECREATIONAL WATER ILLNESSES IN CHEMICALLY TREATED SWIMMING WATER: AN INTERVENTION MEASURING KNOWLEDGE AND BEHAVIOR USING THE STAGES OF CHANGE MODEL

by

Gayle Lynn Bush

A Dissertation Submitted to the
Faculty of The Graduate School at
Middle Tennessee State University
In Partial Fulfillment of the Requirements
for the Doctor of Arts Degree

Murfreesboro, Tennessee
August, 2002

UMI Number: 3059073

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

Bush, Gayle Lynn, D.A. Preventing Recreational Water Illnesses in Chemically Treated Swimming Water: An Intervention Measuring Knowledge and Behavior Using the Stages of Change Model (2002).
Directed by Dr. Peggy O'Hara-Murdock.

ABSTRACT

Rationale

This research addresses the public health importance of waterborne disease prevention and the effectiveness of prevention strategies in non-outbreak settings. Because of the popularity of recreational water activities and the concern for the health of swimmers, this research promotes knowledge and skills related to preventing the spread of waterborne disease.

Study Design

The study design was a behavioral intervention to test the effectiveness of a waterborne disease prevention training session. The primary outcome of this study was to advance aquatic staff in stages of behavior change and knowledge in regard to waterborne disease prevention. Outcome measures were assessed by comparison of pre and posttest survey results.

Measures

A training manual, consisting of information about preventing waterborne diseases, was designed for this intervention. Data collection instruments included three questionnaires: a behavior survey to measure stages of change, a waterborne disease knowledge survey and a demographics survey. An evaluation form was administered after the training session. The stages of change behavior survey assessed each participant's stage in regard to behaviors related to waterborne disease

prevention. There are five emphasis areas in the behavior survey to assess the implementation or existence of recreational water illnesses (RWI) prevention: 1) facility maintenance, 2) pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) recreational water illness training. The knowledge survey consisted of ten multiple choice questions about waterborne diseases and how to prevent them in chemically treated swimming water.

Results

The participants who received the training advanced to another stage or progressed within a stage in all five behavioral emphasis areas. These participants also gained 35 percent in knowledge from pre to posttest. The control participants did not advance in stages of change or increase in knowledge. The data were analyzed using a general linear model approach. Interactions of group and pretest scores were the strongest predictors of the posttests scores ($p < .05$). This intervention has proven to be a useful tool for training aquatic staff in preventing waterborne disease in chemically treated swimming water.

APPROVAL PAGE

PREVENTING RECREATIONAL WATER ILLNESSES IN CHEMICALLY TREATED SWIMMING WATER: AN INTERVENTION MEASURING KNOWLEDGE AND BEHAVIOR USING THE STAGES OF CHANGE MODEL

Committee Chair Peggy O'Hara Murdock

Committee Members Norman Weatherby

Jane L. Williams

HPERS Department Chair Martha H. Whaley

Dean of Graduate Studies Donald L. Coney

ACKNOWLEDGMENTS

I would like to express sincere appreciation to Dr. Peggy O'Hara-Murdock, chairman of the committee, for her time, encouragement, and enthusiasm during this process. Her expertise in the area of behavioral intervention studies and scientific writing skills were invaluable. Appreciation is also expressed to Dr. Norman Weatherby, for serving on the committee, and his expertise in data analysis. I would also like to thank Dr. Jane Williams for serving on the committee, and for her guidance in writing surveys. I thank my committee for all I learned from them in graduate courses. I would also like to thank Dr. Michael Beach of the Centers for Disease Control for providing the background information needed to make the intervention possible, and for editing the intervention training manual. I appreciate these scholars interest in my research and for helping me do excellent work.

I would like to express deep appreciation for the love and support of my parents, Ellis and Juanita Bush, and my siblings and their families. I am so blessed to have all of you. I thank close friends in Murfreesboro, such as Rebecca, Gwen and Kathy, for their encouragement during this five year process. I am thankful for my Christian faith that gives strength and grace for every day. I am also thankful to my precious daughter Heidi for keeping life in perspective. May all her dreams of being a doctor one day come true.

TABLE OF CONTENTS

LIST OF TABLES

Page

Table

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

In the United States there are more than 400 million visits to swimming pools every year (U.S. Bureau of the Census, 2001). Due to the popularity of recreational water activities and the concern for the health and safety of swimmers, the Centers for Disease Control and Prevention (CDC) has established a surveillance system to monitor recreational water outbreaks. Because of the continued possibility for contamination of swimming water, the CDC recommends that health departments and pool managers work together in detecting and controlling pool-associated outbreaks of waterborne disease. A multi-component approach to outbreak prevention is needed to combine education of swimmers and pool staff, pool design modifications, and improved operations and maintenance procedures (MMWR, May 25, 2001 / 50(20); 416-7).

Prevalence of Illnesses

Although swimming is the second most popular recreational activity in the United States, the risk of RWI outbreaks is still low. However, CDC current risk management practices suggest that planning is necessary for low-risk events, such as drowning, lightning strikes and waterborne illness (CDC, Healthy Swimming, 2002). These low-risk events are very serious and have caused death.

During the 1990s in the United States, reports of outbreaks of gastrointestinal disease associated with the use of chemically treated recreational water have increased. Between 1989 and 1998, approximately 10,000 cases of diarrheal illness were associated with recreational waterborne disease outbreaks in chemically treated swimming water. During 1997-1998, a total of 18 states reported 32 outbreaks associated with recreational water (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). These 32 outbreaks caused illness in an estimated 2,128 persons. Rinsing of soiled bodies and overt fecal accidents cause contamination of water (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 – 1998), and the unintentional ingestion of even a very small amount of recreational swimming water can cause gastrointestinal disease (MMWR, May 25, 2001/ 50(20), 410-2).

Awareness and Prevention of Recreational Water Illnesses (RWI)

Public awareness of illness associated with swimming is low because swimmers do not realize that shared pool water contains various bodily fluids from people in the water. Many swimmers are also unaware of the time it takes for chlorine to kill pathogens (CDC, Healthy Swimming, 2002).

Many aquatic directors are unaware of the problem of recreational water illnesses (CDC, Healthy Swimming, 2002). Until May of 2001, pool operators did not have access to resources such as the Healthy Swimming web-site from the Division of Parasitic Diseases (DPD) at the CDC. Until recently, staff trainings have had little to do with RWI transmission and the key role that chlorine and pH balance play as a barrier to the spread of disease (MMWR, May 25, 2001 / 50(20); 416-7). Prevention efforts need to focus on awareness and behavior change of prevention practices by aquatic staff and swimmers.

Because of the large number of swimmers in the United States, there are numerous aquatic facilities with large numbers of staff that could be involved in waterborne disease prevention (Chervin, Revels & Richardson, 1999). There are approximately ten million public or private swimming pools in the United States (U.S. Bureau of the Census, 1995). Lifeguards compose one occupational group that could be on the forefront of waterborne disease prevention (Chervin, 1999). In 1999, the American Red Cross trained 161,873 new lifeguards (B. Smith, personal communication, 2001). However, none of the lifeguard texts contained any information concerning waterborne disease and prevention measures (ARC, 1997). Safety programs at aquatic facilities need to expand training sessions to include proactive prevention planning that reduce the risk of RWI outbreaks (MMWR, May 25, 2001 / 50(20); 416-7).

Rationale for the Study

The purpose of this study was to determine the effectiveness of waterborne disease prevention training in changing knowledge and behaviors among lifeguards and aquatic directors in middle Tennessee. This research addressed the importance of waterborne disease prevention by promoting knowledge and skills related to preventing the spread of RWI, and the maintenance of these preventive behaviors.

Training aquatic staff about prevention of RWI transmission is possible through materials provided by the CDC. In this study, a manual was designed for the intervention which consisted of information about preventing waterborne diseases in chemically treated recreational swimming water. The manual developed for this study focused on awareness and promotion of knowledge and skills training to prevent the spread of RWI.

The DPD has developed a program titled "Healthy Swimming" to promote safer water practices with the use of a web-site that makes information available to aquatic staff and patrons of recreational water facilities. The Healthy Swimming initiative emphasizes waterborne illness prevention related to pool water quality, diaper policies, facility maintenance, pool policies and regular staff training (CDC, Healthy Swimming, 2002). In the present study, these five areas were addressed in surveys and in the intervention training.

The CDC maintains surveillance on outbreaks of recreational water illnesses in treated and fresh water. The DPD has conducted focus group studies with aquatic industry representatives and parents. Past participants of these groups have stated "as we become more knowledgeable, we will have higher standards," indicating a readiness to change (Chervin, et al., 1999).

The transtheoretical model of intentional change, referred to as stages of change, was the theoretical framework of this study (Prochaska, DiClemente, & Norcross, 1992). The stages of change theory states that individuals progress through similar stages of change during the process of changing health behaviors (Prochaska & DiClemente, 1983). The stages of change model has five stages: precontemplation, contemplation, preparation, action and maintenance (Prochaska et al., 1992). The stages provide a framework which allows for a better understanding of when changes occur in both an individual's intention for engaging in a particular behavior as well as actual performance of that behavior (Prochaska et al., 1992). The transtheoretical model can be helpful in designing, administering and evaluating interventions to help people adopt specified behaviors (Glanz, Kristal, Curry & Patterson, 1999).

In this study, effectiveness of the intervention was demonstrated by showing positive increases in stages of change for individuals who received the waterborne disease prevention training in comparison with those who did not, and by advances in knowledge of waterborne disease. Data collection instruments included four questionnaires: a behavior survey to measure stages of change, a waterborne disease knowledge survey, a demographics survey and a training session evaluation form.

An effective intervention should include a range of components and targets for change, so there will be goals for behavior change that are appropriate for participants at all stages of change (Glanz, et al., 1999). In this study, the stages of change behavior survey assessed each participant's stage in regard to behaviors related to waterborne disease prevention. There were five emphasis areas in the behavior survey to assess the implementation or existence of RWI prevention: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) training in RWI. The data were analyzed using a general linear model approach to measure the effect of independent variables and interactions on the dependent variables.

This study was designed to provide a framework for aquatic leadership to train staff and patrons on waterborne disease prevention. The research addressed the importance of waterborne pathogen prevention by promoting knowledge and skills related to preventing the spread of recreational water illnesses, and the maintenance of these behaviors. This study adds to the literature to fulfill in part the CDC's recommendation to educate aquatic staff in waterborne disease prevention. The intervention training session tested preventive strategies in non-outbreak settings (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Research Questions

1. To what extent will lifeguards and aquatic directors advance through the stages of change after the waterborne disease prevention training intervention?
2. To what extent will lifeguards and aquatic directors advance in knowledge of waterborne disease prevention after the training intervention?
3. To what extent do pretest scores for knowledge, pretest scores for the behavioral stages of change, group, age, gender, education, experience, and certification help predict the posttests scores in knowledge or stages of change?

Hypotheses

1. The participants who receive the intervention training will advance further in stages of change than the participants who do not receive the intervention.
2. The participants who receive the intervention training will show a greater increase in knowledge than the participants who do not receive the intervention.
3. When controlling for pretest scores for knowledge, pretest scores for the behavioral stages of change, group, age, gender, education, experience, and certification, the variables group and pretest scores will have the most significance in predicting knowledge and behavioral stages of change posttest scores.

Delimitations

1. All of the participants in this study were from the middle Tennessee region.
2. Drop-out rate of the lifeguards and aquatic directors was not controlled through this study.

Assumptions

1. It was assumed that none of the lifeguards or aquatics directors had been involved in waterborne disease prevention training prior to this study.

Definition of Terms

Interchangeable terms:

1. For the purpose of this study, the terms "aquatic staff" and "lifeguards and aquatic directors" are interchangeable.
2. For the purpose of this study, the terms "recreational water illnesses" and "waterborne diseases" are interchangeable.
3. For the purpose of this study, the terms "aquatic director" and "pool operator" are interchangeable.

Intervention Training Study Terms - Occupational Safety and Health (OS&H, 1998)

1. Training - Refers to the instruction and practice for acquiring skills and knowledge of rules, concepts, or attitudes necessary to function effectively in specified task situations. With regard to OS&H, training can consist of instruction in hazard recognition and control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions. As noted in the 1985 Occupational Training Assessment report, training could also provide

workers with ways to obtain added information about potential hazards and their control; they could gain skills to assume a more active role in implementing hazard control programs or to effect organizational changes that would enhance work-site protection.

2. Performance - Represents observable actions or behaviors reflecting the knowledge or skill acquired from training to meet a task demand. With regard to OS&H, performance can mean signs of complying with safe work practices, using protective equipment as prescribed, demonstrating increased awareness of hazards by reporting unsafe conditions to prompt corrective efforts, and executing emergency procedures should such events occur.

3. Motivation - Refers to processes or conditions that can energize and direct a person's behaviors in ways intended to gain rewards or satisfy needs. Setting goals for performance coincident with learning objectives and use of feedback to note progress have motivational value. With regard to OS&H, motivation can mean one's readiness to adopt or exhibit safe behaviors, take precautions, or carry out self-protective actions as instructed.

CHAPTER II

REVIEW OF LITERATURE

Swimming is second to walking as the most popular exercise activity in the United States, with more than 400 million annual visits to swimming pools (U.S. Bureau of the Census, 2001). The benefits of swimming have been demonstrated in numerous studies (Macey, 1980; Ford, Puckett, Blessing & Tucker, 1989; MacDonald, 1989; Pierpoint, 1998; Stamford, 1984). However, when recreational water is contaminated, it can cause swimmers a variety of illnesses such as diarrhea or skin, ear, eye, and upper respiratory infections (Addiss & Juranek, 1979; CDC, Healthy Swimming, 2002). Waterborne pathogens are common and cause severe illness and death. The increase in outbreaks by disease causing pathogens such as Cryptosporidium parvum and E. coli 0157-H7 have occurred because of the prolonged shedding of the pathogens in the water by infected swimmers and the low infectious dose required to make people sick (CDC, Healthy Swimming, 2002). Children who wear diapers or are toilet training may not be able to control their bowels and are more prone to contaminate the water. Approximately 11% of the United States population has had diarrhea in the last 30 days, and approximately two percent are incontinent (CDC, Healthy Swimming, 2002). Swimmers may accidentally swallow the fecally contaminated water, which could make them sick (MMWR, May 25, 2001/ 50(20), 410-2). An ill swimmer can contaminate the water for everyone in the pool. Because chlorine takes time to kill pathogens, even the best maintained pools can spread disease. In 1.0 parts per million (ppm) chlorinated water, it takes 6 to 7days for a Cryptosporidium oocyst to die (CDC, Healthy Swimming, 2002).

For 30 years the CDC and the Environmental Protection Agency (EPA) have collaborated in the surveillance of occurrences and causes of waterborne disease outbreaks (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). Data are collected regarding outbreaks associated with drinking water and recreational water. Waterborne disease surveillance data identify the types of water systems, swimming venues, their deficiencies, and the associated etiologic agents (CDC, Surveillance for Waterborne Disease Outbreaks, 1995 - 1996). These data are valuable for evaluating the adequacy of approaches to providing safe drinking or recreational water by the EPA and the CDC.

Government agencies rely on state and local health departments to voluntarily record the data on a waterborne disease outbreak report form. These reports are used to document outbreaks of illness after consumption or use of water intended for drinking as well as outbreaks associated with exposure to recreational water, excluding wound infections caused by water related organisms (U.S. Department of Health and Human Services, 2001). The main limitation to surveillance is that not all waterborne disease outbreaks are recognized or reported by the sick individual (MMWR, May 25, 2001/ 50(20), 410-2). Outbreaks involving serious illnesses from etiologic agents with short incubation periods are more likely to be recognized by health authorities than sick individuals who do not realize why they are ill. Also, outbreaks associated with community water systems are more likely to be recognized than those related to recreational water with patrons from various locations (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

The identification of the etiologic agent is dependent on timely recognition of the outbreak so that appropriate testing can be done on the clinical and environmental samples. Most labs will not test for parasites unless specifically requested because of the expense of the test (DPD laboratory, personal communication, 2002). The quality of the data may vary depending on fiscal, investigative, and laboratory resources (Kappus, Juranek & Roberts, 1987). Many people with diarrhea may not visit the doctor, and infected persons may continue swimming over an extended period continuing to infect other swimmers (McAnulty & Fleming, 1994). Also, a few large outbreaks can substantially alter the relative proportion of cases attributed to a disease causing agent (CDC, Surveillance for Waterborne Disease Outbreaks, 1995 - 1996).

Waterborne Pathogens

Common waterborne pathogens include the parasites Cryptosporidium and Giardia, and the bacteria Escherichia coli 0157:H7, Shigella, Pseudomonas aeruginosa, Salmonella and the Norwalk-like viruses (NLV). These seven pathogens have been identified as the cause of the majority of recreational water illnesses outbreaks in chemically treated recreational water (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

For the waterborne pathogens Cryptosporidium, Giardia, E. coli 0157:H7, Salmonella, Shigella and NLV, the onset of symptoms occurs within two to ten days of infection. Symptoms include watery diarrhea, headache, cramps, nausea, and a low-grade fever. For Pseudomonas, the primary symptom is a skin rash similar to the measles. For all these infections, symptoms may last up to two weeks in a healthy person, and longer in the immunocompromised (CDC, Opportunistic Infection Series, 1999). NLV that cause gastroenteritis outbreaks have been associated with sources of contaminated water, including municipal water, well water, stream water, commercial ice, lake water, and swimming pool water (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Water chemistry and waterborne pathogens.

Because swimming involves sharing water with other persons in a pool, the water may contain trace amounts of various bodily fluids such as fecal matter, urine and perspiration (MMWR, May 25, 2001 / 50(20), 410-2). Fecal matter enters the pool when a swimmer releases formed stool or diarrhea into the water, or residual fecal matter on swimmers' bodies is rinsed into the pool. Fecal contamination may be more likely to occur when diaper and toddler aged children enter the water (MMWR, May 25, 2001 / 50(20), 410-2). The accidental ingestion of fecally contaminated water is the primary mode for transmission of enteric pathogens in recreational water outbreaks (MMWR, May 25, 2001 / 50(20); 416-7). Disease transmission occurs when the pathogen leaves its host through a portal of exit and is spread by a mode of transmission. The pathogen then enters a body through a portal of entry and infects a susceptible host (Timmreck, 1998). In a pool, disease transmission happens when a swimmer excretes infectious feces and another swimmer accidentally swallows the contaminated water (MMWR, May 25, 2001 / 50(20), 410-2).

Chlorination of water is one of the primary public health measures used to ensure that both drinking water and recreational water are free of microbial pathogens

(Rice, Clark and Johnson, 1999). Chlorine is an effective disinfectant, but it takes time. Because of frequent fecal contamination and the inability of chlorine to rapidly inactivate pathogens, transmission can occur even in well-maintained pools (CDC, Healthy Swimming, 2002).

There is a large differential between inactivation times for Cryptosporidium, Giardia, NLV and E. coli 0157:H7 (MMWR, May 25, 2001 / 50(20); 416-7; MMWR, June 1, 2001 / 50(RR09); 1-8).

Disinfection times for waterborne pathogens in 1 ppm chlorine:

Parasitic:	Cryptosporidium – 6 to 7 days
	Giardia – 45 minutes
Viral:	NLV – 5 hours
Bacterial:	E. coli, Shigella, Salmonella, and
	Pseudomonas aeruginosa - < 1 minute

The low prevalence of Cryptosporidium and NLV in formed fecal accidents indicates that pool operators can disinfect pool water after a fecal accident as if it contained the moderately chlorine-resistant parasite Giardia. Responding to formed fecal accidents with water treatment sufficient to inactivate Giardia also should be sufficient to inactivate other known viral and bacterial waterborne pathogens, including E. coli O157:H7 (MMWR, May 25, 2001 / 50(20);410-2). The CDC recommends chlorine concentration should be 2.0 ppm and the pH 7.2 - 7.5. The aquatic staff should test the water chemistry to be sure these levels exist throughout all circulating pools by sampling at least three widely spaced locations away from return water outlets. In cases of a diarrheal accident, the chlorine concentration of the water should be raised to 20 ppm with the pH maintained between 7.2 and 7.5. This chlorine and pH level should be maintained for at least 8 hours in order to inactivate Cryptosporidium (MMWR, May 25, 2001 / 50(20); 416-7).

The CDC has made these recommendations for responding to fecal accidents in disinfected recreational water venues, assuming the presence of Giardia in formed stool and the presence of Cryptosporidium in diarrhea (MMWR, May 25, 2001 / 50(20); 416-7). The Giardia inactivation guidelines are based on data developed by the EPA for disinfection of Giardia in drinking water (Giardiasis Surveillance, United States, 1992-1997).

A meta-analysis involving 22 studies suggests there is a causal relationship between gastrointestinal symptoms and recreational water quality (Pruss, 1998). In 19 of the 22 studies, the rate of certain symptoms involving the ears, nose, throat, respiratory system, and the intestines were significantly related to the count of fecal indicator bacteria. Fecal indicator bacteria is a water quality microbial parameter that indicates the potential risk for infectious diseases associated with use of water for drinking, bathing, or recreational purposes (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). Gastrointestinal symptoms were the most frequent health outcome for which significant dose-related associations were reported (Pruss, 1998). Many people swim after the 2-week period of diarrhea is over, but may continue to excrete infectious oocysts for up to five weeks (CDC, Healthy Swimming, 2002). This continues the spread of Cryptosporidiosis to unsuspecting swimmers (Pruss, 1998).

Parasites: Cryptosporidium parvum and Giardia.

Cryptosporidium parvum is a microscopic parasite that is very resistant to chlorine, difficult to filter, and is carried asymptomatically in many animals (Carpenter, Fayer, Trout, & Beach 1999). The mode of transmission can be foodborne or waterborne (Juranek, 1995). Infection begins when a person ingests the thick-walled oocysts. The organism was first recognized by Drs. Clarke and Tyzzer at the turn of the century and was thought to exist only in animals (Guerrant, 1997). In 1976, Dr. Nime reported it as a human pathogen in patients who were immunocompromised (Guerrant, 1997). Because Cryptosporidiosis is not only spread in the water, but person to person and animal to person, there is the possibility for widespread outbreak (Juranek, et al., 1995).

Cryptosporidium has been found in more than half of the children under 5 years old in developing countries. In a controlled study with HIV positive patients and children in developing countries, percentages show the main cause of diarrhea is Cryptosporidium due to contaminated water (Guerrant, 1997).

Cryptosporidium infects the superficial surface of the intestinal epithelium and can derange intestinal function indefinitely. Trained laboratory technicians use an acid-fast or immunofluorescence staining on fecal smears to make the diagnosis of crypto in patients having diarrhea (CDC, DPD, 2002). A study of children in Brazil suggests that the intestines of infected children are damaged to the point of leaving them susceptible to additional diarrheal illnesses (Guerrant, 1997).

Cryptosporidium is resistant to disinfection by chlorine at levels generally used in swimming pools, between 1.0 ppm and 3.0 ppm (CDC, Healthy Swimming, 2002). Cryptosporidium takes 6 to 7 days to die in 1 ppm chlorine (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). Recontamination can occur by an infected swimmer during the time the pool water is being re-circulated and disinfected.

Giardia, a flagellated protozoan, is the most commonly diagnosed intestinal parasite in public health laboratories in the United States (Giardiasis Surveillance, United States, 1992-1997). Giardia is spread from person to person and from animals to humans through fecal-oral transmission. Giardiasis occurs when cysts are ingested through person-to-person transmission or ingestion of fecally contaminated food or water. The infectious dose is low, as few as 10 cysts. Transmission occurs in all major geographic areas of the country and the incidence of Giardiasis is reported to be highest for children aged 0-5 years (Giardiasis Surveillance, United States, 1992-1997). Although Giardiasis reporting is required by 43 states, it is not a nationally notifiable disease. The greatest number of reports of Giardiasis are received during the late summer and early autumn. This seasonal variation has also been shown for Cryptosporidiosis (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). The seasonal peak in age-specific case reports coincides with the summer recreational water season and the high prevalence of diaper-aged children in swimming venues. Giardia is a serious threat because of its low infectious dose, environmental resistance and extended periods of cyst shedding that can occur by an ill swimmer (Gerba, 1995). State surveillance data indicates that as many as 2.5 million cases of Giardiasis occur annually in the United States (Giardiasis Surveillance, United States, 1992-1997).

A case control study of Cryptosporidiosis.

A case control study in Lane County, Oregon supports the literature regarding Cryptosporidium causing illness in swimmers (McAnulty & Fleming, 1994). Case patients were identified as residents of Lane County with the parasite detected in their stool from June to October of 1992. The authors used a matched case-control study design to compare the first 18 case patients with 18 age and neighborhood matched controls selected from the phone directory. In order to be a case patient, one had to be the first in a household to have a confirmed case of Cryptosporidiosis. These patients were asked about common exposures to water, recreation, restaurants, and daycare. They were also asked questions regarding onset of illness and duration of symptoms. There were strict guidelines on who could be considered a control including age, illness, and attendance at a daycare or drinking untreated surface water. Methodology included routine lab testing for Cryptosporidiosis and testing the filter at the water park for Cryptosporidium oocysts. The staff at fifteen other water parks were also interviewed regarding their water treatment procedures (McAnulty & Fleming, 1994). Lab results showed a total of 55 patients with Cryptosporidiosis detected in their stools. Ninety-eight percent of these reported diarrhea and 79% abdominal cramping. No more than three patients reported swimming at any other pool during the 2-week period before the onset of illness. Case patients had been swimming at a waterpark wave pool between July 24 and September 23. Seventeen of the 18 cases reported swimming in the wave pool at the water park during the incubation period of the illness. Exposure spanned a 2-month period. No one in the control group had been to the water park. An important result to consider is that the number of new cases dropped off after the wave pool was drained and refilled. None of the patients tested positive for other diarrheal illnesses, and one Cryptosporidium oocyst was found in the water park filter in the lab tests (McAnulty & Fleming, 1994).

This study is of concern to swimmers, lifeguards, pool operators and public health professionals. Cryptosporidiosis is spread in the water and person to person, creating the possibility for widespread outbreak (MMWR, May 25, 2001 / 50(20); 416-7). The prolonged duration of an outbreak could mean that a single swimmer produced many oocysts that survived in the water, or infected persons continued swimming over an extended period and continued to infect other swimmers, or both (McAnulty & Fleming, 1994). Studies have shown that a person with Cryptosporidiosis may be past the diarrheal phase of the illness and continue to excrete the oocysts for many weeks (MMWR, May 25, 2001 / 50(20); 416-7). If a swimmer enters the water during the diarrheal phase of an illness, he or she may pass millions of infectious oocysts per day, enough to contaminate a large waterpark (CDC, Healthy Swimming, 2002). Swimming is suspect because other outbreaks of this nature have been traced back to the ingestion of fecal contamination in pool water (McAnulty & Fleming, 1994).

Waterborne pathogens of bacterial origin.

E. coli O157:H7 is one strain of the bacterium Escherichia coli. Although most strains are harmless and live in the intestines of healthy humans and animals, this strain produces a powerful toxin and can cause severe illness (Surveillance for Outbreaks of Escherichia coli O157:H7 Infection, Summary of 2000 Data, 2001). In some persons, particularly children under 5 years of age and the elderly, the infection can also cause a complication called hemolytic uremic syndrome, in which the red blood cells are destroyed and the kidneys fail (Moyenuddin, Wachsmuth & Moseley 1989). E. coli, unlike parasites, will die in less than one minute in 1 ppm chlorine (MMWR, May 25, 2001 / 50(20); 416-7). However, in June of 1998, an outbreak occurred in Georgia at a large water park. Twenty-six cases were diagnosed, with seven of those developing hemolytic uremic syndrome. One of those cases, a three year old child, died from the infection. Records of routine tests performed by county environmentalists on three of the four days when infection occurred showed the chlorine level at .25 ppm (Gilbert & Blake, 1998).

Shigellosis is an infectious disease caused by a group of bacteria called Shigella. There are several different kinds of Shigella bacteria. Shigella sonnei, also known as Group D Shigella, accounts for over two-thirds of the Shigellosis in the United States (CDC, Shigella surveillance: annual tabulation summary, 1999). Shigella is present in the diarrheal stools of infected persons while they are sick and for up to two weeks afterwards. Approximately 14,000 cases of Shigella are diagnosed each year in the United States, and most occur in young children (CDC, Shigella surveillance: annual tabulation summary, 1999). On June 15, 2001, local physicians reported 11 cases of diarrhea to a county health department. Stool samples from two of these persons were culture confirmed for Shigella. A preliminary investigation found that nine of these persons recently had visited a large city park with a wading pool. This outbreak involved a 60 year old drain-and-fill pool containing municipal water at 0.5 ppm chlorine, with no subsequent chlorination. The pool was probably unchlorinated for most of the time it was in use. This pool was frequented by diaper and toddler aged children, who demonstrate an increased prevalence of enteric infections. This created a favorable environment for transmission of Shigellosis. Transmission of Shigellosis over several days may have been a result of persons with diarrhea visiting the pool on subsequent days. The infectious dose for Shigella is low, so a small amount of ingested water can cause infection (MMWR, September, 21, 2001 / 50(37); 797-800).

Salmonellosis is a bacterial infection with an estimated 1.4 million cases occurring annually in the United States. Approximately 40,000 are culture-confirmed cases by the CDC (The National Salmonella Surveillance System, 2001). Salmonella are bacteria that can cause diarrheal illness in humans. In some persons the diarrhea may be so severe that the patient needs to be hospitalized. In these patients, the Salmonella infection may spread from the intestines to the blood stream, and then to other body sites and can cause death unless the person is treated promptly with antibiotics. The elderly, infants, and those with impaired immune systems are more likely to experience severe illness (The National Salmonella Surveillance System, 2001).

Dermatitis infections are often caused by the bacteria Pseudomonas aeruginosa. Dermatitis is spread by direct skin contact with contaminated water. The rash usually occurs within a few days of swimming in poorly maintained hot tubs or spas, but can also be spread by swimming in a contaminated pool or lake. Chlorine levels are depleted faster in warmer water, which makes hot tubs and spas more susceptible to the growth of Pseudomonas aeruginosa (Griffiths, 1994).

Waterborne pathogens of viral origin.

Norwalk-like viruses cause an estimated 181,000 cases of gastrointestinal infection in the United States each year (MMWR, June 1, 2001 / 50(RR09); 1-18). Until the 1970s, diagnostic techniques for infectious diarrhea were limited to bacteria and parasites. Investigators had hypothesized that viruses might account for many of the cases of unknown etiology. In 1972 during an examination of stool specimens, electron microscopy identified the Norwalk agent, the most common viral cause of gastroenteritis outbreaks among adults (MMWR, April 27, 1990 / 39(RR-5); 1-24). The main symptoms of viral gastroenteritis are watery diarrhea and vomiting. The affected person may also have headache, fever, and abdominal cramps. There is no vaccine or medicine currently available that prevents viral gastroenteritis. Waterborne outbreaks are far less common than foodborne outbreaks, but NLV gastroenteritis outbreaks have been associated with sources of contaminated swimming pool water (Dadswell, 1996; Kappus & Marks, 1982).

Pool filter design and waterborne disease transmission.

The DPD has done numerous studies on swimming pool filters to determine which ones, if any, can remove the Cryptosporidium oocyst from water (NCID, 1998). Because a Cryptosporidium oocyst measures only 4-6 microns in diameter, pool filtration systems that use sand or other large granular materials, without the special chemical pretreatment coagulants commonly used by the drinking water industry, might not be effective in removing oocysts (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). Sand and cartridge filters have not been able to stop oocysts (Chapman & Rush, 1990). The diatomaceous earth filter has been shown to remove most oocysts, but it takes many hours for water turnover (Williams, 1999). The risk for transmission of Cryptosporidiosis remains because of the protracted periods of time necessary for moving all water through filtration equipment and problems in pool design that result in poor water circulation (MMWR, May, 25 2001 / 50(20); 416-7). Because pool closure is inconvenient and causes lack of revenue, most pools will not close the length of time necessary for removal of the oocysts (Gilbert & Blake, 1998).

The mixing of water from various pools within a facility during filtration and the depletion of chlorine by organic matter also reduces the chance that Cryptosporidium and other pathogens will be killed (CDC, Healthy Swimming, 2002). It is important that aquatic staff understand why time is needed for the chlorine to destroy the pathogens before allowing swimmers to re-enter the water (CDC, Healthy Swimming, 2002).

Waterborne Disease Outbreaks During 1997-1998

During the 1990s, reports of outbreaks of gastrointestinal disease associated with the use of chemically treated recreational water have increased. Between 1989 and 1998, there were 83 recreational waterborne disease outbreaks in chemically treated water venues in the United States. During 1997-1998, 18 states reported 32 outbreaks associated with recreational water. Of these 32 outbreaks, 15 were associated with fresh water and 17 were associated with chemically treated water. Outbreaks from chemically treated water are reported in Table One. The 32 outbreaks during 1997 and 1998 caused illness in an estimated 2,128 persons (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Five deaths were reported from the 1997-1998 outbreaks. Four of the deaths were traced to amebic meningoencephalitis, and one to E. coli 0-157:H7 strain. All deaths were individuals under the age of 18. All but 1 of the 18 outbreaks of gastroenteritis occurred during the summer. Six of the eight outbreaks of dermatitis occurred during January or February (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Outbreaks of parasitic origin.

Of the gastrointestinal outbreaks attributed to parasites during 1997 and 1998, all were caused by Cryptosporidium. Ninety percent were associated with recreational use of treated water in venues such as swimming pools and fountains. Human fecal accidents were suspected in most of these outbreaks (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). Two outbreaks of Cryptosporidiosis occurred in Minnesota during 1998, one at a swim club and the other at a community pool. The source of the outbreak at the community pool was unknown, but the suspected source at the swim club was a child with Cryptosporidiosis who swam in the pool 10 days before the outbreak (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). This is important because it may mean that the Cryptosporidium oocysts lived 10 days in the chemically treated water before the outbreak.

The suspected source of contamination for an outbreak of Cryptosporidiosis in Wisconsin was fecal accidents. This outbreak involved three public swimming pools at separate locations with 12 persons acquiring Cryptosporidiosis. The suspected source of the outbreak was an infected child who swam in three community swimming pools on three successive days. Pool operators were unaware of the accidents until the mother of the child reported them two weeks later (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Outbreaks of bacterial origin.

Four of the 18 outbreaks of gastroenteritis in fresh and treated water reported in 1997-1998 were attributed to bacteria. One of these was attributed to E. coli 0-157:H7 in treated water. This outbreak caused the death of one child at an Atlanta water park. Low chlorine levels were inadequate for inactivating the E. coli.

Nine persons became ill from Shigella in Massachusetts. This outbreak was associated with a wading pool that included a sprinkler fountain. The system re-circulated chlorine-treated water and many diaper-aged children were observed sitting in the wading pool.

In Minnesota, 369 persons became ill after playing in a sprinkler fountain at a local zoo. Water was sprayed through the air, drained through grates, collected, passed through a sand filter, chlorinated and re-circulated. The original source of contamination was unknown, but it had become a popular interactive play area for children (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998).

Pseudomonas aeruginosa is a bacterial infection that causes dermatitis. There were eight outbreaks of dermatitis in pools, hot tubs, springs or lakes during 1997 – 1998. Seven of these were associated with Pseudomonas aeruginosa, six of which occurred in chemically treated water. Hot tubs foster the growth of Pseudomonas because of the warm water temperature (Favero, 1984).

Outbreaks of viral origin.

The only outbreak of viral origin reported during 1997-98 was traced to swimming in a lake. This would not qualify as chemically treated water, only as recreational swimming water.

Table 1

*Waterborne disease outbreaks associated with chemically treated recreational water – United States, 1997-98 (CDC, Surveillance for Waterborne Disease Outbreaks).**

State	Date	Etiologic agent	Illness	Cases	Source
1. Massachusetts	July, 1997	Shigella	Gastroenteritis	9	Pool
2. Minnesota	July, 1997	Cryptosporidium	Gastroenteritis	369	Fountain
3. Arkansas	Jan, 1997	Pseudomonas	Dermatitis	12	Pool
4. Indiana	Feb, 1997	Pseudomonas	Dermatitis	42	Hot tub
5. Florida	July, 1998	Cryptosporidium	Gastroenteritis	7	Pool
6. Georgia	June, 1998	E. coli	Gastroenteritis	26	Pool
7. Minnesota	April, 1998	Cryptosporidium	Gastroenteritis	45	Pool
8. Minnesota	July, 1998	Cryptosporidium	Gastroenteritis	7	Pool
9. Oregon	August, 1998	Cryptosporidium	Gastroenteritis	69	Pool
10. Wisconsin	June, 1998	Norwalk-like virus	Gastroenteritis	18	Fountain
11. Wisconsin	June, 1998	Cryptosporidium	Gastroenteritis	12	Pool
12. Wisconsin	July, 1998	Cryptosporidium	Gastroenteritis	9	Pool
13. Wisconsin	July, 1998	Cryptosporidium	Gastroenteritis	12	Pool

*Four outbreaks of Pseudomonas aeruginosa with less than 9 cases each were not reported in this table.

Recommendations for Preventing Waterborne Illness

CDC prevention efforts have focused on preventing the transmission of recreational water illnesses, national statistics on RWI, disinfecting and data procedures, the role of the aquatics staff in prevention, and the role of the aquatics staff in educating patrons. CDC recommendations involve these five behavioral emphasis areas: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) training in RWI.

The Healthy Swimming initiative has developed a fecal accident policy and instructions on training employees to implement the policy (CDC, Healthy Swimming, 2002). Officials and pool managers should educate staff and patrons about ways to reduce recreational water illness transmission. Posting signs about good hygiene around the pool and offering orientations for groups of children that visit the pool will help patrons become aware of healthy swimming practices. To prevent transmission, it is recommended that persons with diarrhea should not swim, swimmers should avoid swallowing pool water, and persons should practice good hygiene before swimming, after using the restroom, and after changing a diaper (MMWR, May 25, 2001 / 50(20), 410-2).

Improved pool design and management is also recommended to reduce the risk for disease transmission. Pool operators are instructed to consider using separate filtration systems for baby pools and other pools to decrease the potential for cross-contamination (CDC, Healthy Swimming, 2002). Another way reported to optimize filtration rates is to increase the suction capacity in order to decrease the length of time that swimmers would be exposed to pathogens (CDC, Healthy Swimming, 2002).

The CDC recommends pool operators provide restrooms and diaper changing areas that are close to the pool and in good repair (CDC, Healthy Swimming, 2002). Swim diapers do not prevent leakage of diarrhea. Therefore, they are not an acceptable solution for a child with a diarrheal infection and are not a substitute for frequent diaper changing away from poolside (CDC, Healthy Swimming, 2002). The Healthy Swimming initiative encourages lifeguards to recognize unhealthy behaviors and promote good hygiene by enforcing pool policies that help prevent the spread of RWI. Such policies include calling for mandatory bathroom breaks, and asking swimmers not to spit and swallow pool water. Lifeguards can use materials provided by the CDC to educate themselves and others about healthy swimming.

Waterborne illness and the immunodeficient population.

The Working Group on Waterborne Cryptosporidiosis of the CDC designed an informational brochure for persons infected with HIV regarding the potential of acquiring opportunistic infections (CDC, Opportunistic Infection Series, 1999). Cryptosporidium is presented as a very serious health hazard to the immunodeficient population.

If a person is HIV infected, a CD4 count below 200 indicates low immunity. When infected with Cryptosporidium, a person with low immunity may suffer diarrheal symptoms for weeks. If a person's CD4 count is over 200, indicating a stronger immune system, the symptoms from Cryptosporidiosis will only last a few weeks. However, the parasites will stay in the body, and symptoms will reappear if a person's CD4 count drops below 200 again. This CDC brochure informs the immunodeficient population about how to avoid contracting Cryptosporidiosis (CDC, Opportunistic Infection Series, 1999).

Other potential populations who swim and have low immunity include chemotherapy patients, organ transplant patients, and people with chronic diseases (CDC, Healthy Swimming, 2002).

Previous Research Using Populations of Aquatic Staff

Most studies involving aquatic staff have to do with increasing revenue, aquatic maintenance or risk management. The majority of emerging articles on recreational water illnesses can be found on or linked to the CDC "Healthy Swimming" web-site (CDC, Healthy Swimming, 2002).

Other studies directed toward aquatic directors involve maintenance of facilities. The focus of an article on wave pool maintenance was to suggest that pool operators design the pump room for easy maintenance of chemical feeders (Fleurette & Woodland, 2002). Risk management is often discussed as something to be taught at lifeguard in-service sessions. Creative ideas for in-service can be found in a recent article directed toward aquatic directors preparing for the summer (McCottry, 2001).

Attempts to test the effectiveness of recreational water illness prevention training to change knowledge and behavior with aquatic staff have not been reported to date.

Stages of Change Theoretical Model

The transtheoretical model of change was developed by James Prochaska and Carlo DiClemente in an attempt to better understand and explain intentional behavior change (Prochaska & DiClemente, 1982). The model represents an attempt to explain behavior change across a variety of problems from affective disorders to health behaviors (Prochaska & DiClemente, 1983; Prochaska, et al., 1992). Also, the model attempts to explain diverse forms of change: cessation of existing behaviors, alteration of existing behaviors, and adoption of new behaviors (Prochaska et al., 1992). The model represents a comprehensive approach to understanding and explaining behavioral change (Prochaska & DiClemente, 1982; Prochaska & DiClemente, 1986; Prochaska et al., 1992; Prochaska, et al., 1994).

The transtheoretical model was originally developed in an attempt to integrate the important components of diverse systems of psychotherapy, thus the name transtheoretical (Prochaska et al., 1992). Much of the model was developed in the area of smoking cessation (Prochaska & DiClemente, 1983). Since that time, it has been applied to the study of a wide variety of health issues. Health issues to which the model has been applied include obesity (O'Connell & Velicer, 1988), ultraviolet light exposure (Rossi, 1989), alcohol use (Norcross, Prochaska, & Hambrecht 1991), participation in physical activity (Sonstroem, 1988; Prochaska & Marcus, 1995), condom use with HIV populations (Harlow, et al., 1999) and the relationship of diet and cancer (Cotugna, Subar, Neimendinger, & Kahle, 1992). The transtheoretical model can be helpful in designing, administering and evaluating interventions to help people adopt specified behaviors, as in dietary interventions (Prochaska & Velicer, 1997; Glanz, et al., 1999).

In this study, the theoretical model guiding the interventions recognizes the role of both cognitive and overt components to the process of personal behavior change. The interventions to be evaluated seek to modify both of these, and it is therefore appropriate to employ a measure of outcome that takes both into account. The five-stage change dimension postulated by Prochaska and DiClemente (1986) provides such a measure.

The transtheoretical theory states that individuals progress through the stages of change during the process of changing their behavior (Prochaska & DiClemente, 1983). The stages provide a framework which allows for a better understanding of when changes occur in both an individual's intention for engaging in a particular behavior as well as actual performance of that behavior (Prochaska et al., 1992). The stages of change model is a framework of five stages: precontemplation, contemplation, preparation, action and maintenance (Prochaska, et al.1992). Precontemplation involves no intention to change because the individual is unaware or has limited awareness of the problem. The central element of this stage is resistance to recognizing or modifying a problem. Contemplation involves an individual who is aware of a problem, but has not made a commitment to any action of change. The central element consists of serious consideration being made of problem resolution. The preparation stage involves combining intention with behavioral criteria. The individual is intending to take action within the next month. The central element is decision-making. The action stage is when the individual modifies his or her behavior or environment to overcome the problem. The individual has made a visible change for a period of at least one day to six months. The central element is the modification of a problem to an acceptable criterion with significant overt efforts. In the maintenance stage, the individual works to consolidate or maintain the gains made during the action stage. This is not a static stage, but a continuation of change. The central element is maintaining and stabilizing the change (Prochaska et al., 1992). The level of progress through the stages of change related to adoption of a specific behavior should be directly related to variation in the levels of information, motivation, and behavioral skills preceding the behavior (Prochaska & DiClemente, 1982). Although it was originally thought that individuals progressed through the stages in a linear fashion (Prochaska & DiClemente, 1982), further research indicated that change can best be conceptualized as occurring in a cyclical fashion (Prochaska et al., 1992; Prochaska & Velicer, 1997). Individuals cycle and recycle through the stages at different rates, sometimes remaining in stages for prolonged periods of time. Often individuals progress to the later stages of action and maintenance only to relapse back to earlier stages of precontemplation, contemplation, or preparation (Prochaska et al., 1992). Progression from some stages to other specific stages is more likely, such as from precontemplation to contemplation, and from contemplation to preparation (Prochaska et al., 1992). However, change from any one stage to almost any other stage is possible, although by definition one must pass through the stage of action to enter the stage of maintenance (Prochaska & Velicer, 1997). The transtheoretical model is described as a dynamic model of behavior change in which change is viewed as a process, rather than as states of exhibiting or not exhibiting the behavior of interest (Prochaska et al., 1992).

Since the 1980's, the transtheoretical model has emerged as one of the leading integrative approaches to individual and occupational change (Levesque & Prochaska, 1999). Using stages of change instruments that exist in the literature, questionnaires have been developed for assessing specific occupational group behaviors such as dental hygienists (Stach, Annan, Tilliss, Astroth, & Cross-Poline, 2000) and manufacturing workers (Emmons, Marcus, Linnan, Rossi, & Abrams, 1994).

Application of the transtheoretical model in a university setting.

Measures of the core constructs of the transtheoretical model were developed to apply stages of change in guiding the development of a change management program for a university's integrated service delivery (Levesque & Prochaska, 1999). Thirty-one university staff completed an assessment in the stages of change format measuring behaviors related to integrated service delivery. The data provided evidence of the applicability of the model to occupational change (Levesque & Prochaska, 1999). A classification algorithm was used to stage individuals on the basis of responses to questions about his or her intentions, past behaviors and present behaviors. It is expected that stage of change in pretests will predict future behaviors measured in posttests (DiClemente, Prochaska, Fairhurst & Velicer, 1991).

Application of the transtheoretical model in a worksite intervention trial.

One of the largest early trials to use stages of change was the Working Well Trial in 1990 with 20,801 respondents, a 71.6% overall response rate (Glanz, Patterson, Kristal, Feng, Linnan, & Hebert, 1998). Core questions in the baseline surveys included knowledge and stages of change questions related to nutrition, smoking and cancer. The transtheoretical model has since been applied to health problems behaviors such as eating disorders, high fat diet, and dietary intake of fruits and vegetables (Glanz, et al., 1998). Other areas include mammography screening, condom use, medication compliance, radon testing, birth control practices, cocaine use, pain management, and the sterilization of needles among IV drug users (Prochaska & Velicer, 1997).

A behavior change intervention with employees in the Take Heart Project.

Approximately 70% of adults in the United States between the ages of 18 and 65 work on a regular basis (Glasgow, Wilson & McCauley, 1994). The Take Heart Project was an intervention study with employees at their worksite targeting behavior change in tobacco use and dietary habits. This intervention study links a worksite intervention to employee behavior change. Twenty-six worksites enrolled their employees to participate in the study (Glasgow, et al., 1994). This provides opportunities for individual change that has a "spill-over" effect with other employees and family members (Glasgow, et al., 1994). This study reinforced the literature that a worksite is an excellent setting for health promotion which targets behavioral change.

CHAPTER III

METHODS

The methods section is divided into six sections: 1) study design 2) participants, 3) data collection procedures, 4) measures, 5) intervention and 6) data analysis.

Study Design

This study design was a behavioral intervention to test the effectiveness of waterborne disease prevention training with individuals randomly assigned to either intervention or control conditions. Outcome measures were assessed by comparison of pre and posttest survey results. Effectiveness of the intervention was demonstrated by showing positive increases in stages of change for individuals who received the waterborne disease prevention training in comparison with those who did not, and by advances in knowledge of waterborne disease prevention. The participants were volunteers from lifeguard groups and their aquatic directors in middle Tennessee. The participants were randomly selected to be exposed to the intervention training session on waterborne disease prevention. The control participants were given the option to receive the training at the end of the study. A recreational water illness prevention training manual, designed for this study by the researcher, was used in the intervention training.

Participants

The participants were lifeguards and aquatic directors from aquatic facilities in middle Tennessee. The aquatic directors at 42 facilities were contacted by mail, and then by phone, for consent to participate with their lifeguard staff in the study. Fifteen aquatic organizations were recruited, but two facilities that had verbally agreed to participate dropped out of the study. One of these aquatic facilities dropped out before the pretest and the other dropped out after the pretest but prior to the posttest. Thirteen organizations completed the study, resulting in a participation rate of 31%. These aquatic organizations were entered into a cluster for randomization. Within the cluster, groups were randomly assigned to either intervention or control. All individuals that agreed to participate were enrolled in the study. Participants from seven groups received the intervention training and participants from the other six groups did not receive the training. The lifeguards and aquatic directors consisted of males and females age 16 years and older holding current lifeguard certifications. Consent forms were signed prior to participation. Because the American Red Cross considers 16 year old individuals eligible for lifeguard certification, assent forms were signed before participation of minors. Participants were assured of confidentiality. Names were coded on the cover sheet of the surveys and then separated from the surveys.

Data Collection Procedures

Data were collected from three surveys developed specifically for this study and administered by the study researcher at each aquatic facility. Surveys regarding demographics, knowledge of waterborne disease transmission and behaviors related to waterborne disease transmission were given to the intervention and control participants at the aquatic facilities where they were employed. The surveys were used to develop two baseline measures, one to assess stages of change and one to assess knowledge of RWI and prevention. The information from the demographics surveys was used to assure that all lifeguards and aquatic directors had current lifeguard certifications and had experience in this occupation. The demographics were also used in the data analysis as covariates.

Baseline surveys were given in June of 2001, and posttest surveys were given six weeks later. Immediately after the pretest, the intervention participants received the training session on prevention of waterborne disease transmission in chemically treated recreational swimming water. The training was presented at seven aquatic facilities for the intervention participants enrolled in the study. The training session lasted approximately one hour. An evaluation form was administered after the training session. No name was required on this form. Six weeks later, the same knowledge and behavior surveys were given as a posttest. The control participants were given the knowledge, behavior and demographics surveys at a special pretest session at their aquatic facility and again six weeks later. The control participants received the intervention training session after the posttests.

The names on the knowledge, behavior and demographics surveys were removed and coded for later identification by the researcher in order to maintain participant confidentiality. The surveys were separated in files and organized by pre and posttest. Surveys were stored in a locked office for protection of the participants' identities.

Lifeguards under the age of 18 who did not return an assent form were not allowed to participate in the study. Also excluded were those lifeguards and aquatic directors who did not attend both the pre and posttest sessions, and for the intervention group, the training session.

Measures

Data collection instruments included four questionnaires: 1) a behavior survey to measure stages of change, 2) a waterborne disease knowledge survey, 3) a demographics survey and 4) a training session evaluation form.

The stages of change behavior survey assessed each individual's stage in regard to behaviors related to waterborne disease prevention. There were five emphasis areas in the behavior survey to assess the implementation or existence of RWI prevention: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) training in RWI. There were 20 questions on the aquatic director survey, and 15 questions on the lifeguard survey. Both surveys had the same five emphasis areas for analysis. According to answers on the surveys given before the training sessions, each participant was placed in a baseline stage for each emphasis area and knowledge. Levels of behavior change were characterized as precontemplation, contemplation, preparation, action, and maintenance stages.

In order to determine baseline stage level, participants were asked to answer each question according to this scale:

A. No, not at the present time

B. No, but I intend to in the next 3 months

C. No, but I intend to in the next 30 days

D. Yes, I have, but for less than 3 months

E. Yes, I have, for more than 3 months

Aquatic directors and lifeguards were classified into stages according to the majority of their answers in one of the following categories:

A. Precontemplation – is not thinking about change and / or is not intending to change in the next 3 months

B. Contemplation – does intend to change in the next 3 months

C. Preparation – does intend to change in the next 30 days

D. Action – has performed a behavior, but for less than 3 months

E. Maintenance – has performed a behavior, for over 3 months

In the analysis of stages of change questionnaires in Prochaska's university integrated service delivery study, the five stages of change were recoded as "A" = 1 progressing to "E" = 5. Answers from the five behavioral emphasis areas in the pretest surveys were averaged for every participant in order to place each participant in a baseline stage for each emphasis area (Levesque & Prochaska, 1999). The analysis in the present study was patterned after the Levesque and Prochaska methodology.

2) The knowledge survey consisted of ten multiple choice questions about water chemistry and pool policies as they relate to preventing the spread of disease, facts about waterborne pathogens and facts about swimming in the United States. The intervention participants received the survey immediately before the intervention training session, and six weeks later. Each participant was scored by percent correct

each time he or she took the survey. The control group received the survey at a pretest meeting, and at six weeks posttest.

3) The demographics survey documented gender, age, education, aquatic job experience and lifeguard certification. This information assured that all lifeguards and aquatic directors had current lifeguard certifications and experience in this occupation. This survey was given with the pretest surveys.

4) The post session evaluation form consisted of seven questions answered on a Likert scale from "not helpful at all" to "very helpful," and three short answer questions. This form was designed to contribute to the planning of future studies involving training in waterborne disease prevention. This form was optional.

All study questionnaires were pilot tested at an intervention training session for reliability, time and proper use of terms. The pilot study took place at University of North Alabama in Florence. Attendees consisted of seven college age lifeguards from a city aquatic facility, and two aquatic directors from separate facilities.

The Intervention

A waterborne disease prevention training manual was designed by the researcher for the intervention. The manual consists of basic information on waterborne pathogens and how to prevent them in chemically treated recreational swimming water. The manual is titled "Recreational Water Illnesses: A Training Manual for Use with Lifeguards" and is based on data from the CDC waterborne surveillance outbreak reports, the CDC Healthy Swimming 2001 web-site and documentation supported by the DPD Recreational Water division. Design for the intervention manual was influenced primarily by manuals such as Moving in New

Directions (O'Hara, Messick, Fichtner, & Parris, 1997). Other instructor manuals of similar design are that of the YMCA's lifeguard instruction program manual (1995) and the American Red Cross lifeguard instructor's manual (1997).

The intervention included training in preventing the transmission of recreational water illnesses by focusing on these five emphasis areas: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies 4) diaper policies and 5) education of staff and patrons in RWI prevention. Training also discussed national statistics on RWI and examples of case studies in outbreak surveillance reports.

After the one-hour training session led by the study researcher, CDC brochures and fact sheets were given to the aquatic director for use at that facility for the 6-week period between assessments. All intervention participants were encouraged to use the CDC materials in the education of patrons in the prevention of RWI. The long-term goal is to use this intervention with aquatic staff on a large scale.

Data Analysis

Using stages of change to measure outcome, the intervention effectiveness was demonstrated by movement in stages of change for individuals who received the waterborne disease prevention training in comparison with those who did not. In addition to stages of change, intervention effectiveness was also evaluated by percent correct on the knowledge survey. To characterize the study population, demographic variables describing participants were listed by group and by percent rate (see Table 2).

In the first hypothesis, it was postulated that lifeguards receiving the intervention training would show greater advancement in stages of change than lifeguards who did not receive the intervention. The stages of change in each behavioral emphasis area were determined at pre and posttest in order to determine advancement through the stages of change as a result of the intervention. Stages of change were recoded as "A" = 1 progressing to "E" = 5. Questions from each emphasis were averaged and then the individual was staged (Levesque & Prochaska, 1999). Stages of change were calculated for each participant by subtracting the pre-stage value from the post-stage value to produce a change score (Levesque & Prochaska, 1999). The intervention and control groups were separated to show pre and posttest mean scores for each behavior emphasis area in stages of change (see Table 3). Shifts in stages of change from pretest to posttest were calculated to show movement between stages for intervention and control groups (see Table 4).

In the second hypothesis, it was postulated that lifeguards receiving the intervention training would show greater advancement in knowledge than lifeguards who did not receive the intervention. The intervention and control groups were separated to show pre and posttest mean scores (see Table 3). Then, advancement in knowledge was calculated for each participant in the intervention and control groups by subtracting the pre-stage value from the post-stage value to produce a change score for each individual (see Table 5).

In the third hypothesis, it was postulated that the variables group and pretest scores would have the most significance in predicting posttest scores, according to pre and posttest surveys. As a first step to determine if group and pretest scores influenced the posttest scores, correlation procedures were utilized to detect relationships. The variables of knowledge, facility maintenance, pool chemistry, pool policies, diaper policies and RWI training were analyzed (see Tables 6 - 11). Analysis of Covariance was then employed to determine if the independent variables pretest, group, age, gender, education, experience, and certification, or a combination of these variables, would predict posttest scores for knowledge and each behavioral stage of change. The unstandardized regression coefficients indicate the extent to which group and the control variables effect change from pretest to posttest (see Tables 12 - 17).

CHAPTER IV

RESULTS

This study design was a behavioral intervention to test the effectiveness of waterborne disease prevention training with individuals randomly assigned to either intervention or control conditions. Outcome measures were assessed by comparison of pre and posttest survey results. Effectiveness of the intervention was demonstrated by showing positive increases in stages of change for individuals who received the waterborne disease prevention training in comparison with those who did not, and by advances in knowledge of waterborne disease.

Hypothesis one postulated that the participants who received the intervention training would advance further in stages of change than the participants who did not receive the intervention. The stages of change survey scores were analyzed for movement between the stages of change in each behavioral emphasis area by percent of the sample in each stage at pre and posttest for the intervention and control participants. There were five emphasis areas in the behavior survey to assess the implementation or existence of RWI prevention: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) training in RWI.

Hypothesis two postulated that the participants who received the intervention training would show a greater increase in knowledge than the participants who did not receive the intervention. The knowledge scores were analyzed as percent correct between pre and posttests for the intervention and control participants.

Hypothesis three postulated that when controlling for pretest scores for knowledge, pretest scores for the behavioral stages of change, group, age, gender, education, experience, and certification, the variables group and pretest scores would have the most significance in predicting knowledge and behavioral stages of change posttest scores. The correlation analysis was used first to determine significance of relationships between all variables. All tests were two-tailed. Analysis of Covariance (ANCOVA) was used to predict significant changes in the stages of change score between the pretest and posttest scores when controlling for the variables pretest, group, age, gender, education, experience, and certification, or a combination of these variables.

Description of Participants

Fifteen aquatic organizations were recruited from a list of 42 in middle Tennessee. Two facilities that had verbally agreed to participate in the study dropped out. One aquatic facility dropped out before the pretest and the second dropped out after the pretest but prior to the posttest. Thirteen organizations completed the study, resulting in a participation rate of 31%.

To determine the effectiveness of the intervention training session, 191 lifeguards completed pretest surveys on knowledge and behavior regarding waterborne disease prevention, and a demographics survey. One hundred and one lifeguards and seven aquatic directors completed the pretest as intervention participants, and 90 lifeguards and five aquatic directors completed the pretest as control participants. The intervention group, who completed the posttest surveys six weeks after the baseline assessment, consisted of 60 lifeguards and four aquatic directors. The control group, who completed the posttest surveys six weeks after the baseline assessment, consisted of 58 lifeguards and three aquatic directors.

A participant was excluded from the study if both the pre and posttest surveys were not completed. Of the 191 lifeguards and 12 aquatic directors that completed pretest surveys, there was a total drop out rate of 58% for the lifeguards and a 42% drop-out rate for the aquatic directors due to absenteeism, job change or aquatic facility drop-out.

Because there were not enough aquatic directors in the sample, they were not included in the analysis. Seven aquatic directors completed the pretest as intervention participants, and five aquatic directors completed the pretest as control participants. After six weeks, four aquatic directors from the intervention group and three aquatic directors from the control group completed the posttest.

The lifeguard intervention group (N = 60) consisted of 34 females and 26 males. Forty-eight participants were between the ages of 16 and 19, and 12 participants were between the ages of 20 and 29. Twenty-seven of the participants had not completed high school, 12 were high school graduates, 18 had completed at least one year of college and three were college graduates. Twenty-one lifeguards had worked less than one year in this occupation. Nine participants had worked as a lifeguard for one year, 12 for two years and 18 for three years or more. Seventeen of the intervention lifeguards held both ARC and YMCA lifeguard certifications.

Twenty-three lifeguards held only ARC certification and 20 lifeguards held only YMCA certification.

Table 2

Demographic Characteristics of the Sample

	Intervention Group (n = 60)	Control Group (n = 58)
Characteristic	N	N
Age 16 - 19	48	23
Age 20 - 29	12	35
Female	34	32
Male	26	26
Currently in high school	27	13
High school graduate	12	14
Completed one year college	18	27
College graduate	3	4
Worked < one year*	21	15
Worked one year	9	6
Worked two years	12	13
Worked three years	18	24
ARC and YMCA certified	17	15
ARC certified	23	27
YMCA certified	20	16

*One year = worked one summer season as a lifeguard

The lifeguard control group (N = 58) consisted of 32 females and 26 males for a total of 58. Twenty-three participants were between the ages of 16 and 19, and 35 participants were between the ages of 20 and 29. Thirteen of the subjects had not completed high school, 14 were high school graduates, 27 had completed at least one year of college and four were college graduates. Fifteen guards had worked less than one year in this occupation. Six had worked one year, 13 had worked two years and 24 had worked three years or more as a lifeguard. Fifteen of the control lifeguards had both ARC and YMCA lifeguard certifications. Twenty-seven lifeguards only had ARC and 16 lifeguards only had YMCA certification. There were three aquatic directors in the control group.

Survey Results

Table 3 shows the pre and posttest knowledge scores of the intervention and control lifeguards. Pretest mean knowledge scores of the intervention lifeguards and the control lifeguards did not show significant differences. The posttest scores showed a positive change of 35.34% from pretest in the intervention group. The control group showed slightly lower scores in posttests.

Table 3 also shows the means and standard deviations for the pre and posttests stages of change scores of the intervention and control lifeguards. Coded response options for stages of change were: 1) precontemplation, 2) contemplation, 3) preparation, 4) action and 5) maintenance. The intervention group showed positive change in all areas. The facility maintenance behavioral emphasis section showed average increases in stages of change from the contemplation stage to the preparation stage. The pool policies behavioral emphasis showed average increases in stages of change from the precontemplation stage to the contemplation stage. The control group did not show a stage change in any of the five behavioral emphasis areas.

Table 3

Means and Standard Deviations for Pre and Posttest Knowledge Scores and Five Stages of Change Scores for Lifeguards

	Intervention (n = 60)		Control (n = 58)	
	M	SD	M	SD
Knowledge Scores				
pretest	42.83	10.90	42.24	12.98
posttest	78.17	15.74	38.62	13.30
Stages of Change Emphasis Areas				
Facility Maintenance				
pretest	2.78	1.46	3.05	1.38
posttest	3.26	1.59	3.05	1.52
Pool Chemistry				
pretest	2.55	1.40	2.60	1.25
posttest	2.68	1.47	2.41	1.33
Pool Policies				
pretest	1.70	0.92	1.68	0.73
posttest	2.01	0.85	1.53	0.77
Diaper Policies				
pretest	2.08	0.99	1.96	0.91
posttest	2.16	1.04	1.56	0.81
RWI Training				
pretest	2.51	1.14	2.27	1.05
posttest	2.73	1.17	2.53	1.46

Knowledge scores had a possible total of 100% correct.

Response options for stages of change were: 1 = Precontemplation, 2 = Contemplation, 3 = Preparation, 4 = Action, 5 = Maintenance.

Shifts in stages of change.

Table four shows the shifts in stages of change for the pretests and posttests of the five emphasis areas. The intervention group advanced in stages of change by attaining a larger percentage of lifeguards in advanced stages in the posttest than in the pretests in all areas. The facility maintenance section demonstrated the largest percentage of change for lifeguards who began in the precontemplation stage and ended in the maintenance stage. The pool chemistry section showed the largest percent of lifeguards beginning in the precontemplation stage and ending in the action stage. The pool policies section showed the largest percent of lifeguards beginning in the precontemplation stage and ending in the contemplation stage. The diaper policies section showed the largest percent of lifeguards beginning in the contemplation stage and ending in the contemplation or preparation stages. The RWI training section showed the largest percent of lifeguards beginning in the contemplation stage and ending in the contemplation stage. The control group did not show a stage change in any of the five behavioral emphasis areas.

Table 4
Shifts in Stages of Change for Lifeguards

	Facility Maintenance		Pool Chemistry		Pool Policies		Diaper Policies		RWI Training	
	N	%	N	%	N	%	N	%	N	%
Precontemplation										
Intervention										
Pretest	17	28.3	19	31.7	30	50.0	19	31.7	13	21.7
Posttest	14	23.3	20	33.3	18	30.0	20	33.3	8	13.3
Control										
Pretest	14	24.1	16	27.6	26	44.8	19	32.8	16	27.6
Posttest	17	29.3	23	39.7	35	60.3	32	55.2	16	27.6
Contemplation										
Intervention										
Pretest	10	16.7	13	21.7	23	38.3	24	40.0	18	30.0
Posttest	6	10.0	9	15.0	26	43.3	17	28.3	22	36.7
Control										
Pretest	3	5.2	9	15.5	25	43.1	27	46.6	19	32.8
Posttest	2	3.4	4	6.9	17	29.3	23	39.7	11	19.0
Preparation										
Intervention										
Pretest	12	20.0	12	20.0	4	6.7	11	18.3	17	28.3
Posttest	11	18.3	9	15.0	13	21.7	17	28.3	13	21.7
Control										
Pretest	15	25.9	19	32.8	6	10.3	8.0	13.8	15	25.9
Posttest	12	20.7	20	34.5	4	6.9	2.0	3.4	15	25.9
Action										
Intervention										
Pretest	11	18.3	8	13.3	1	1.7	5.0	8.3	9	15.0
Posttest	8	13.3	14	23.3	3	5.0	5.0	8.3	12	20.0
Control										
Pretest	18	31.0	10	17.2	1	1.7	1.0	1.7	7	12.1
Posttest	15	25.9	6	10.3	2	3.4	2.0	3.4	12	20.7
Maintenance										
Intervention										
Pretest	10	16.7	8	8.0	2	3.3	1	1.7	3	5.0
Posttest	21	35.0	13	13.3	3	5.0	1	1.7	5	8.3
Control										
Pretest	8	13.8	4	6.9	0	0.0	1	1.7	1	1.7
Posttest	12	20.7	5	8.6	1	1.7	1	1.7	7	12.1

Distribution of knowledge scores.

Table five shows the distribution of pre and posttest knowledge scores for the intervention and control groups. At pretest, groups had their highest number of participants score in the 50 percentile range on the knowledge survey. The posttest scores showed a significant change from pretest with the intervention group scoring 31.7% of participants in the 80 percentile range and 30% of subjects in the 90 percentile range. The control group did not show any significant change in posttest scores with 27.6% of participants each in the 30 and 40 percentile range.

Table 5

Distribution of Pre and Posttest Knowledge Scores for the Intervention and Control Lifeguard Groups

Pre-test Scores

	Intervention group (n=60)		Control group (n=58)	
% Correct	N	%	N	%
10%	0	0.0	1	1.7
20%	2	3.3	6	10.3
30%	14	23.3	8	13.8
40%	17	28.3	16	27.6
50%	20	33.3	20	34.5
60%	6	10.0	5	8.6
70%	1	1.7	2	3.4
80%	0	0.0	0	0.0
90%	0	0.0	0	0.0
100%	0	0.0	0	0.0

Posttest Scores

	Intervention group (n=60)		Control group (n=58)	
% Correct	N	%	N	%
10%	0	0.0	2	3.4
20%	0	0.0	6	10.3
30%	1	1.7	16	27.6
40%	1	1.7	16	27.6
50%	6	10.0	11	19.0
60%	2	3.3	6	10.3
70%	8	13.3	1	1.7
80%	19	31.7	0	0.0
90%	18	30.0	0	0.0
100%	5	8.3	0	0.0

Correlation analysis.

Correlation analysis was employed to determine the relationships among variables. As a first step to determine if group and pretest scores influenced the posttest scores, correlation procedures were utilized to detect relationships. The variables knowledge, facility maintenance, pool chemistry, pool policies, diaper policies and RWI training were analyzed. All tests were two-tailed.

In Table 6, the correlations between group, knowledge pretest and knowledge posttest showed a significant relationship between group and posttest ($p < .01$).

Table 6

Correlations between Group and Knowledge Pretest and Posttest Scores

Variable	Group	Knowledge Pretest	Knowledge Posttest
Group	-		
Knowledge Pretest	.025	-	
Knowledge Posttest	.806**	.160	-

(** $p < .01$)

In Table 7, the correlations between group, maintenance pretest and maintenance posttest showed a significant relationship between pretest and posttest ($p < .01$). Group was not related to the pretest and posttest scores.

Table 7

Correlations between Group and Maintenance Pretest and Posttest Scores

Variable	Group	Maintenance Pretest	Maintenance Posttest
Group	-		
Maintenance Pretest	-.095	-	
Maintenance Posttest	.069	.492**	-

(** $p < .01$)

In Table 8, the correlations between group, water chemistry pretest and water chemistry posttest showed a significant relationship between pretest and posttest ($p < .01$). Group was not related to the pretest and posttest scores.

Table 8

Correlations between Group and Pool Chemistry Pretest and Posttest Scores

Variable	Group	Pool Chemistry Pretest	Pool Chemistry Posttest
Group	-		
Pool Chemistry Pretest	-.020	-	
Pool Chemistry Posttest	.096	.713**	-

(** p < .01)

In Table 9, the correlations between group, pool policies pretest and pool policies posttest showed a significant relationship between group and posttest, and pretest and posttest ($p < .01$).

Table 9

Correlations between Group and Pool Policies Pretest and Posttest Scores

Variable	Group	Pool Policies Pretest	Pool Policies Posttest
Group	-		
Pool Policies Pretest	.006	-	
Pool Policies Posttest	.285**	.400**	-

(** $p < .01$)

In Table 10, the correlations between group, diaper policies pretest and diaper policies posttest showed a significant relationship between group and posttest, and pretest and posttest ($p < .01$).

Table 10

Correlations between Group and Diaper Policies Pretest and Posttest Scores

Variable	Group	Diaper Policies Pretest	Diaper Policies Posttest
Group	-		
Diaper Policies Pretest	.062	-	
Diaper Policies Posttest	.305**	.385**	-

(** $p < .01$)

In Table 11, the correlations between group, RWI training pretest and RWI training posttest showed a significant relationship between training pretest and posttest ($p < .01$). Group was not related to the pretest and posttest scores.

Table 11

Correlations between Group and RWI Training Pretest and Posttest Scores

Variable	Group	RWI Training Pretest	RWI Training Posttest
Group	-		
RWI Training Pretest	.110	-	
RWI Training Posttest	.075	.521**	-

(** $p < .01$)

Analysis of Covariance (ANCOVA).

ANCOVA was employed to determine the extent to which the variables pretest, group, age, gender, education, experience, and certification, or a combination of these variables, would predict posttest scores. The unstandardized regression coefficients indicate the extent to which group and the control variables effect change from pretest to posttest. ANCOVA provides information to determine which independent variables contribute significantly to the prediction of change between pretest and posttest scores and also allows for the partitioning of the total variance accounted for in a dependent variable by a set of predictors (Vincent, 1995).

A summary of the regression analysis for variables predicting knowledge survey posttest scores for lifeguards consisted of three models. The first model tests the main effects: knowledge pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. When interactions as a set did not significantly increase the explanatory power of the model, all interactions were dropped in favor of a main effects model. When interactions between group and other covariates were significant, regressions were performed separately by group. In the final model, the significant predictors for the knowledge posttest and each behavioral stage of change posttest are shown. In addition to significance of predictors, R^2 and R^2 change are listed below the final model. The increase in R^2 change shows a significant increase in the explanatory power of the model.

A summary of the regression analysis for variables predicting the posttest scores for the knowledge (Table 12) consisted of three models. In the final model, the significant predictors of knowledge posttest were knowledge pretest ($p < .05$), and group ($p < .001$). Posttest knowledge scores were on average 39.375 points higher for members of the intervention group than for members of the control group.

There was a high degree of colinearity between the interaction terms and the main effects, especially for the variable group. This is evident because of the high value of the standardized regression coefficient for group and for group*education.

Table 12
Summary of Hierarchical Regression Analysis for Variables Predicting Knowledge Posttest Scores for Lifeguards

Model 1	Variable	B	SE B	β
	Constant	18.392	15.864	
	Knowledge pretest	.276	.112	.134 *
	Group	40.995	2.911	.836 ***
	Age	3.816	3.432	.076
	Gender	1.477	2.746	.030
	Education	.648	1.339	.033
	Experience	-.962	1.515	-.041
	Certification	-3.149	3.029	-.057
Model 2 Main Effects:				
	Constant	-10.411	21.399	
	Knowledge pretest	.282	.151	.137
	Group	86.880	34.774	1.002 *
	Age	3.386	4.504	.068
	Gender	-1.098	4.226	-.022
	Education	3.242	1.781	.167
	Experience	-1.388	2.169	-.060
	Certification	-8.656	4.640	-.157
Interactions:				
	Group* Knowledge pretest	-.033	.234	-.032
	Group*Experience	1.244	3.093	.056
	Group*Age	.822	1.781	.284
	Group*Gender	6.207	5.734	.115
	Group*Education	-5.448	2.725	-1.353 *
	Group*Certification	10.434	6.217	.149
Model 3	Constant	26.449	5.035	
	Knowledge pretest	.288	.111	.140 *
	Group	39.375	2.628	.803 ***

Note: R^2 = .679 for Model 1; Change in R^2 = .027 for Model 2 from Model 1(not significant).
R^2 for Model 3 = .670 (p < .001).
*p < .05. **p < .01. ***p < .001.

A summary of the regression analysis for variables predicting the posttest scores for the maintenance behavioral emphasis area of the stages of change survey consisted of three models. The first model tests the main effects: knowledge pretest, maintenance pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. In the third model, the significant predictors of maintenance posttest were knowledge pretest ($p < .05$), maintenance pretest ($p < .01$), experience ($p < .001$), group*experience ($p < .01$), and group*certifications ($p < .01$).

Since the interaction terms involving group were significant, the final models four and five were run separately by group. In model four, the intervention group maintenance pretest and certifications were positively related to the maintenance posttest scores ($p < .001$ for both). Years of experience and knowledge were not related to maintenance pretest. The R^2 for model four was .597 ($p < .001$). In model five, the control group maintenance pretest scores and years of experience were positively related to the maintenance posttest scores ($p < .05$ and $p < .01$ respectively). Certifications and knowledge were not related to maintenance pretest. The R^2 for model five is .280 ($p < .01$).

Table 13

Summary of Hierarchical Regression Analysis for Variables Predicting Behavior in Maintenance Posttest Scores for Lifeguards

	Variable	B	SE B	β
Model 1				
	Constant	.303	1.523	
	Knowledge pretest	.021	.010	.163 *
	Maintenance pretest	.497	.090	.454 ***
	Group	.288	.272	.093
	Age	-.271	.318	-.085
	Gender	-.346	.255	-.111
	Education	.011	.125	.010
	Experience	.213	.140	.145
	Certification	.496	.287	.142
Model 2 Main Effects:	Constant	.033	1.923	
	Knowledge pretest	.028	.013	.215 *
	Maintenance pretest	.312	.123	.285 *
	Group	-1.684	3.116	-.543
	Age	-.445	.390	-.140
	Gender	.026	.366	.008
	Education	-.001	.155	.001
	Experience	.669	.188	.456 **
	Certification	-.526	.417	-.151
Interactions:				
	Group* Knowledge pretest	-.011	.020	-.162
	Group*Experience	-.785	.268	-.559 **
	Group*Age	.099	.154	.542
	Group*Gender	-.252	.498	-.074
	Group*Education	.059	.238	.232
	Group*Certification	1.699	.553	.385 **
	Group* Maintenance pretest	.369	.168	.413 *
Model 3				
	Constant	.182	.614	
	Knowledge pretest	.021	.009	.166 *
	Maintenance pretest	.325	.119	.297 **
	Group	-.097	.642	.032
	Experience	.575	.154	.392 ***
	Certifications	-.554	.381	-.159
	Group*Experience	-.674	.214	-.479 **
	Group*Certifications	1.731	.517	.392 **
	Group* Maintenance pretest	.352	.161	.394 *

Model 4				
	Constant	.561	.678	
Intervention	Knowledge pretest	.015	.013	.105
Group	Maintenance pretest	.684	.095	.628***
	Experience	-.109	.131	-.073
	Certifications	1.152	.307	.329***
Model 5				
	Constant	-.001	.779	
Control	Knowledge pretest	.020	.014	.222
Group	Maintenance pretest	.323	.134	.292*
	Experience	.576	.173	.398**
	Certifications	-.556	.427	-.161

Note: R^2 = .320 for Model 1; Change in R^2 = .142 for Model 2 from Model 1 ($p < .05$).
R^2 for Model 3 = .305 ($p < .001$). R^2 for Model 4 = .597 ($p < .001$). R^2 for Model 5 = .280 ($p < .01$).
*$p < .05$. **$p < .01$. ***$p < .001$.

A summary of the regression analysis for variables predicting the posttest scores for the pool chemistry policies behavioral emphasis area of the stages of change survey consisted of three models. The first model tests the main effects: knowledge pretest, pool chemistry policies pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. Interactions as a set did not significantly increase the explanatory power of the model, so all interactions were dropped in favor of a main effects model. In the final model, the pretest scores for pool chemistry policies were positively related to posttest scores ($p < .001$). Group did not explain changes in pool chemistry policies behavior.

Table 14
Summary of Hierarchical Regression Analysis for Variables Predicting Behavior in Pool Chemistry Policies Posttest Scores for Lifeguards

	Variable	B	SE B	β
Model 1				
	Constant	.767	1.130	
	Knowledge pretest	.003	.008	.031
	Maintenance pretest	.759	.074	.715 ***
	Group	.422	.203	.150 *
	Age	.260	.241	.091
	Gender	-.061	.191	-.022
	Education	-.065	.093	.059
	Experience	.124	.107	.093
	Certification	-.084	.216	-.027
Model 2				
Main Effects:				
	Constant	.122	1.479	
	Knowledge pretest	.000	.010	.002
	Chemistry pretest	.596	.109	.561 ***
	Group	-1.375	2.496	-.489
	Age	.007	.312	.003
	Gender	.119	.291	.042
	Education	.023	.122	.021
	Experience	.256	.154	.193
	Certification	-.499	.319	-.158
Interactions:				
	Group* Knowledge pretest	.019	.016	.318
	Group*Experience	-.047	.216	-.037
	Group*Age	.214	.123	1.289
	Group*Gender	-.458	.393	-.147
	Group*Education	-.265	.188	-1.147
	Group*Certification	.751	.435	.188
	Group* Chemistry pretest	.258	.148	.297
Model 3				
	Constant	.601	.200	
	Chemistry pretest	.757	.069	.713 ***

Note: R^2 = .536 for Model 1; Change in R^2 = .056 for Model 2 from Model 1 (not significant). R^2 for Model 3 = .508 ($p < .001$).
*$p < .05$. **$p < .01$. ***$p < .001$.

A summary of the regression analysis for variables predicting the posttest scores for the pool policies behavioral emphasis area of the stages of change survey consisted of four models. The first model tests the main effects: knowledge pretest, pool policies pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. In the third model, the significant predictors of pool policies posttest were policies pretest ($p < .001$), group*knowledge pretest ($p < .05$) and group*policies pretest ($p < .05$). Since the interaction terms involving group were significant, the final models four and five were run separately by group. In model four, the intervention group pool policies pretest was positively related to the pool policies posttest scores ($p < .05$). Knowledge was not related to pool policies pretest. The R^2 for model four was .141 ($p < .05$). In model five, the control group pool policies pretest was positively related to the pool policies posttest scores ($p < .001$). Knowledge was not related to pool policies pretest. The R^2 for model five is .374 ($p < .001$).

Table 15
Summary of Hierarchical Regression Analysis for Variables Predicting Behavior in Pool Chemistry Policies Posttest Scores for Lifeguards

	Variable	B	SE B	β
Model 1				
	Constant	.995	.834	
	Knowledge pretest	-.000	.006	-.000
	Policies pretest	.401	.084	.394***
	Group	.591	.152	.350***
	Age	.241	.179	.140
	Gender	-.045	.143	-.027
	Education	-.036	.070	-.054
	Experience	.105	.079	.132
	Certification	-.034	.158	-.018
Model 2 Main Effects:				
	Constant	1.280	1.101	
	Knowledge pretest	-.014	.008	-.207
	Policies pretest	.631	.136	.619***
	Group	-.044	1.815	-.026
	Age	.294	.236	.170
	Gender	-.146	.217	-.086
	Education	-.037	.092	-.055
	Experience	.102	.112	.128
	Certification	-.074	.238	-.039
Interactions:				
	Group* Knowledge pretest	.035	.012	.969**
	Group*Experience	.059	.160	.077
	Group*Age	.020	.092	.201
	Group*Gender	.018	.294	.010
	Group*Education	-.059	.141	-.428
	Group*Certification	.135	.320	.056
	Group* Policies pretest	-.377	.171	-.478*
Model 3				
	Constant	1.026	.394	
	Knowledge pretest	-.012	.007	-.175
	Policies pretest	.612	.131	.600***
	Group	-.197	.569	-.116
	Group*Knowledge pretest	.029	.011	.791*
	Group*Policies pretest	-.340	.166	-.432*

Model 4				
	Constant	.829	.458	
Intervention	Knowledge pretest	.017	.010	.216
Group	Policies pretest	.272	.113	.295*
Model 5				
	Constant	1.026	.341	
Control	Knowledge pretest	-.012	.006	-.208
Group	Policies pretest	.612	.113	.576***

Note: R^2= .275 for Model 1; Change in R^2 = .087 for Model 2 from Model 1 (not significant).
R^2 for Model 3 = .240 ($p < .001$). R^2 for Model 4 = .141 ($p < .05$). R^2 for Model 5 = .374 ($p < .001$).
*$p < .05$. **$p < .01$. ***$p < .001$.

A summary of the regression analysis for variables predicting the posttest scores for the diaper policies behavioral emphasis area of the stages of change survey consisted of three models. The first model tests the main effects: knowledge pretest, diaper policies pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. Interactions as a set did not significantly increase the explanatory power of the model, so all interactions were dropped in favor of a main effects model. In the final model, the pretest scores for diaper policies ($p < .001$), group ($p < .001$) and experience ($p < .05$) were positively related to posttest scores.

Table 16

Summary of Hierarchical Regression Analysis for Variables Predicting Behavior in Diaper Policies Posttest Scores for Lifeguards

	Variable	B	SE B	β
Model 1				
	Constant	1.148	.973	
	Knowledge pretest	.003	.007	.047
	Diaper policies pretest	.356	.089	.346 ***
	Group	.608	.177	.310 **
	Age	.082	.215	.041
	Gender	.045	.167	.023
	Education	-.072	.081	-.094
	Experience	.194	.094	.210 *
	Certification	.082	.184	.037
Model 2				
Main Effects:				
	Constant	2.104	1.325	
	Knowledge pretest	-.008	.009	-.106
	Diaper policies pretest	.363	.139	.353 *
	Group	-1.794	2.279	-.916
	Age	.080	.295	.040
	Gender	-.195	.261	-.099
	Education	-.080	.113	-.103
	Experience	.079	.136	.085
	Certification	.122	.287	.055
Interactions:				
	Group* Knowledge pretest	.028	.015	.669
	Group*Experience	.246	.195	.277
	Group*Age	.041	.113	.361
	Group*Gender	.259	.355	.120
	Group*Education	-.015	.173	-.096
	Group*Certification	.135	.384	.048
	Group* Diaper policies pretest	.019	.186	.025
Model 3				
	Constant	1.070	.197	
	Diaper policies pretest	.360	.084	.350 ***
	Group	.604	.160	.308 ***
	Experience	.163	.076	.176 *

Note: R^2 = .268 for Model 1; Change in R^2 = .046 for Model 2 (not significant).
R^2 for Model 3 = .258 ($p < .001$).
*$p < .05$. **$p < .01$. ***$p < .001$.

A summary of the regression analysis for variables predicting the posttest scores for the RWI training section of the stages of change survey consisted of three models. The first model tests the main effects: knowledge pretest, RWI training pretest, group, age, gender, education, experience, and certification. The second model tests interactions and main effects. Interactions as a set did not significantly increase the explanatory power of the model, so all interactions were dropped in favor of a main effects model. In the final model, the pretest scores for RWI training were positively related to posttest scores ($p < .001$). Group did not explain changes in RWI training behavior.

Table 17
Summary of Hierarchical Regression Analysis for Variables Predicting Posttest Scores in Behavior Regarding RWI Training for Lifeguards

	Variable	B	SE B	β
Model 1				
	Constant	.097	1.314	
	Knowledge pretest	.012	.009	.114
	Training pretest	.642	.098	.535 ***
	Group	.222	.230	.084
	Age	.382	.271	.142
	Gender	-.097	.217	-.037
	Education	.015	.107	-.015
	Experience	.051	.122	.049
	Certification	-.178	.239	-.060
Model 2				
Main Effects:				
	Constant	-1.087	1.869	
	Knowledge pretest	.022	.012	.202
	Training pretest	.806	.160	.671 ***
	Group	1.641	3.005	.622
	Age	.349	.369	.130
	Gender	.117	.335	.044
	Education	.014	.145	-.014
	Experience	.270	.190	.216
	Certification	-.516	.367	-.174
Interactions:				
	Group* Knowledge pretest	-.020	.019	-.355
	Group*Experience	-.484	.258	-.405
	Group*Age	.012	.143	.083
	Group*Gender	-.131	.455	-.045
	Group*Education	.068	.219	.316
	Group*Certification	.488	.493	.130
	Group* Training pretest	-.338	.205	-.383
Model 3				
	Constant	1.133	.251	
	Training pretest	.626	.095	.521 ***

Note: $R^2 = .317$ for Model 1; Change in $R^2 = .060$ for Model 2 (not significant).
R^2 for Model 3 = .272 ($p < .001$).
*$p < .05$. **$p < .01$. ***$p < .001$.

The results of the ANCOVA analysis show that the main effects of experience, group, knowledge pretest score, behavior pretest score, the interaction of group with the knowledge or behavior pretests, or the interaction of group with years of experience and types of certifications were significant in predicting the posttests scores for maintenance, pool policies and diaper policies. For each dependent variable, a lifeguard's group or pretest score was a predictor of his or her posttest score. For the maintenance behavioral emphasis area, interactions between group and maintenance pretest score, years of experience and certifications were significant. This shows that in this area, a lifeguard's group, years of experience and certification were important in prediction of posttest scores. This was the only behavioral area that showed this result. For the pool policies behavioral emphasis area, interactions between group and knowledge pretest, and group and pool policies pretest were significant. This was the only behavior area in which the knowledge pretest score interaction was significant in prediction in the third model. For the diaper policies behavioral emphasis area, diaper policies pretest, group and years of experience were significant. This shows that in this area, a lifeguard's group and years of experience, as well as pretest score, were important in prediction of change in scores from pretest to posttest. This supports hypothesis three and the use of this data analysis procedure for this study.

CHAPTER V

DISCUSSION

This research addressed the importance of waterborne disease prevention by promoting knowledge and skills related to preventing the spread of waterborne disease, and the maintenance of these preventive behaviors. The main purpose of this study was to determine if the participants who received the intervention training would advance further in stages of change than the participants who did not receive the intervention. The second purpose of the study was to determine if the participants who received the intervention training would show a greater increase in knowledge than the participants who did not receive the intervention. The third purpose of the study was to determine if the variables knowledge pretest score, behavior pretest score, group, age, gender, education, experience, or certification would show significance in predicting the posttest scores in knowledge or behavioral stages of change. The primary outcome of this study was to advance lifeguards in stages of behavior change and knowledge in regard to waterborne disease prevention.

Chapter V is divided into three sections. The sections are: 1) Summary, 2) Conclusions and 3) Recommendations. The summary discusses the researcher's conclusions based on those findings described in Chapter IV. The conclusions discuss the effectiveness of the intervention training. The recommendations are based on the results of the present study for future research.

Summary

The demographics survey contained questions regarding age, gender, education, aquatic job experience and lifeguard certification. The age and education of the lifeguards shows that the control group had more college-age guards (n = 39) than the intervention group (n = 21). The control group had more high school age lifeguards (n = 27) than the intervention group (n = 13). The results of this study suggest that high school age lifeguards can be trained effectively in knowledge and prevention of waterborne disease.

The intervention group had more lifeguards that worked less than one year (n = 21) than the control group (n = 15). Also, the intervention group did not have as many participants with three or more years of experience (n = 18) as the control group (n = 24). This suggests that lifeguards with limited experience can still gain in knowledge and advance in stages of change in behavior change with regard to waterborne disease prevention.

The nature of aquatic staff populations and the occupation of lifeguarding have characteristics that may lead to drop-out, training and scheduling problems. Forty two letters of request for participation were mailed, and 13 aquatic facilities completed the study, resulting in a participation rate of 31%. One aquatic director said he could not afford to pay a large lifeguard staff for one more hour of staff training time in order to participate in the study (personal communication, May, 2002). Low pay and physical demands of the job lead to a high turnover rate. Of the 191 lifeguards and 12 aquatic directors who completed pretest surveys, there was a total drop-out rate of 58% for the lifeguards and a 42% drop-out rate for the aquatic directors. Aquatic staff may work long hours in the heat and sun, which can lead to burnout. An aquatic director commented at a posttest meeting that it is very difficult to retain lifeguard staff all summer (personal communication, August, 2002). In late July and August, many lifeguards will quit and take an indoor job or take a break before they go back to school. An aquatic director also mentioned that absentee rates go up in July and August (personal communication, August, 2002). Aquatic directors must re-train staff as new employees are hired. The results of this research show that a significant drop-out rate during a study in this occupation can be expected. If there had been fewer drop-outs, the results would have been more representative of the lifeguard population in middle Tennessee.

The majority of both groups had American Red Cross lifeguard certification rather than YMCA or a combination of both. This suggests that the type of lifeguard certification the participants had did not have an effect on the outcome of the study.

The first assumption of this study was that that lifeguards receiving the intervention training would show greater advancement in stages of change than lifeguards who did not receive the intervention. Stages of change survey scores were analyzed for movement between the stages of change in each behavioral emphasis area by percent of the sample in each stage at pre and posttest for the intervention and control participants. These findings support the assumption that training in RWI prevention has a positive effect on lifeguards in behaviors related to prevention.

At baseline, a larger number of lifeguards were in the precontemplation or contemplation stages of change than the action or maintenance stages of change. Prior studies of self-change show that few people are in the preparation, action or maintenance stages at the time of intervention (Prochaska, et al., 1992; Glanz, et al., 1999). People moving through stages of change should make predictable changes in their behavior (Glanz, et al., 1999). The intervention group showed positive change in all areas, with a stage change in facility maintenance and pool policies. Facility maintenance showed increases in stages of change from the contemplation stage to the preparation stage, suggesting that lifeguards are more willing to perform maintenance duties because they understand that a cleaner facility helps prevent the spread of disease. The pool policies emphasis showed increases in stages of change from the precontemplation stage to the contemplation stage, suggesting that lifeguards are thinking about the role pool policies play in the prevention of waterborne disease. In the precontemplation stage, the lifeguards were not even considering this fact. Because there is little education in RWI, this result may reflect the lack of knowledge and awareness of the problem and steps that lifeguards can take in prevention. Although there was not a stage change in every area, there was advancement within each stage for each behavioral emphasis area in the intervention group. Lifeguards exposed to the intervention progressed in their intentions to change. The mean scores of the control group do not show a stage change or advancement in knowledge (see Table 3).

The second assumption of this study was that the participants who received the intervention training would show a greater increase in knowledge than the participants who did not receive the intervention. In the intervention group, the posttest mean score showed a 35.34% positive change from the pretest mean. The control group showed a four percent lower posttest mean. This slight change in score may be a result of guessing at the survey questions by the control group. This result shows that the intervention training session had a positive influence on the lifeguards' knowledge with regard to waterborne disease prevention.

The third assumption of this study was when controlling for independent variables, group and pretest scores would have the most significance in predicting knowledge and behavioral stages of change posttest scores. There were six dependent variables: posttests in knowledge, facility maintenance, use of pool chemicals and water quality, pool policies, diaper policies and RWI training. Correlation analysis was used first to determine significance relationships between all variables ($^{**}p < .01$). ANCOVA was used to predict significant differences between the pretest and posttest scores by controlling for independent variables or a combination of these variables ($^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$).

ANCOVA provides information to determine which independent variables contribute significantly to the prediction of pretest and posttest scores. This is important because it shows which variables were significant in the analysis. The results of the ANCOVA analysis show that the variables knowledge pretest score, behavior pretest score, group, or an interaction of these variables, were significant in predicting the posttests scores for maintenance and pool policies. For each dependent variable, each lifeguard's group or pretest score was a predictor of his or her posttest score.

For the behavioral areas of maintenance and pool policies, interactions between control variables were significant. This information can help future researchers develop new studies.

Four of the six dependent variables showed group as a significant predictor of posttest scores. In knowledge, maintenance, pool policies and diaper policies, group was significant. In the areas of pool chemistry and RWI training, the pretest stage of change, but not group, was significant. This may have occurred because pool chemistry can be difficult to understand and RWI training is a new concept.

For the maintenance behavioral emphasis area of the stages of change, the significant predictors of maintenance posttest were knowledge pretest, maintenance pretest, a lifeguard's group, years of experience and certification. This was the only behavioral area that showed this result. The intervention made a positive difference in how lifeguards perform maintenance duties, because they learned that a cleaner facility helps prevent the spread of waterborne illnesses.

For the pool policies behavioral emphasis area, the significant predictors of pool policies posttest were policies pretest, group*knowledge pretest and group*policies pretest. This was the only behavior area in which a knowledge pretest score interaction was significant in prediction in the third model. For this area, a lifeguard's pretest knowledge and group were important as related to general pool policies and the prevention of waterborne disease.

For the diaper policies behavioral emphasis area, the significant predictors of posttest were diaper policies pretest, years of experience and the lifeguard's group. The intervention made positive changes in how lifeguards handle diaper policies. One lifeguard made signs for her facility requiring the use of swim diapers for non toilet trained swimmers (personal communication, August, 2002). These proactive measures are helpful in preventing the spread of waterborne disease.

Conclusions

The CDC prevention efforts presented in the Healthy Swimming initiative began in May of 2001. From the recommendations made by the authorities at the CDC in recreational swimming water, the intervention training used in this study focused on these five emphasis areas: 1) facility maintenance, 2) use of pool chemicals and water quality, 3) pool policies, 4) diaper policies and 5) training in RWI. This study included a range of components and targets for change, so there were goals for behavior change for participants at all stages of change (Glanz, et al., 1999).

In the behavioral emphasis area of facility maintenance, the lifeguards in the intervention group showed a mean score change from the contemplation stage of change to the preparation stage of change. The participants had not been intending to change their facility maintenance behaviors before the intervention, and after the training they were intending to change in the next 30 days. The behaviors that demonstrated an intention to change included general maintenance of the pool area and making daily reports about cleaning duties in order to monitor cleanliness of the facility. Actions such as these have the potential to help prevent the spread of disease (MMWR, May 25, 2001/ 50(20), 410-2).

The behavioral emphasis area of pool chemicals as monitoring water quality was emphasized during the training as part of a lifeguard's job (ARC, 1997). After the training, there were 36.6% of lifeguards from the intervention group in the action and maintenance stages combined, while the control group had only 18.9% of lifeguards in the action and maintenance stages combined. This means only 36.6% of the intervention lifeguards were checking chemicals for water quality, backwashing filters, adjusting chemicals as needed, and making daily reports on these activities at posttest. Because the CDC states that effective disinfection of pool water is vital for protecting swimmers from recreational water illnesses, this action demonstrates an important public health improvement that can be made to protect recreational swimmers (CDC, Healthy Swimming, 2002).

The behavioral emphasis area of pool policies emphasized guidelines for preventing the spread of waterborne disease. The intervention lifeguards had a mean score change from the precontemplation stage to the contemplation stage, which means they were considering changing their behavior in this area in the next three months. The control group had the highest number of participants in the precontemplation stage, not considering change at all. The Healthy Swimming initiative encourages lifeguards to recognize unhealthy behaviors and promote good hygiene by enforcing pool policies that help prevent the spread of RWI (CDC, Healthy Swimming, 2002). Such policies addressed in the intervention and in the surveys included calling for mandatory bathroom breaks, limiting the number of swimmers in the pool and asking swimmers not to spit and swallow pool water. Also, posting signs about good hygiene around the pool and offering orientations for groups of children who visit the pool will help patrons become aware of healthy swimming practices. Because pool policies are usually created by aquatic directors in order to comply with health department codes, lifeguards may remain in the early stages of change, waiting for pool directors to take action. The CDC encourages officials and pool managers to educate staff about ways to reduce RWI transmission (CDC, Healthy Swimming, 2002).

In the behavioral emphasis area of diaper policies, the intervention group had 40.0% of lifeguards in the contemplation stage before the training, and 56.6% of lifeguards in the contemplation and preparation stages combined after the training. The control group had a majority of lifeguards in the precontemplation stage, with 55.2% of lifeguards in the precontemplation stage at posttest. Group was a significant predictor of posttest scores. Behaviors in this emphasis area included keeping the diaper changing area clean and asking caregivers to use the designated area instead of changing diapers poolside. Lifeguards were also asked if they called for regular bathroom breaks and if they asked caregivers to put swim diapers on small children. These specific policies related to diaper changing are substantiated by the RWI outbreaks related to baby and "kiddie pools" (CDC, Surveillance for Waterborne Disease Outbreaks, 1997 - 1998). The Healthy Swimming initiative has developed a fecal accident policy and instructions on training employees to implement the policy (CDC, Healthy Swimming, 2002). To prevent disease transmission, the CDC recommends that persons with diarrhea should not swim, swimmers should avoid swallowing pool water, and persons should practice good hygiene before swimming, after using the restroom, and after changing a diaper (MMWR, May 25, 2001 / 50(20), 410-2). The CDC recommends pool operators provide restrooms and diaper changing areas that are close to the pool and in good repair (CDC, Healthy Swimming, 2002). Swim diapers do not prevent leakage of diarrhea. Therefore, they are not an acceptable solution for a child with a diarrheal infection and are not a substitute for frequent diaper changing away from poolside (CDC, Healthy Swimming, 2002). These recommendations were addressed in the training.

In the behavioral emphasis area of RWI training, there was only a slight movement within the contemplation stage for both groups. Lifeguards were asked if they had received training in RWI at that facility, and if they would be willing to educate others about the transmission of RWI. This would involve talking to swimmers or giving brochures to them about the transmission of RWI. This means both groups were considering change in the next three months. Lifeguards may only be considering change because they do not view themselves as educators, or see this as their responsibility. The CDC encourages aquatic directors to include training in RWI at regular staff trainings. As the lifeguards learn more about how educating swimmers relates to preventing the spread of disease, they may be more interested in talking with swimmers about waterborne illnesses. Aquatic directors can educate lifeguards on how to talk to parents and young children in appropriate ways about actions that spread disease. Also, aquatic directors can provide lifeguards incentives to make changes in behavior regarding preventing RWI by letting them use the pool before or after hours for staff recreation time. If lifeguards use the pool, they may be more inclined to employ and enforce healthy swimming practices when on duty.

The knowledge survey asked the lifeguards questions about water chemistry and pool policies as they relate to preventing the spread of disease, facts about waterborne pathogens and facts about swimming in the United States. These questions were used as a basis for discussion in the intervention training. In the intervention group, the average score changed from 42.83% at pretest to 78.17% at posttest. This shows that over a six week period, the lifeguards who received the training remembered the information to make a positive change of 35.34% from the pretest mean. The information learned in the knowledge survey can support behavior change, such as in maintaining proper water quality, or understanding how pool policies can help prevent the spread of RWI. This shows that the training promoted knowledge gain for the lifeguards in the intervention group. The control group did not show any positive change on the knowledge survey.

The post session evaluation form consisted of seven questions answered on a Likert scale from "not helpful at all" to "very helpful," and three short answer questions. This form contributes to the planning of future studies involving training in waterborne disease prevention.

The evaluation form was also used to reinforce the learning by asking questions related to the major topics in the training session. The Likert scale questions included were about RWI transmission and prevention related to the five emphasis areas. The short answer questions asked the participants what they liked most and least about the intervention training, and what else they would like to know. The participants stated that they liked the pictures of the pathogens, the brochures from the CDC, and the information about chlorine and pH as it relates to time required to kill pathogens. They liked the game about disease transmission. They thought the "shared water" concept was helpful in understanding how recreational water is an effective mode of infectious disease transmission. The participants wanted brochures to give the children, and not just information geared for parents. They suggested a book of pictures with few words, in English and in Spanish, about good hygiene around the pool. They also wanted large picture posters of swimmers rinsing or wiping off the pathogens to promote the use of bathrooms, showers, and diaper changing facilities. The lifeguards mentioned that many elementary school-aged swimmers attend pools without parental supervision and need the books and posters geared for low-level readers. Something a participant liked the least was discussing the role of fecal matter in the transmission of disease.

This intervention training has proven effective in all five areas of behavior change and in knowledge, making it a useful tool for aquatic directors to use with pool staff. This intervention has shown the value of training staff in preventing RWI in chemically treated swimming water. This study has followed the CDC recommendations to educate aquatic staff about RWI transmission and prevention in non-outbreak settings.

Recommendations

As a result of the findings obtained in this study, the following recommendations are presented:

1) Replicate this study with a larger sample size.
2) Replicate this study with posttests being given at 6 weeks, 3 months, six months and one year.
3) Replicate this study with participants from more than one state.
4) Replicate this study with on-site observation and include qualitative data.

5) Provide a training session specifically for aquatic directors, so they can train their own staff. Monitor the progress in stages of change for the aquatic director and staff over a two year period.
6) Update a 2002 training manual with the latest information from the CDC "Healthy Swimming" web-site.
7) That RWI prevention information be included in the next editions of lifeguard training manuals.

The CDC recommends that aquatic professionals work together in controlling pool-associated outbreaks of waterborne disease. The CDC has suggested a multi-component approach to waterborne disease prevention that combines education of aquatic staff, pool design modifications, and improved facility operations (MMWR, May 25, 2001 / 50(20); 416-7). As aquatic staff are more informed about preventing the spread of recreational water illnesses, they can provide information on waterborne disease prevention to the patrons of their facilities. Aquatic staff could provide information to their supervisors to support funding for pool design modifications and to improve facility operations with regard to preventing the spread of RWI. These actions would address the importance of waterborne disease prevention by promoting knowledge and skills related to preventing the spread of RWI, and the maintenance of these preventive behaviors.

APPENDIX A

Institutional Review Board Approval

Elementary and Special Education Department
P.O. Box 69
Middle Tennessee State University
Murfreesboro, Tennessee 37132
(615) 898-2680

To: Gayle Bush

From: Nancy Bertrand, Chair Nancy Bertrand
MTSU Institutional Review Board

Re: "Waterborne Pathogen Prevention Training in Chemically Treated Recreational Swimming Water: An Occupational Study Utilizing the Stages of Change Model"
Protocol #01-170

Date: May 16, 2001

The above named human subjects research proposal has been re-reviewed and approved. This approval is for one year only. Should the project extend beyond one year or should you desire to change the research protocol in any way, you must submit a memo describing the proposed changes or reasons for extensions to your college's IRB representative for review.

Best of luck in the successful completion of your research.

cc: Peggy O'Hara Murdock

APPENDIX B

Consent Form

Middle Tennessee State University
Informed Consent Agreement, Waterborne Pathogen Prevention Training Research

You are being asked to participate in a research study. Before you give your consent to participate, it is important that you read the following information and understand what you are being asked to do.

Gayle Bush, a doctoral student at Middle Tennessee State University, is conducting this research. Dr. Peggy O'Hara-Murdock of Middle Tennessee State University is supervising this research.

The purpose of this study is to determine the effectiveness of a training program designed to increase knowledge about the prevention of recreational water illnesses. Pool water can become contaminated by germs from swimmers and cause a variety of illnesses. A prevention training manual has been designed for presentation to lifeguards and aquatics directors.

The length of this consent form reflects federal government requirements that are required for all research studies involving people. Please take the time to read it before you sign.

Description of the study

If you decide to participate, you will be a part of one of 20 lifeguard groups and their aquatic directors that will be asked to complete two questionnaires. These surveys should take about 10 minutes. After six weeks, everyone will complete the same surveys again. The surveys will include questions on the aquatic staff's duties as a lifeguard, knowledge of recreational water illnesses, current policies and signs, and facility maintenance.

Half of the facilities will be chosen by random selection. If you are in one of those groups, you will also receive a training session on the prevention of recreational water illnesses. The training session will last about one hour and consists of basic information on recreational water illnesses and how to prevent them. This training will take place at your facility in June of 2001. The training includes: information about common germs in the water and how they are transmitted, disinfecting and monitoring procedures, the role of the aquatic staff in prevention, examples of case studies, and Centers for Disease Control's prevention recommendations.

This research is designed to determine if the training session increases the level of knowledge about recreational water illnesses and prevention, and promote behavior changes that help prevent the spread of germs in the water.

Risks

There are no perceived health risks from your participation in this research.

Benefits

There are perceived benefits resulting from your participation in this research. The information you receive should help you to maintain your aquatic facility in ways that prevent water illnesses. You will learn how water illness is transmitted and how to help prevent the spread of germs in the water. You will learn how to better protect swimmers from water illnesses and be more prepared to answer questions about this subject. If your facility does not receive the initial training session as a part of random selection for the study, you will have the opportunity to receive the training manual and CDC materials at a later date. This study will fulfill in part the Centers for

Disease Control and Prevention's recommendation to educate aquatic staff in recreational water illness prevention.

Costs

There are no expected costs for you to participate in this research program. This research will be conducted at your facility. This researcher will pay for any mailing necessary.

Your Rights

Participation in the study is entirely voluntary. You are free to refuse to participate in this study or withdraw at any time. Your withdrawal or lack of participation will not affect your relationship with Middle Tennessee State University in any way. Your supervisor will not be informed about which staff does not wish to participate.

The Internal Review Board of Middle Tennessee State University has approved this consent form. You may contact them if you have any questions about research that involves people.

Confidentiality

All responses to the questionnaires will be kept confidential, to the extent provided by law. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. All responses will be kept confidential; any identifying material will be modified to maintain confidentiality. The information provided for the study will be coded with a number, not a name, to protect your identity. If you offer your permission by signing this document, only the investigators and faculty advisor will have witness to the data. After the study, any information linking you to the research will be destroyed. Your names will not be kept and you will not be contacted after completion of the study. Your supervisor will not have access to your answers.

Questions about the study

If you have any questions about the research, please contact Gayle Bush at (615) 904-8326. You may also contact her at this address:
Department of Health, Physical Education, Recreation and Safety, Box 96
Middle Tennessee State University
Murfreesboro, TN 37132

Your signature below indicates that you have read the information above and have had a chance to ask any questions you have about the study. You agree to be in the study and have been told that you can change your mind and withdraw your consent to participate at any time. You will be given a copy of this agreement.

-- --

Signature of Subject Date

APPENDIX C

Assent Form

Middle Tennessee State University
Assent Agreement
Waterborne Illness Prevention Training Research

Parent Permission Form

Your child is being asked to participate in a research study. Before you give your consent for him or her to participate, it is important that you read the following information and understand what your child is being asked to do.

Gayle Bush, a doctoral student at Middle Tennessee State University, is conducting this research. Dr. Peggy O'Hara-Murdock of Middle Tennessee State University is supervising this research.

The purpose of this study is to determine the effectiveness of a training program designed to increase knowledge about the prevention of recreational water illnesses. Pool water can become contaminated by germs from swimmers and cause a variety of illnesses. A prevention training manual has been designed for presentation to lifeguards and aquatics directors.

The length of this consent form reflects federal government requirements that are required for all research studies involving people. Please take the time to read it before you sign.

Description of the study

If your child decides to participate, he or she will be a part of one of 20 lifeguard groups their aquatic directors that will be asked to complete two questionnaires. These surveys should take about 10 minutes. After six weeks, everyone will complete the same surveys again. The surveys will include questions on the aquatic staff's duties as a lifeguard, knowledge of recreational water illnesses, current policies and signs, and facility maintenance.

Half of the facilities will be chosen by random selection. If your child is in one of those groups, he or she will also receive a training session on the prevention of recreational water illnesses. The training session will last about one hour and consists of basic information on recreational water illnesses and how to prevent them. This training will take place at your facility in June of 2001. The training includes: information about common germs in the water and how they are transmitted, disinfecting and monitoring procedures, the role of the aquatic staff in prevention, examples of case studies, and Centers for Disease Control's prevention recommendations.

This research is designed to determine if the training session increases the level of knowledge about recreational water illnesses and prevention, and promote behavior changes that help prevent the spread of germs in the water.

Risks

There are no perceived health risks from your child's participation in this research.

Benefits

There are perceived benefits resulting from your child's participation in this research. The information your child receives should help him or her to maintain an aquatic facility in ways that prevent water illnesses. Your child will learn how water illness is transmitted and how to help prevent the spread of germs in the water. Your child will learn how to better protect swimmers from water illnesses and be more prepared to answer questions about this subject. If your child's group does not receive the
initial training session as a part of random selection for the study, he or she will have the opportunity to receive the CDC materials at a later date. This study will fulfill in part the Centers for Disease Control and Prevention's recommendation to educate aquatic staff in recreational water illness prevention.

Costs

There are no expected costs for you for your child to participate in this research program. This research will be conducted at the aquatic facility where your child is employed. This researcher will pay for any mailing necessary.

Your Rights

Participation in the study is entirely voluntary. Your child is free to refuse to participate in this study or withdraw at any time. His or her withdrawal or lack of participation will not affect your child's relationship with Middle Tennessee State University in any way. Your child's supervisor will not be informed of staff that does not wish to participate in the study. The Internal Review Board of Middle Tennessee State University has approved this consent / assent form. You may contact them if you have any questions about research that involves people.

Confidentiality

All responses to the questionnaires will be kept confidential, to the extent provided by law. Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. All responses will be kept confidential; any identifying material will be modified to maintain confidentiality. The information provided for the study will be coded with a number, not a name, to protect your child's identity. If you offer your permission by signing this document, only the investigators and faculty advisor will have witness to the data. After the study, any information linking your child to the research will be destroyed. Your child's name will not be kept, and he or she will not be contacted after completion of the study. Your child's supervisor will not have access to his or her answers.

<u>Questions about the study</u>
If you have any questions about the research, please contact Gayle Bush at (615) 904-8326. You may also contact her at this address:

Department of Health, Physical Education, Recreation and Safety, Box 96
Middle Tennessee State University
Murfreesboro, TN 37132

You and your child's signatures below indicate that you have read the information above and have had a chance to ask any questions you have about the study. You and your child agree to him or her being a part of the study and have been told that you can change your mind and withdraw your consent for him or her to participate at any time. You will be given a copy of this agreement.

"I agree____ I do not agree____ to participate in the above outlined study, which I have read or has been explained to me by____."

-- --------------------------------------
Signature of Subject Date

-- --------------------------------------
Signature of Parent or Legal Guardian Date

APPENDIX D

Letter of Request for Participation for Aquatic Directors

Letter of Request for Participation

Dear Aquatics Director,

You are being asked to participate in a research study. Gayle Bush, a doctoral student at Middle Tennessee State University, is conducting this research. Dr. Peggy O'Hara-Murdock, Professor, HPERS Department of Middle Tennessee State University is supervising this research.

The Centers for Disease Control and Prevention (CDC) is in a continuing process of surveillance of recreational water illnesses. Recent studies show that more people are getting sick from germs in swimming water than ever before. The purpose of this study is to determine the effectiveness of a newly developed waterborne illness prevention training with lifeguards.

Lifeguards compose one occupational group that could be on the forefront of recreational water illness prevention. If you decide to participate, your lifeguards will be a part of one of 30 lifeguard groups and that will be asked to complete 2 paper and pencil questionnaires. Each questionnaire should take about 10 minutes. After eight weeks, everyone will complete the same questionnaires again. One questionnaire will contain true / false questions on the lifeguard's knowledge of water illnesses. The other questionnaire will be about the lifeguard's duties. All responses will be kept confidential, to the extent provided by law.

If your facility is one of the 15 chosen in the random selection, your lifeguards will receive a one and a half hour training session about recreational water illnesses and how to prevent them. The training includes: information about common water illnesses and how they are transmitted, disinfecting and monitoring procedures, the role of the aquatic staff in prevention, examples of case studies, and CDC's prevention recommendations. This training will take place at your facility in June of 2001. If your facility does not receive this initial training session as a part of random selection for the study, you will have the opportunity to receive the training at a later date. You will receive a copy of the recreational water illness lifeguard training manual that will be used in the session.

There are perceived benefits resulting from your participation in this research. The information you receive should help you to maintain your aquatic facility in ways that prevent water illnesses. You will learn how water illness is transmitted and how to help prevent the spread of germs in the water. Your staff will learn how to better protect swimmers from water illnesses and be more prepared to answer questions about this subject. You will receive free brochures and information sheets from the CDC for distribution at your facility.

I will be contacting you soon to determine your willingness to participate. If you have any questions, you may reach me at Middle Tennessee State University, (615) 904-8326. Thank-you for considering involvement in this study.

Sincerely,

Gayle Bush
Instructor, HPERS Department
Middle Tennessee State University

APPENDIX E

Recreational Water Illnesses: A Manual for use with Lifeguards

RECREATIONAL WATER ILLNESSES: A TRAINING MANUAL FOR USE WITH LIFEGUARDS

Table of Contents:

Part 7) Proper pool chemistry – the main defense against RWI

a) Chlorine does kill all germs, but "it takes time"

b) How does chlorine work?

c) Effective chlorination

SECTION III. Reduce the Risk of Spreading RWI

- **R-E-D-U-C-E**
- Reduce the risk – Protect yourself and others
- Educate yourself – stay abreast of RWI information
- Disinfect the water – Swimming water is shared by everyone in the pool
- Use good hygiene for healthy swimming – CDC brochure
- Choose to use the 6 "P-L-E-A's" – Stop germs from entering the pool in the first place
- Educate others – Communicate with brochures, signs, policy enforcement, and most of all, by example.
- Closure: Role play scenarios: how to talk with swimmers about RWI.

APPENDIX (or attachments)

1. Keys to Leading a Productive Training Session
2. The 4 "C's" - Connect with your group, communicate, be concrete, remember that your discussions remain confidential
3. Developing speaking skills
4. Preparing for a training session
5. Introductions – How to introduce yourself and get to know your audience
6. Knowledge of RWI survey
7. Evaluation of training session survey
8. CDC healthy swimming brochure
9. CDC healthy swimming information sheets
10. Pictures of the germs
11. Games and role plays
12. Information guide and handout – "Where to go for more information"
13. Pool chemistry component
14. R-E-D-U-C-E poster

INTRODUCTION

Keys to reading this manual:

This one and a half-hour session will show you how to teach lifeguards to help prevent recreational water illnesses (RWI) and promote healthy swimming. This session will include lecture, discussion, games and role-plays to teach these prevention and promotion strategies.

1. Section 1 will give a general background in RWI. A handout on where to go for more information can be found in the appendix. This handout will be useful to you and can be given to the lifeguards at the end of the training.
2. Section 3 will explain the information you need to discuss RWI in a step by step way. Some of the fact sheets and handouts you will need are located in the appendix.
3. Section 4 uses the acronym "R-E-D-U-C-E" as a springboard for teaching the lifeguards how to reduce the risk of spreading RWI. Fact sheets from the CDC will also be used with this section.
4. Section 5 is the appendix containing questionnaires, brochures, fact sheets, pictures, posters, an information guide, a handout of places to go for more information, how to lead a productive training session, including the "4 C's," communication skills, and how to teach groups of lifeguards..

BASIC OUTLINE OF THE COMPONENTS OF THE TRAINING SESSION: RWI AND HEALTHY SWIMMING

Part 1) Magnitude of swimming exposure

a) Statistics on United States swimming activities

b) Statistics on risks in the aquatic environment

Part 2) RWI: an emerging threat to swimmers

a) Anticipating the emergence of RWI

b) Case studies in RWI

Part 3) How do RWI affect the job of a lifeguard?

a) RWI affects a lifeguard's physical health

b) Maintaining proper pool chemistry is already your job!

Part 4) What are recreational water illnesses (RWI)?

a) The most current information

b) Pictures of the germs

c) What are the symptoms of RWI?

d) Play the "epidemic game"

Part 5) How are RWI transmitted?

a) Pool water is "shared water"

b) Explanation of the chain of infection

Part 6) For those with compromised immune systems

a) Who might have a compromised immune system?

b) If a person has a compromised immune system, why should he or she be concerned about cryptosporidium?

Part 7) Proper pool chemistry – the main defense against RWI

a) Chlorine does kill all germs, but "it takes time"

b) How does chlorine work?

c) Effective chlorination

Part 1 – Magnitude of Swimming Exposure

1. Statistics on United States swimming activities

- In the United States, 61,353,000 people swim at least six times each year.
- There are 368,000,000 person-visits to swimming venues each year in the U.S. for people over six years old.
- There are approximately ten million swimming pools in the U.S. (U.S. Bureau of the Census, 1995).
- In 1999, the American Red Cross trained 161,873 new lifeguards. However, none of the texts contain any chapters to train lifeguards in waterborne pathogen hazards and prevention measures.

2. Statistics on risks in the aquatic environment in the United States:

- Drownings – 4,000 / year
- Recreational water illnesses – In 1997 – 98, 18 states reported 32 outbreaks associated with recreational swimming water affecting 2,128 persons.
- Spinal cord injuries from diving accidents – 1,000 / year
- Lightning strikes – 87 / year

Part 2 - RWI: An Emerging Threat to Swimmers

1. Anticipating the emergence of RWI

- Discuss RWI as emerging infectious illnesses

2. Mention case studies to raise awareness

- Use the 97 – 98 waterborne disease outbreak surveillance summary
- Mention high profile cases, such as the Milwaukee and Atlanta outbreaks

Part 3: How do RWI effect the job of a lifeguard?

a) RWI effects a lifeguard's physical health

- A lifeguards duties puts him or her "at risk" for RWI:
- Practicing and executing rescues,
- Cleaning in and around the pool,
- Close contact with swimmers
- Benefits of being on the forefront of this knowledge
  - Personally
  - Professionally

Part 4 - What are Recreational Water Illnesses (RWI)?

a) The most current information

Use the "Healthy Swimming 2001" brochure from the CDC to explain RWI.

b) Pictures of the germs

Use overheads or charts to show the lifeguards pictures of cryptosporidium, giardia, salmonella, e.coli, pseudomonas, and shigella.

Use the "Healthy Swimming 2001" information sheets on crypto, giardia, etc. to explain the germs in detail (what, why, how)

c) What are the symptoms of RWI

- For the waterborne germs cryptosporidium, giardia, e.coli 0157, salmonella and shigella, the onset of symptoms occurs within two to ten days after infection: watery diarrhea, headache, cramps, nausea, and a low-grade fever.
- For pseudomonas, the primary symptom is a skin rash similar to the measles.
- For all these infections, symptoms may last up to two weeks in a healthy person, and longer in persons with compromised immune systems.

d) Play the Epidemic Game on next page:

<u>The Epidemic Game</u>

Purpose: To show how RWI can spread in an aquatic environment.

Materials needed:

- Enough index cards to pass out to everyone in the room.
- One card with a small picture of a crypto on the back.
- Pens or pencils for everyone

Instructions:

1. Pass out an index card to each person in the group.
2. Tell the class "First, put your name on the top of the card and underline it. Then, pass the card to a neighbor. Do not turn the cards over."
3. "Does everyone have a card from their neighbor? Put your name on your neighbor's card and give it back."
4. "Now pass your card to a different neighbor. Put your name on that card and give it back. Remember not to turn the cards over."
5. Repeat one or more times.
6. "Now turn your cards over……who has a picture on the back of their card? For this activity, you have crypto."
7. "Anyone with ______'s name on their card, please stand up. You went swimming the day _______went swimming, or sometime within about a week after, and swallowed a little contaminated pool water, and now you have crypto."

Discuss how easily RWI's can spread. This game leads into the next component about chlorine and time.

Part 5 - How are RWI Transmitted?

a) Continue to use the CDC "Healthy Swimming 2001" brochure and information sheets to explain the chain of infection as it relates to **the transmission of** waterborne illnesses.

b) The "chain of infection:"

Agent - the waterborne germ

Reservoir - infected person

Portal of exit - usually contaminated feces

Mode of transmission - water

Portal of entry – swallowed

Host - susceptible person

c) Pool water is "shared water."

- The CDC and EPA consider recreational swimming like communal bathing.
- Since 1988, the National Center for Infectious Diseases at the Centers for Disease Control (NCID) has documented more than 10 large outbreaks of cryptosporidiosis at waterparks and swimming pools (NCID, 1998).
- The authors of the water park study note that the prolonged duration of the outbreak could mean that a single swimmer produced many oocysts that survived for quite some time in the water.
- The rinsing of soiled bodies and overt fecal accidents cause contamination of the water.

- The unintentional ingestion of even a very small amount of recreational swimming water can cause gastrointestinal disease.
- Studies show that a person with crypto may be past the diarrheal phase of the illness and still excrete the oocysts for many weeks (NCID, 1998).
- If a swimmer enters the water during the diarrheal phase of the illness, he or she may pass millions of infectious oocysts per day, enough to contaminate a large waterpark (NCID, 1998).
- A person's susceptibility and immersion time can also influence his or her risk of infection.
- During 1995 and 1996, 17 states reported 37 outbreaks associated with recreational swimming water affecting 9,129 persons.
- All but one of the outbreaks of gastroenteritis caused by parasites were attributed to cryptosporidium. This is because the infectious crypto oocysts are only 4 – 6 microns in size and highly resistant to chlorine.

Part 6 - For Those with Compromised Immune Systems

Use the CDC fact sheet from "Healthy Swimming 2001" on crypto and compromised immune systems to discuss these questions:

a) Who might have a compromised immune system?
b) If a person has a compromised immune system, why should he or she be concerned about cryptosporidium?
c) How should a person protect himself or herself from crypto?

7 - Proper Pool Chemistry: The Best Defense Against RWI

a) Explanation of the phrase "it takes time."

- Pool water is shared by everyone in the pool
- If someone with diarrhea contaminates the water, swallowing the water can make you sick.
- Chlorine does kill germs, but not right away, it takes time.
- Even the best maintained pools can spread illness.

b) Examples of "it takes time"

- Use CDC information sheets on the amount of time it takes chlorine to kill germs in the pool at 1ppm.

c) Play the "window of time" game on next page *(optional):*

WINDOW OF TIME GAME

Purpose: To demonstrate the amount of time it takes for chlorine to kill certain RWI. Materials needed:

- Enough index cards to pass out to everyone in the room.
- Six cards will have small pictures of the RWI that have been discussed on the back.
- Pens or pencils for everyone

Instructions:

1. Pass out an index card to each person in the group. Let the group know this game is played just like the epidemic game, but with a different outcome.
2. Tell the class "First, put your name on the top of the card and underline it. Pass the card to a neighbor. Do not turn the cards over."
3. "Does everyone have a card from their neighbor? Put your name on your neighbor's card and give it back."
4. "Now pass your card to a different neighbor. Put your name on that card and give it back. Remember not to turn the cards over."
5. Repeat one or more times.
6. "Now turn your cards over......who has a picture of a RWI on the back of their card? For this activity, you are infected with that parasite or bacteria."
7. "Let's talk about giardia first. Who has a giardia on the back of their card? Anyone with ______'s name on their card, please stand up. You went swimming the day _______went swimming, within ______amount of time, and swallowed a little contaminated pool water. Now you have giardia."
8. Continue with each of the 6 RWI that have been discussed.

DEVELOPING SKILLS TO
REDUCE THE RISK OF SPREADING
RECREATIONAL WATER ILLNESSES

1. R-E-D-U-C-E
2. **R**educe the risk
3. **E**ducate yourself
4. **D**isinfect the water
5. **U**se good hygiene for healthy swimming
6. **C**hoose to follow the 6 "P-L-E-A's"
7. **E**ducate others

REDUCE THE RISK

Reinforce the many ways a lifeguard can help prevent the spread of RWI every time he or she is on duty.

- Understanding and enforcing a fecal accident policy.
- Watch out for fecal accidents and other behaviors that put swimmers at risk. These actions include diapering a child poolside and then rinsing soiled buttocks and hands in the pool water.
- Since most germs enter the water from a patron with watery diarrhea, signs must be posted to inform swimmers of the hazards of swimming with or shortly after a diarrheal illness.
- Signs must also be posted asking the patrons who have experienced diarrhea 2 weeks prior to refrain from swimming
- Post signs warning swimmers not to swallow or spit pool water.
- A separate pool for diapered children would be beneficial, but only if there is also a separate filter. The children in that pool would still be at risk as well as any adults who swam in that pool.
- Swimmers must be required to shower thoroughly before entering the pool.
    - Help maintain adequate bathroom facilities.
    - Limiting the number of swimmers according to the size of the pool.
    - Educating swimmers, including
    - Keep filtration (water turnover rates) on schedule, such as backwashing and cleaning filters.
    - Check chemicals every 30 minutes to an hour, depending on the specifics of how much chlorine your pool uses, to keep your pool at 1ppm. Remember that pool size, indoor or outdoor, the weather (for outdoors), and number of swimmers in the water all effect how fast chlorine is used up.
    - Help promote adequate disinfecting methods, such as scheduled cleanings of the locker room and deck with bleach solutions.
    - Support changes in water industry practices that promote healthy swimming.
    - If your facility has this design, post signs specifying pools with separate filtration systems for non-toilet trained swimmers.

EDUCATE YOURSELF

- Reinforce the need to stay abreast of emerging RWI and related information
- Use the information guide and handout titled "Where to go for more information" located in the appendix.

DISINFECT THE WATER

- Review the symptoms of RWI
- Pool water is shared water
- Remember that very small amounts of fecal matter and diarrhea:
- Can contain germs that make people sick
- Can leak through the swim diapers
- Can stay on a person's bottom even after a diaper change or going the restroom
- Can be on a person's hands after he or she changes a diaper or goes to the restroom
- Can be on a diapered child's hand because children often put their hands in their diapers or swim diapers. Then, anything the child touches spreads germs to surfaces and objects in and around the pool and causes contamination.
- Proper disinfection with chlorine can stop most RWI outbreaks

USE GOOD HYGIENE FOR HEALTHY SWIMMING, CHOOSE TO FOLLOW THE 6 "P-L-E-A's, and EDUCATE OTHERS

(15 minutes)

- Use the CDC brochure located in the appendix to discuss how lifeguards can help all swimmers and especially parents of young children prevent RWI and promote healthy swimming.
- Closure - Role play scenarios about how to talk with swimmers about RWI: see next page

ROLE PLAYS FOR DISCUSSING RWI WITH SWIMMERS

(10 minutes)

What should the lifeguard do and say?

(Suggested dialog can be found in the appendix.)

1. A parent or caregiver is diapering a child poolside.
2. Children are spitting water as they are playing in the pool.
3. A group of children are coming out of the locker room and are going to get in the pool without showering.
4. A child is begging a parent to take him or her to the bathroom. The parent is busy talking to a friend and continues to tell the child to wait a minute.
5. You notice the locker room diaper changing area and lavatory are not being well maintained.

APPENDICES

- Keys to Leading a Productive Training Session
- The 4 "C's" - Connect with your group, communicate, be concrete, remember that your discussions remain confidential
- Developing speaking skills
- Preparing for a training session
- Introductions – How to introduce yourself and get to know your audience
- Knowledge of RWI survey
- Evaluation of training session survey
- CDC healthy swimming brochure
- CDC healthy swimming information sheets
- Pictures of the germs
- R-E-D-U-C-E poster
- Games and role plays
- Information guide and handout – "Where to go for more information"

KEYS TO LEADING A PRODUCTIVE TRAINING SESSION: THE 4 "C's"

Since lifeguards will be asking you questions about recreational water illnesses, it is important for you to be approachable and easy to talk to. As you teach this manual, remember the 4 "C's:"

1. First you need to CONNECT with the group.

- Make sure the group understands from the introduction that you are a lifeguard and the credentials that give you the right to be sharing this information with them. Let them know you are interested in their job as a lifeguard and their personal health.

2. Next, you need to COMMUNICATE.

- Discuss the next section on "Developing speaking skills"
- Remember, listen to comments and do not pass judgement. You want to encourage openness in the group. Communication does not work when you interrupt or don't listen.

3. Be CONCRETE.

- Give facts, not opinions. If you do not know the right answers, find it out, or tell the person where to find the information.
- Be specific and to the point, for sake of time.

4. Remember that all talks are CONFIDENTIAL.

- Let the group know that personal information shared will not be discussed with their supervisors.

DEVELOPING SPEAKING SKILLS

How you present information to a group influences how much they listen and how much they learn. Remember these key points:

1. Be energetic!

   Make sure the audience listens to you. Don't read straight from the page. That will put your audience to sleep.

2. Pause after important points!

   Give the group time to let the big ideas sink in. It gives everyone more time to think about what you have said.

3. Be careful with the language you use!

   Remember to use words everyone can understand. If you are introducing a new idea, make sure you explain it well. Don't generalize. Do not assume anything about your audience; you do not know what experiences they have had in their duties as a lifeguard.

4. Respect your audience!

   It is very important not to speak down to the group. As an instructor, you will know much more about recreational water illnesses than the people you are teaching. Even if you are discussing RWI with a group with a basic level of knowledge, you will lose their respect if you treat them like they know nothing.

5. Have the audience participate!

   Remember to let the group share what is on their mind. The more people talk and interact, the more they will remember. Lifeguard participation, such as the games and role-plays, will make the session run smoother and will make it much easier for you to lead the session.

PREPARING FOR A TRAINING SESSION

1. Course planning
2. Know your audience
3. Organize the presentation
4. Give the information meaning
5. Roll play for retention

1. COURSE PLANNING

Certain preparations must be made in order to have a successful training session. This includes:

a) Classroom preparations
   - Desks or chairs can be arranged classroom style
   - A table at the front can have all need supplies for the session
   - Posters of the 6 germs causing most RWI can be posted around the room

b) Activity supplies prepared beforehand
   - Index cards prepared for the "epidemic game" and the "window of time" game
   - Pens or pencils; simple stick-on name tags

c) Equipment for transparencies or posters
   - Know whether or not you can use transparencies, or if you will need to use a large chart on a tripod stand. This gives the lifeguards a visual aid to follow your lecture.

d) Handouts: brochures and fact sheets
   - These materials from the CDC will be used at crucial times during the presentation. Don't give them out too early; this will distract the guards from you!

2. KNOW YOUR AUDIENCE

- Find out how long the lifeguards have been certified, how long they have worked as lifeguards, and what other types of facilities have they guarded besides the one at present.
- Knowing the demographics of the lifeguards will help you present the information in a way that will relate best to them.
- You can get this info at the beginning of session during introductions (see "components of the training session" in the next section).

3. ORGANIZATION

- The more you review, the easier the session will go.
- Have all your materials ready.
- Look over the main points for the session and break the learning into parts.
- Be prepared to answer questions.
- Understand the concept each activity or role play is meant to emphasize.

4. MEANING

- Use mnemonic devices – P-L-E-A's and R-E-D-U-C-E
- Translate learning into the lifeguard's language.
- Establish a reason for learning (make it relevant).
- Focus on concepts, like "it takes time."
- Check for understanding during instruction - monitor and adjust.

5. ROLE PLAY

- Role plays must be meaningful
- Keep role play sessions short
- Guide or demonstrate if needed
- Role play areas of difficulty

INTRODUCTIONS: HOW TO INTRODUCE YOURSELF AND GET TO KNOW YOUR AUDIENCE

(5 minutes)

1. Welcome lifeguards to the training session. Let them know you believe they are a part of a very important profession with serious responsibilities. Introduce yourself by giving your name and pertinent aquatic background. Tell the lifeguards that you are about to share with them some information regarding RWI that could effect their personal health, their job, and the lives of the swimmers for which they are responsible.

2. Tell the lifeguards about the benefits they will receive from being a part of this training. Let them know that:

- the information they receive will help them to maintain their aquatic facility in ways that prevent water illnesses.
- they will learn how water illness is transmitted and how to help prevent the spread of germs in the water.
- they will learn how to better protect themselves and swimmers from water illnesses.
- they will be more prepared to answer questions about this subject.

3. Find out how long they have worked as lifeguards, and what other types of facilities have they guarded besides the one at present.

- You can do this by asking for a show of hands: "who has been a lifeguard for more than 5 years, 3 years, 1 year"
- Ask them what other kinds of facilities they have guarded. If no one responds, ask for a show of hands again, for lakes, community pools, beaches, waterparks, etc.

4. Knowing the demographics of the lifeguards will help you present the information in a way that will relate best to them.

- With a show of hands, ask how many are in high school, then college, then working full time or part time.
- Ask the lifeguards if they know each other. Let them know that this training session will include some games that will help them get to know each other better, as well as the information about RWI

Recreational Water Illnesses
Evaluation of Lifeguard Training Session
(5 minutes)

DATE:___________

In order to improve today's presentation, please answer the following questions by circling the best response.

1. Was it made clear to you who the instructor was and why he or she was here today?

No, not at all……………………Yes, most definitely
1 2 3 4 5

2. Was today's instructor helpful to you in learning:

a) What is a recreational water illness? Not helpful at all……………….....very helpful
1 2 3 4 5

b) How swimmers get water illnesses?
Not helpful at all……………….....very helpful
1 2 3 4 5

c) That it takes time for chlorine to kill germs in swimming pool water?

Not helpful at all……………….....very helpful
1 2 3 4 5

d) That even the best maintained pools can spread illness?

Not helpful at all……………….....very helpful
1 2 3 4 5

e) Why policies and signs about water illnesses can help swimmers understand how to prevent the spread of germs that make swimmers sick?

Not helpful at all……………….....very helpful
1 2 3 4 5

f) What you can do as a lifeguard to help prevent the spread of water illness and promote healthy swimming?
Not helpful at all……………….....very helpful
1 2 3 4 5

3. What did you like most about today's presentation?

4. What did you like least about today's presentation?

5. What else would you like to know about recreational water illness and how to promote healthy swimming?

SWIMMING POOL CHEMISTRY

CHLORINE, ITS PURPOSE AND APPLICATION:

Chlorine is the most widely applied disinfecting agent for swimming pool water (Pool and Spa, 2001). The most common form of chlorine for home swimming pool consumption is calcium hypochlorite containing 70% available chlorine. This solid, white material is available as either a free flowing powder, or tablets. Both types have excellent stability under all normal storage conditions. In use, this material dissolves quickly, releasing free available chlorine which is needed to kill waterborne pathogens.

Pool water should always contain 0.1 to 0.3 parts per million (ppm) chlorine (Pool and Spa, 2001). This chlorine residual may be achieved by adding one ounce of granular calcium hypochlorite for each 5,000 gallons of pool water.

There are a number of factors which affect the rate at which chlorine is consumed in the swimming pool. Chlorine dissipates more rapidly in warm water than in cold water. Sunlight causes an increase in the rate of consumption as does the presence of organic matter. Perspiration and bacteria that are carried in on bather's skin also increase the amount of chlorine needed to maintain an adequate chlorine residual. For these reasons, it will be necessary to add more chlorine on sunny hot days and when there are more people in the pool.

ALGAE: ITS APPEARANCE, CAUSE and DESTRUCTION

Algae are very tiny plants that grow in untreated water. The air contains millions of algae spores which either settle into the water or are carried in during rain storms. Once present in water they may be recognized initially, by the formation of slime on the sides and floor of the pool. Cloudiness in the water may develop, accompanied by a sudden increase in the pH. In the advanced stages of growth, they take on a green or brown color and emit fish type odors. Intense sunlight is very conducive to algae growth by causing increased water temperatures and more rapid loss of residual chlorine. Algae usually will not develop where the proper chlorine residual is maintained at all times (Pool and Spa, 2001). However, it is most difficult to maintain the proper chlorine residual at all times since intense sunlight and increased water temperatures increase the consumption of chlorine therefore making it more expensive to control the growth of algae.

Should algae be allowed to gain a foothold in the pool, "shock" treatment is often necessary to remove the growth. This consists of applying from five to ten times the usual amount of chlorine, when the pool is not in use. Allow the chlorine residual to settle back to normal before resumption of swimming. While chlorine may be considered an effective algaecide, it has become common practice to employ specific algaecide solutions to control the growth of algae. This leaves the chlorine free to act on bacteria. Another factor in favor of algaecides is that most algae require much higher concentrations of available chlorine to be killed than do bacteria (Pool and Spa, 2001).

PH, ITS IMPORTANCE AND CONTROL:

PH is a measure of acidity or alkalinity measured by the pH scale. This scale runs from 0 to 14. A pH reading between 0 and 7 is on the acid side. A pH of 7 is neutral, and pH readings between 7 and 14 are alkaline. The pH of swimming pool water should be controlled within the range of 7.2 to 7.8 (Pool and Spa, 2001).

Improper pH causes irritation to eyes and mucous membranes, and bleaching of hair and swim suits. Swimmers feel comfortable in a relatively narrow pH zone (7.2 to 7.8) and it is fortunate that the effectiveness of chlorine is greatest in this same range.

Pool water which is acidic (pH below 7.2) is corrosive to filters, pipes and other metal fixtures and will result in excessive chlorine consumption. Overly alkaline water (pH above7.8) tends to form unsightly whitish deposits called "scale" which adhere to pool fixtures (Pool and Spa, 2001). In this alkaline range, the effectiveness of chlorine is greatly reduced.

CONTROL OF pH:

Adjusting the pH of water is a simple matter. To raise a pH which is below 7.2, soda ash or pH positive powder or briquettes must be added. To reduce a pH which is above 7.8, muriatic acid or pH negative powder must be added. ("Swimming Pool Care & Maintenance" – Rockwin Products Co.)

NEED MORE INFORMATION?

Center for Disease Control

www.cdc.gov/healthyswimming

National Center for Infectious Diseases

www.cdc.gov/ncidod/ncid.htm

Morbidity and Mortality Weekly Report

www2.cdc.gov/mmwr/

Occupational Safety and Health Act

www.osha.gov/

APPENDIX F

Knowledge Survey

Knowledge of Recreational Water Illnesses Survey

Name:____________________________________

Aquatic facility:____________________________

Job title:___________________________________

Date:_____________________________________

This survey is about your current knowledge of recreational water illnesses. This survey is the "pre-test" for this research. Completing this survey is voluntary. The answers you give will be kept private. Your supervisors will not know what you write, so please be honest.

The answers to these questions will be used to develop training sessions that will help lifeguards and aquatic directors learn more about recreational water illnesses and how to promote healthy swimming. After completion of the survey, your answer sheet will be given a code, and your name removed. The information will not be used to find out your name. No names will ever be reported. In 4 to 6 weeks, you will complete this same survey again, which will be the "post-test" for this research. You will not be contacted after the completion of this study. Thank you for your time.

Please circle the letter beside the one best answer for each of the following items:

1. Which of the following happens most frequently to swimmers in the U.S.?
   a. drowning in swimming pools
   b. getting sick from pool water
   c. lightning strikes in a water setting
   d. spinal injury from diving accidents
2. Chlorine can kill all germs in the water in about:
   a. 30 minutes
   b. 3 hours
   c. 1 day
   d. 1 week
3. The most common symptom of a person with a waterborne illness is:
   a. fever
   b. rash
   c. diarrhea
   d. respiratory illness

4. Which of the following germs takes the longest amount of time to die in 1 ppm chlorine?
   a. Cryptosporidium
   b. E. coli
   c. Giardia
   d. Shigella
5. Which of the following is the only way swimmers can contract Cryptosporidium, E. coli, Giardia, Shigella and Salmonella?
   a. By skin contact
   b. By swallowing pool water
   c. Through open sores
   d. Through water in the ear

6. The smell of chlorine in the pool area means:
   a. There is poor air circulation around the pool
   b. The chlorine concentration is too high
   c. The chlorine has a reduced ability to kill germs
   d. The chlorine has an increased ability to kill germs

7. Which of the following is the recommended course of action if a child has diarrhea?
   a. More frequent bathroom breaks
   b. More frequent changing of swim diapers away from poolside
   c. Keeping the child out of the pool
   d. Thorough washing of the child before putting on swim diaper

8. A fecal accident policy refers to:
   a. Bathroom maintenance
   b. clean up of fecal matter
   c. diaper changing facilities
   d. the use of swim diapers

9. In the United States, how many people swim at least 6 times a year?
   a. about 10 million
   b. about 20 million
   c. about 40 million
   d. about 60 million

10. Which of the following is the first line of defense for protecting swimmers from recreational water illnesses?
    a. Effective disinfection of pool water
    b. Frequent disinfection of locker rooms
    c. Use of swim diapers by non-toilet trained swimmers
    d. Well-maintained pool filters

APPENDIX G

Behavior Survey for Lifeguards

Survey of Lifeguards on Recreational Water Illnesses;

Maintenance, Policies and Training

Name:____

Job title:_______________________________________

Date:________________

Name of

Organization:____

Location of

organization:____

This survey is about your job as a lifeguard. Completing this survey is voluntary. The answers you give will be kept private. Your supervisors will not know what you write, so please be honest.

The answers to these questions will be used to develop training sessions that will help lifeguards learn more about recreational water illnesses and how to promote healthy swimming. After completion of the survey, your answer sheet will be given a code, and your name removed. The information will not be used to find out your name. No names will ever be reported. After filling out this survey again in 6 weeks, the study will be complete, and you will not be contacted again. Your supervisors will not have access to your answers.

Please mark the answers that describe your job as a lifeguard at this facility.

1. Do you do general maintenance of this aquatic facility?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

2. Do you make daily reports about your cleaning duties?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

3. Do you measure the chlorine and pH levels of the pool water?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

4. Do you adjust the chemical balance of the pool water?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

5. Do you make daily reports about pool chemical levels?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

6. Do you backwash the pool filters?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

7. Do you clean a diaper changing area in this facility?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

8. Do you ask caregivers to use swim diapers for small children?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

9. Do you ask caregivers to diaper children only in designated diaper changing areas of this facility?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

10. Do you call for regular bathroom breaks for the kiddie pool?

A._____No, not at the present time

B._____No, but I intend to in the next 3 months

C._____No, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

11. Do you limit the number of swimmers in the pool?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

12. Do you ask swimmers not to spit and swallow pool water?

A._____No, not at the present time

B._____No, I haven't, but I intend to in the next 3 months

C._____No, I haven't, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

13. Would you be willing to hand out brochures to swimmers about the prevention of recreational water illnesses?

A._____No, not at the present time

B._____No, but I intend to in the next 3 months

C._____No, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

14. Would you be willing to speak to swimmers about how to prevent the spread water illnesses?

A._____No, not at the present time

B._____No, but I intend to in the next 3 months

C._____No, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

15. Have you previously received training at this aquatic facility about illnesses you can get from swimming in a pool?

A._____No, not at the present time

B._____No, but I intend to in the next 3 months

C._____No, but I intend to in the next 30 days

D._____Yes, I have, but for less than 3 months

E._____Yes, I have for more than 3 months

APPENDIX H

Behavior Survey for Aquatic Directors

Survey of Aquatic Directors on Recreational Water Illnesses;

Maintenance, Policies and Training

Name:____

Job title:______________________________________

Date:________________

Aquatic facility and location:________________________________

This survey is about your job as an aquatic director. This survey is the "pre-test" for this research. Completing this survey is voluntary. The answers you give will be kept private. Your supervisors will not know what you write, so please be honest.

The answers to these questions will be used to develop training sessions that will help aquatic directors and lifeguards learn more about recreational water illnesses and how to promote healthy swimming. After completion of the survey, your answer sheet will be given a code, and your name removed. The information will not be used to find out your name. No names will ever be reported. In 6 weeks, you will complete this same survey again, which will be the "post-test" for this research. You will not be contacted again after this study.

Please mark the answers that describe your aquatic director job.

1. Does this facility have any policies to minimize the spread of recreational water illnesses (RWI's)?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

2. Does this facility have a plan for managing an outbreak of RWI's?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

3. Does this facility have a policy limiting the number of swimmers in the pool?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

4. Does this facility have a fecal accident response policy?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

5. Does this facility have a policy that all non-toilet trained or incontinent swimmers must use a separate pool from the adult pool?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

6. Does this facility have a policy requiring non-toilet trained or incontinent swimmers to wear a swim diaper?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

7. Does this facility have a policy that bleach must be used for sanitation and cleaning at this facility?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

8. Does this facility post signs warning swimmers not to swallow pool water?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

9. Does this facility post signs asking swimmers who have diarrhea to refrain from swimming?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

10. Does this facility post signs asking caregivers to use the appropriate diaper changing facilities provided, rather than change diapers poolside?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

11. Does this facility provide swimmers with well-maintained bathrooms near the pool to maximize hygiene, convenience, and usage?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

12. Does this facility provide swimmers with well-maintained diaper changing areas near the pool to maximize hygiene, convenience, and usage?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

13. Does this facility provide any information for swimmers about RWI's and how to prevent them?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

14. Does this facility require the lifeguards to check the chemical levels of the pool at certain times each day?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

15. Does this facility allow lifeguards to adjust the chemical levels of the pool?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

16. Has this facility provided for any engineering changes in order to prevent RWI's, such as separate filter systems for the pools that allow diapered age children?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

17. Does this facility have separate filtration systems for each pool at this facility?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

F.______Not applicable to this facility

18. Does this facility offer any training to staff regarding RWI prevention?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

19. Is this facility supervised by an aquatic staff person with a professional certification in pool operation?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

20. Does this facility provide funds for changes that promote the prevention of recreational water illnesses?

A.______No, not at the present time

B.______No, but it intends to in the next 3 months

C.______No, but it intends to in the next 30 days

D.______Yes, but for less than 3 months

E.______Yes, for more than 3 months

APPENDIX I

Demographics Survey for Lifeguards

Lifeguard Demographics Survey

Name:____

Aquatic facility:___________________________________

This survey is about your background. Completing this survey is voluntary. The answers you give will be kept private. No one will know what you write.

The answers to these questions will be used only to describe the characteristics of lifeguards involved in this training session. The information will not be used to find out your name. No names will ever be reported.

Please circle the letter beside the answer that is true about you.

1. How old are you?
   a. 16 - 19 years
   b. 20 - 29 years
   c. 30 - 39 years
   d. 40 years or older

2. Are you male or female?
   a. male
   b. female

3. What is the highest grade or level of school that you have completed?
   a. have not graduated from high school
   b. high school graduate
   c. completed at least one year of college
   d. college graduate

4. How many years have you worked as a lifeguard?
   (For this survey, you must have worked at least **two months** during a year to count that year.)
   a. less than one year
   b. one year
   c. two years
   d. three years or more

5. What type of lifeguard certification to you have?
   a. American Red Cross
   b. YMCA
   c. Both

APPENDIX J

Demographics Survey for Aquatic Directors

Aquatic Director Demographics Survey

Name:____

Aquatic facility:__________________________________

This survey is about your background. Completing this survey is voluntary. The answers you give will be kept private. No one will know what you write.

The answers to these questions will be used only to describe the characteristics of aquatic directors involved in this training session. The information will not be used to find out your name. No names will ever be reported.

Please circle the letter beside the answer that is true about you.

1. How old are you?
    a. 16 - 19 years
    b. 20 - 29 years
    c. 30 - 39 years
    d. 40 years or older

2. Are you male or female?
    a. male
    b. female

3. What is the highest grade or level of school that you have completed?
    a. have not graduated from high school
    b. high school graduate
    c. completed at least one year of college
    d. college graduate

4. How many years have you worked as a lifeguard?
    (For this survey, you must have worked at least **two months** during a year to count that year.)

    a. less than one year
    b. one year
    c. two years
    d. three years or more

5. How many years have you worked as an aquatic director?
    (For this survey, you must have worked at least **two months** during a year to count that year.)

    a. less than one year
    b. one year
    c. two years
    d. three years or more

6. What type of lifeguard certification to you have?

    a. American Red Cross
    b. YMCA
    c. Both

APPENDIX K

RWI Training Evaluation Form

Evaluation of Training Session
Regarding Recreational Water Illnesses

DATE:___________

In order to improve today's presentation, please answer the following questions by circling the best response.

1. Was it made clear to you who the instructor was and why he or she was here today?

No, not at all........................Yes, most definitely
1 2 3 4 5

2. Was today's instructor helpful to you in learning:

a) What is a recreational water illness? Not helpful at all.......................very helpful
1 2 3 4 5

b) How swimmers get water illnesses?
Not helpful at all.......................very helpful
1 2 3 4 5

c) That it takes time for chlorine to kill germs in swimming pool water?

Not helpful at all.......................very helpful
1 2 3 4 5

d) That even the best maintained pools can spread illness?

Not helpful at all.......................very helpful
1 2 3 4 5

e) Why policies and signs about water illnesses can help swimmers understand how to prevent the spread of germs that make swimmers sick?

Not helpful at all.......................very helpful
1 2 3 4 5

f) What you can do as a lifeguard to help prevent the spread of water illness and promote healthy swimming?
Not helpful at all.......................very helpful
1 2 3 4 5

3. What did you like most about today's presentation?

4. What did you like least about today's presentation?

5. What else would you like to know about recreational water illness and how to promote healthy swimming?

REFERENCES

Addiss, D., & Juranek D. D. (1979). Bacterial indicators and health effects among swimmers. *Abstracts of the Annual Meeting of the American Society for Microbiology, 222.*

American Red Cross (1997). *Lifeguarding Today Instructors Manual,* Boston, MA.

Carpenter, C., Fayer, R., Trout, J., & Beach, M. J. (1999). Chlorine disinfection of recreational water for Cryptosporidium parvum. *Emerging Infectious Diseases, 5*(4), 1-5.

Chapman, P., & Rush, B. (1990). Efficiency of sand filtration of removing Cryptosporidium oocysts from water. *Journal of Medical Microbiology 32,* 243-245.

Centers for Disease Control and Prevention. Shigellosis outbreak associated with an unchlorinated fill-and-drain-wading pool - Iowa, 2001. *Morbidity and Mortality Weekly Report, September 21, 2001, 50*(37), 797-800.

Centers for Disease Control and Prevention. Protracted outbreaks of Cryptosporidiosis associated with swimming pool use - Ohio and Nebraska, 2000. *Morbidity and Mortality Weekly Report, May 25, 2001, 50*(20), 406-410.

Centers for Disease Control and Prevention. Norwalk-like viruses; Public health consequences and outbreak management. *Morbidity and Mortality Weekly Report, June 1, 2001, 50*(RR09), 1-18.

Centers for Disease Control and Prevention. Prevalence of parasites in fecal material from chlorinated swimming pools; United States, 1999, *Morbidity and Mortality Weekly Report, May 25, 2001, 50*(20), 410-412.

Centers for Disease Control and Prevention. Surveillance summaries for waterborne disease outbreaks; United States, 1995-1996. CDC Surveillance Summaries (1998). *Morbidity and Mortality Weekly Report, 47*(5), 1-34.

Centers for Disease Control and Prevention. Surveillance summaries for waterborne disease outbreaks; United States, 1997-1998. CDC Surveillance Summaries (2000). *Morbidity and Mortality Weekly Report, 49*(SS04), 1-35.

Centers for Disease Control and Prevention. Surveillance for outbreaks of Escherichia coli O157:H7 infection; Summary of 2000 Data, August 12, 2001, 1-5.

Centers for Disease Control and Prevention. Surveillance for Outbreaks of Salmonella Serotype Enteritidis: Summary of 1999 Data, March 1, 2000, 1-4.

Centers for Disease Control and Prevention. Shigellosis Outbreak Associated With an Unchlorinated Fill-and-Drain Wading Pool - Iowa, *Morbidity and Mortality Weekly Report, September 21, 2001, 50*(37), 797.

Centers for Disease Control and Prevention. Shigella Surveillance: Annual Tabulation Summary, 1999. Atlanta, Georgia: U.S. Department of Health and Human Services, CDC, 2000.

Centers for Disease Control and Prevention. (1992). CDC surveillance summaries: Waterborne-disease outbreaks, 1989-1990. *Morbidity and Mortality Weekly Report, 40*(3), 1-22.

Centers for Disease Control and Prevention. Healthy Swimming 2002. Retrieved May, 2001-April, 2002, from http://www.healthyswimming.org.

Centers for Disease Control and Prevention. Cryptosporidium and Water: A Public Health Handbook. Atlanta, Georgia: Working Group on Waterborne Cryptosporidiosis (1997).

Centers for Disease Control and Prevention. You can prevent Cryptosporidiosis: a guide for people with HIV infection [Brochure]. Opportunistic Infections Series, *American Medical Association, 20,* 1597-1601.

Centers for Disease Control and Prevention. (1994). Cryptosporidium infections associated with swimming pools - Dane County, Wisconsin. *Morbidity and Mortality Weekly Report 43*(31), 561-563.

Centers for Disease Control and Prevention. (1996). Waterborne Disease Outbreak Report,U.S. Department of Health and Human Services, Atlanta, Georgia.

Chervin, D. D., Revels, M., & Richardson, L. (1999). *Cryptosporidium and waterparks: An opportunity for disease prevention.* Macro International, Inc.

Colley, D. G. (1995). Waterborne Cryptosporidiosis threat addressed. *Emerging Infectious Diseases, 1*, 2-3.

Cotugna, N., Subar, A. S., Neimendinger, J., & Kahle, L. (1992). Nutrition and cancer prevention knowledge, beliefs, attitudes, and practices: The 1987 National Healthy Interview Survey. *Journal of the American Dietetic Association, 92* (8), 963-969.

Dadswell, J. V. (1996). Managing swimming, spa, and other pools to prevent infection. *Communicable Disease Report. CDR Review* 6(2), 37-40.

DiClemente, C. C., Prochaska, J. O., Fairhurst, S. K., & Velicer, W. F. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation,and preparation stages of change. *Journal of Consulting and Clinical Psychology, 59,* 295-304.

Emmons, K. M., Marcus, B. H., Linnan, L., Rossi, J. S., & Abrams, D. B. (1994). Mechanisms in multiple risk factor interventions: Smoking, physical activity, and dietary fat intake among manufacturing workers. *Preventive Medicine, 23,* 481-489.

Favero, M. S. (1984). Whirlpool spa-associated infections: are we really in hot water? *American Journal of Public Health, 74*(7), 653-658.

Fleurette, J., & Woodland, D. (2002). Pumps and circumstances. *Aquatics International, 1,* 24-26.

Ford, H. T., Puckett, J. R., Blessing, D. L., & Tucker, L. A. (1989). Effects of selected physical activities on health-related fitness and psychological well-being. *Psychological Reports, 64*(1), 203-209.

Gerba, C. (1995). Outbreaks caused by Giardia and Cryptosporidium associated with swimming pools. *Journal of the Swimming Pool and Spa Industry, 1*(3), 9-18.

Gilbert, L., & Blake, P. (1998). Outbreak of Escherichia coli O157:H7 infections associated with a waterpark. *Georgia Epidemiology Report, 14*, 1-2.

Glanz, K., Patterson, R. E., Kristal, A. R., Feng, Z., Linnan, L., & Hebert, J. (1998). Impact of worksite health promotion on stages of dietary change: The Working Well Trial. *Health Education Behavior, 25,* 448-463.

Glanz, K., Kristal, A. R., Curry, S. J., & Patterson, R. E. (1999). How can stages of change best be used in dietary interventions? *Journal of the American Dietetic Association, 99*(6), 670-684.

Glasgow, R. E., Wilson, W., & McCauley, K. D. (1994). Regimen adherence: A problematic construct in diabetes research. *Diabetes Care 8,* 300-301.

Griffiths, T. (1994). *The Complete Swimming Pool Reference.* St. Louis, Mosby Lifeline.

Guerrant, R. (1997). Cryptosporidiosis: An emerging, highly infectious threat. *Emerging Infectious Diseases 3*(1), 51-57.

Harlow, L. L., Prochaska, J. O., Redding, C. A., Rossi, J. S., Velicer, W. F., Snow, M.G., Schnell, D., Galavotti, C., O'Reilly, K., & Rhodes, F. (1999). Stages of condom use in a high HIV-risk sample. *Psychology and Health, 14,* 143-157.

Juranek, D. (1995). Cryptosporidiosis: Sources of infection and guidelines for prevention. *Clinical Infectious Diseases 21*(1), 57-61.

Juranek D. D., Addiss, D., Bartlett, M. E., Arrowood, M. J., Colley, D.G., Kaplan, J. K., Perciasepe, R., Elder, J. R., Regli, S. E., & Berger, P. S. (1995). Cryptosporidiosis and public health: Workshop report. *Journal of the American Water Works Association, 87,* 54-68.

Kappus, K. K., & Marks, J. S. (1982). An outbreak of Norwalk gastroenteritis associated with swimming in a pool and secondary person-to-person transmission. *American Journal of Epidemiology, 116*(5), 834-843.

Kappus, K. K., Juranek D. D., & Roberts J. M. (1987). Results of testing for intestinal parasites by state diagnostic laboratories. *Morbidity and Mortality Weekly Report, 40*(4), 25-47.

Levesque, D. A., & Prochaska, J. O. (1999). Stages of change and integrated service delivery. *Consulting Psychology Journal: Practice and Research, 51*(4), 226-241.

MacDonald, L. (1989). Swimming: Fitness afloat. *Diabetes Forecast, 42,* 7.

Macey, J. M. (July 13, 1980). Swimming as exercise: the better alternative. *The New York Times, 129,* 5.

McAnulty, J. M., & Fleming, D. W. (1994). A community-wide outbreak of Cryptosporidiosis associated with swimming at a wave pool. *JAMA, 272*(20), 1597-1600.

McCottry, B. J. (2001). Aquatic programming; the urban experience. *Parks and Recreation, Aquatics, 2,* 80-82.

Moyenuddin, M., Wachsmuth, I. K., & Moseley, S. L. (1999). Serotype, antimicrobial resistance, and adherence properties of Escherichia coli strains associated with outbreaks of diarrheal illness in children in the United States. *Journal of Clinical Microbiology, 27,* 2234-2239.

National Center for Infectious Diseases at the Centers for Disease Control (1998). Cryptosporidium and Cryptosporidiosis: Information for swimming pool operators. Division of Parasitic Diseases.

Norcross, J. C., Prochaska, J. O., & Hambrecht, M. (1991). Treating ourselves vs. treating our clients: A replication with alcohol abuse. *Journal of SubstanceAbuse, 3*, 123-129.

O'Connell, D. O., & Velicer, W. F. (1988). A decisional balance measure and the stages of change model for weight loss. *International Journal of the Addictions, 23*, 729-750.

O'Hara, P., Messick, B. J., Fichtner, R. R., & Parris, D. (1996). A peer-led prevention program for students in alternative schools. *Journal of School Health, 66*(5), 176-82.

Pierpoint, M. (1998). Swim into great shape. *American Health For Women, 17*(5), 50.

Prochaska, J. O., & DiClemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research, and Practice, 19*, 276-288.

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395.

Prochaska, J. O., & DiClemente, C. C. (1986). Toward a comprehensive model of change. *Addictive Behaviors: Processes of Change.* W. R. Miller and N. Heather. New York, Plenum Press: 3-27.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist, 47*(9), 1102-1114.

Prochaska, J. O., & Marcus, B. H. (1994). The transtheoretical model: Applications to exercise. In R. K. Dishman (Ed.), *Advances in Exercise Adherence*. Champaign, IL: Human Kinetics Books, 1-9.

Prochaska, J. O., Velicer, W. F., Rossi, J. S., Goldstein, M. G., Marcus, B. H., Rakowski, W., Fiore, C., Harlow, L. L., Redding, C. A., Rosenbloom, D., & Rossi, S. R. (1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychology, 13*(1), 39-46.

Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*(1), 38-48.

Pruss, A. (1998). Review of epidemiological studies on health effects from exposure to recreational water. *International Journal of Epidemiology, 27*(1), 1-9.

Rice, E. W. (1982). Inactivation of Giardia cysts by chlorine. *Applied Environmental Microbiology 4,* 250-251.

Rice, E. W., Clark, R. M., & Johnson, C. H. (1999). Chlorine Inactivation of Escherichia coli O157:H7. *Emerging Infectious Diseases, 5*(3), 461-464.

Rossi, J. S. (1989). The hazards of sunlight: A report on the Consensus Development Conference on Sunlight, Ultraviolet Radiation, and the Skin. *The Health Psychologist, 11*(3), 4-6.

Rossi, J. S. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation, and preparation stages of change. *Journal of Consulting and Clinical Psychology, 5*(2), 295-304.

Sonstroem, R. J. (1988). Psychological Models. In R. K. Dishman (Ed.), *Exercise Adherence: Its impact on public health*. Champaign, IL: Human Kinetics Books, 125-154.

Stach, D., J., Annan, S. D., Tilliss, T., Astroth, D. B., & Cross-Poline, G. (2000). Development of a stages of change instrument. *Journal of Dental Hygiene, 74*(12),679-685.

Stamford, B. (1984). Swimming for fitness. *The Physician and Sportsmedicine, 12,* 158.

Timmreck, T. C. (1998). *An Introduction to Epidemiology.* Boston: Jones and Bartlett Publishers.

U.S. Bureau of the Census, Statistical Abstract of the United States: 1995 (115th edition). Washington, DC, 1995.

Vincent, W. J. (1995). *Statistics in Kinesiology.* Champaign: Human Kinetics, Inc.

Williams, K. (1999). Filtration: Facts, fallacies and futures. *Pumproom Press, 3,* 16-19.

Young Men's Christian Association. (1995). *On the Guard Instructor's Manual,* Champaign, IL: Human Kinetics Books.