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The Impact of Alcohol Consumption on Fire Egress Behavior

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____
Andrew K. Pantelis

Abstract

In a nine month span, Prince George's County, Maryland had experienced two fatalities as a result of fires in off-campus student housing. Alcohol consumption has been identified as a factor in both incidents. The problem was that the Prince George's County Fire & EMS Department did not have the ability to demonstrate the adverse impact that alcohol consumption has on fire egress behavior, resulting in an inability to educate university students to the associated dangers. The purpose of this research was to obtain empirical data that demonstrates the relationship between alcohol consumption and human behavior during fire emergencies. Evaluative research was utilized to test the research hypothesis that egress time would increase proportionately to an increase in the research subject's alcohol concentration. A process for evaluating the effects of alcohol consumption on fire egress time was defined and collaborative partners were identified. Utilizing a convenience sample, test subjects were provided with controlled amounts of alcohol and were tasked with completing several fire escape drills. The raw data was recorded, analyzed, and converted to a usable form. The data supports the research hypothesis that egress time increased with alcohol consumption. The results illustrate a 70.58% average increase in escape time between the evolution conducted without alcohol and those conducted with a Breath Alcohol Content (BrAC) of 0.12%. The author recommends further study in the relationship between alcohol and fire deaths in student housing. The author further recommends the development of a permanent coalition of stakeholders tasked with the responsibility of acquiring funding for research expansion and the development of fire education programs that illustrate the deadly combination of alcohol and fire.

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Introduction

The United States Fire Administration (USFA) has recorded that approximately fifty percent of university-related fire fatalities nationwide involved people who were under the influence of alcohol at the time of incident. With two off-campus student fire fatalities in less than one year, the University of Maryland's student population is not immune to this statistic.

The Prince George's County Fire and Emergency Medical Services Department (PGFD) is responsible for fire protection to the University of Maryland College Park and its surrounding communities. The Department is further tasked with developing fire prevention tools and delivering educational programs to at-risk populations within its jurisdiction.

The research problem is that the Prince George's County Fire & Emergency Medical Services Department does not have the ability to demonstrate the adverse impact that alcohol consumption has on fire egress behavior, resulting in an inability to educate university students to the associated dangers. The purpose of this research is to obtain empirical data that demonstrates the relationship between alcohol consumption and human behavior during fire emergencies.

This applied research project will utilize evaluative research methods to determine the effect that alcohol consumption has on the ability to escape from a fire environment. The project will include a comprehensive literature review, a collaboration of public safety agencies, and a research exercise utilizing live test subjects to produce empirical

data. The research hypothesis is that egress time will increase proportionately to an increase in the research subject's consumption of alcohol.

Background and Significance

Prince George's County is located in the State of Maryland immediately adjacent to the District of Columbia. With a population approaching 900,000, the county is the wealthiest African-American majority jurisdiction in the United States (U.S. Census, 2005). Established in 1696, Prince George's County was formed from land in Calvert and Charles Counties by an act of the Maryland General Assembly on St. George's Day, April 23, 1696. The County was named for Prince George of Denmark, husband of Princess Anne, heir to the throne of England (Bryant, 1999).

In 1970, Prince George's County adopted a charter form of government comprised of an executive branch headed by a County Executive and a Legislative Branch consisting of an elected County Council (Bryant, 1999). With the enactment of Charter Government came the creation of the Prince George's County Fire & Emergency Medical Services Department, under the command of a Fire Chief, appointed by the County Executive, and confirmed by the County Council. The Charter unified 44 independent volunteer fire corporations under the authority of a central County department. Additionally, the first career fire fighter positions in the history of Prince George's County were established at that time (Prince George's County Fire & EMS Department [PGFD], 2005a).

Today, the Prince George's County Fire & EMS Department is one of the busiest combination career and volunteer systems in the nation, responding to over 130,000 calls for service each year. The Department is currently comprised of a combination of

approximately 1500 career uniformed personnel and volunteers staffing 44 community based fire and rescue stations. The Department is responsible for all fire suppression activities, both Advanced Life Support and Basic Life Support delivery systems, hazardous materials mitigation, and fire prevention and investigations (PGFD, 2008).

The PGFD is responsible for providing fire protection services to a number of high-profile facilities including the NASA Goddard Space Flight Center, Andrews Air Force Base, the United States Census Bureau, the National Harbor, Six Flags America, the Washington Redskins FedEx Field, and the University of Maryland in College Park. According to the PGFD Annual Report (2008), the above-referenced venues generate approximately 10% of the department's annual call volume.

The University of Maryland in College Park is a major public research university located on 1,250 acres in the northeastern end of Prince George's County. The University has a total enrollment of over 36,000 students and employs an additional 12,500 faculty and staff. As the State of Maryland's flagship university, it has the largest and most diverse student body, the most comprehensive range of academic programs and the most competitive admissions standards. Students are drawn from all 50 states and 150 countries around the world (University of Maryland [UMD], 2008). Each year, the PGFD responds to approximately 2,000 emergency calls for service at the University of Maryland and its surrounding community (PGFD, 2008).

Fire resonates with particularly tragic memories in College Park. In the early morning hours of April 30, 2005, University of Maryland senior Michael Scrocca was killed in a house fire less than a mile from campus. The fire started when an intoxicated partygoer set the front porch of the house ablaze after a dispute with other housemates.

PGFD fire crews found Scrocca's body on the floor of his second-story bedroom, unconscious and not breathing as a result of smoke inhalation (PGFD, 2005b). The investigative report further revealed that a large quantity of alcohol was served at the home during a party, creating an atmosphere which contributed to the tragedy that night.

Less than nine months later, University of Maryland senior David Ellis also died in a fire at one of the notorious "Knox Box" apartments, clusters of cheap rental blocks abutting the south end of campus. Firefighters found Ellis unconscious and not breathing in his bedroom of the basement apartment that caught fire as a result of a malfunctioning appliance. Interviews conducted by fire investigators revealed that on the night of the fire, Ellis had consumed a significant amount of alcohol at area bars prior to returning home (PGFD, 2006).

According to Wechsler, Lee, and Kuo (2000), on college campuses across the country more than half of students engage in high-risk drinking characterized by frequent and deliberate intoxication. Though this behavior is often glamorized by popular culture and viewed as a rite of passage by many, these young people are more likely than their non-drinking peers to suffer harm as a result of excessive alcohol use (Smith, Branas, & Miller, 1999). The consequences of excessive alcohol use often result in decreased safety and a diminished quality of life for students.

There is significant existing research demonstrating that alcohol consumption impairs perception and judgment and from this it can be assumed that alcohol intoxication hampers fire evacuation efforts. However, there is no evidence to support that empirical data has been collected in a controlled environment to determine the

impact of alcohol on fire egress behavior. Research in this area is necessary to produce statistical information that could prove to be a valuable fire prevention tool.

An objective of the Strategies for Community Risk Reduction course presented at the National Fire Academy is to emphasize the importance of applying a strategic process to address a risk challenge that is present in our home community (National Fire Academy [NFA], 2008b). The subject matter that is presented in this Applied Research Project relates directly toward educating a target population about risk behaviors that increase the incidence of injury and loss of life from the effects of fire. This applied research project also relates to the United States Fire Administration's objective of responding appropriately in a timely manner to emerging fire service issues (NFA, 2008a). Although significant advances have been made in the area of campus fire safety, university and college-related fire deaths are not declining (Marshall et al, 2008). This research will illustrate a significant risk factor that contributes to such fire fatalities.

Literature Review

Alcohol is one of the oldest and most widely used psychoactive drugs on earth (Levinson, 2002). The term alcohol is used to describe several types of alcohol including the three most common: ethyl alcohol, methyl alcohol, and isopropyl alcohol. All forms of alcohol have a similar chemical structure and contain a hydroxyl group attached to a saturated carbon molecule. Methyl and isopropyl alcohol are not meant for human consumption, with 6-8 ounces (177.44-236.59 ml) being a lethal dose (Brick, 2002).

The alcohol that is the subject of this research and that is consumed as a beverage is ethyl alcohol, a relatively clear and odorless chemical. The lethal dose of acute ethanol (ethyl alcohol) is estimated to be a blood alcohol concentration of about 0.40 percent,

although death may occur at higher or lower concentrations (Brick, 2002). Ethanol is commercially produced using a process called fermentation. Fermentation is a course of action whereby the carbohydrates such as starch and sugars in the plants are transformed into ethyl alcohol and carbon dioxide. The ethyl alcohol molecule produced by the fermentation process is the same for all alcohol beverages (Centers for Disease Control & Prevention [CDC], 2008).

Alcoholic beverages come in a variety of sizes and containers resulting in a selection of drinks that contain different amounts of alcohol. In the United States, a standard drink is any alcoholic beverage that contains 0.6 fluid ounces (17.74 ml) of pure alcohol. A standard drink is generally calculated as a 12 ounce (340.96 ml) glass of beer, four ounce (113.65 ml) glass of wine, or a one ounce (28.41 ml) shot of hard liquor (CDC, 2008). These measures do not factor the differences in alcohol content within beverage categories, such as malt liquor beers or high proof distilled spirits, which have higher alcohol content by volume. The alcoholic content in a beverage is determined relative to its proof, which is twice the alcohol content (Hanson, Venturelli, & Fleckenstein, 2005).

Alcohol is classified as a depressant because it slows down the central nervous system, causing a decrease in motor coordination, reaction time and intellectual performance (Bledsoe, Porter, & Cherry, 2008). At high doses, the respiratory system slows drastically and can result in a loss of consciousness or death. The effects of alcohol on an individual depend on several factors including age, weight, sex, health, tolerance, expectation, mood and environment (Gould, 2006). Furthermore, the use of

alcohol in combination with illicit and prescription drugs adds significantly to its effect upon any individual (Hanson, Venturelli, & Fleckenstein, 2005).

From the moment an alcoholic beverage comes in contact with an individual's lips, the body is affected. When the alcohol enters the lining of the mouth, a small percentage is absorbed into the body. It irritates the mouth lining as well as the esophagus, acting as an anesthetic. Once swallowed, a drink enters the stomach and small intestine, where small blood vessels carry it to the bloodstream. Approximately 20% of alcohol is absorbed through the stomach and most of the remaining 80% is absorbed through the small intestine from where the alcohol can reach every cell of the body (Gershwin, German, & Keen, 2000). In its circulation through the body, alcohol reaches the brain and the consumer begins to feel the effects of intoxication. The severity and longevity of these effects are dependent on the concentration of alcohol in the blood. A factor that affects the concentration of alcohol in the blood is the rate at which the alcohol reaches the small intestine. This rate is dependent on the strength of the alcohol as well as whether or not there is food in the stomach. If the stomach is empty, alcohol can reach the small intestine in less than five minutes (Gould, 2006).

Nutrients, protein, carbohydrates, and fat can be stored in our bodies, but alcohol cannot. For this reason, it takes priority over the previously listed items in order to be metabolized; doing so means that all of the other processes that should be taking place are interrupted (Marieb & Hoehn, 2006). Approximately 90% of alcohol is metabolized by the liver, where dehydrogenase enzymes break down the alcohol. In general, the liver can process one ounce of liquor in one hour. If more than one ounce of alcohol is consumed, the additional alcohol will accumulate in the blood and body tissues until it

can be metabolized. The remaining 10% of alcohol is expelled by means of perspiration and by elimination through the lungs and kidneys (Gershwin, German, & Keen, 2000).

As the alcohol that is not being metabolized continues to be dispersed, the brain experiences various impairments. Alcohol's effect on the brain is dangerous, as the brain is usually protected from chemicals and drugs by the blood/brain barrier (Marieb & Hoehn, 2006). Normally, only water has the ability to pass through; however, the simple molecular structure of alcohol allows it to penetrate the barrier. This directly affects the brain's ability to coordinate critical body functions such as the senses, perception, speech, and judgment (Gould, 2006).

The consumption of beverage alcohol products has played an accepted and important role in the cultural and social traditions of both ancient and modern society. Historically, alcoholic beverages have served as sources of needed nutrients and have been widely used for their medicinal, antiseptic, and analgesic properties (Hanson, Venturelli, & Fleckenstein, 2005). Today, alcoholic beverages are readily available and are produced in a multitude of forms at a variety of costs. Alcohol can be utilized as a social lubricant, can facilitate relaxation, can provide pharmacological pleasure, and can increase the pleasure of eating (Brick, 2002). Yet, the negative impact of alcohol on the nation may be more devastating than any other substance. It is centrally related to a number of persistent threats to public health (United States Fire Administration [USFA], 1999).

Numerous studies have shown the harmful effects of alcohol on cognitive and physical functions. Alcohol affects judgment, balance, and motor coordination, all of which lead to an increased rate of unintentional injury (Smith, Branas, & Miller, 1999).

Very low levels of alcohol can affect judgment and performance, and even a very small effect may be relevant where a high degree of skill is needed, where the risk is already high, or where the safety of others is involved (Volkow et al., 2008). Furthermore, according to Tzambazis & Stough (2000), alcohol significantly impairs total information processing for both simple and complex tasks.

Many of the studies produced on the relationship between death or injury and alcohol impairment focus traditionally on injuries that result from motor vehicle crashes. There is, however, no equivalent and comprehensive body of research for the relationship between alcohol and fire. Fire is the fifth leading cause of unintentional death in the United States and is responsible for the loss of approximately 4,500 lives each year (CDC, 2005). The United States mortality rate from fires ranks sixth among the top 25 developed countries (International Association for the Study of Insurance Economics, 2003). Although the number of fatalities and injuries caused by residential fires has declined gradually over the past several decades, many residential fire-related deaths remain preventable and continue to pose a significant public health problem (Karter, 2007).

Several researchers have found that a significant percentage of people who died in a fire were under the influence of alcohol at the time of the fire. In a study of North Carolina fire deaths, more than half of the victims had alcohol in the blood exceeding 0.05% (Patetta & Cole, 1990). In Minnesota, public safety records revealed that between the years 1996 to 2002, over 36% of Minnesota's fire fatalities involved people who had alcohol levels of 0.1 or higher (USFA, 2003a). Additionally, a meta-analysis conducted at the Johns Hopkins School of Hygiene and Public Health Center for Injury Research

and Policy revealed that alcohol use contributes to an estimated 40% of residential fire deaths (Smith, Branas, & Miller, 1999). Not only does alcohol increase the risk for fire and burn injuries, but it may also contribute directly to the cause of the fire (Howland & Hingson, 1987).

The problem of alcohol-related fire fatalities is not exclusive to the United States. The number of people killed in fires in Scotland rose by more than 60% last year, with alcohol identified as a significant factor. Alcohol was a contributory factor in 41% of fatal house fires, according to Her Majesty's Fire Service Inspectorate for Scotland Annual Report (2008). In Sweden, a study of unnatural deaths revealed that alcohol involvement was a common factor in 44% of reported fire cases (Sjogren, Eriksson, & Ahlm, 2000). This trend was also identified to be significant problem in London, England. Of the unintentional-dwelling-fire victims, 40% had blood alcohol concentrations in excess of the legal limit for driving in the United Kingdom, while 24% of additional victims were highly intoxicated at their time of death (Holborn, Nolan, & Golt, 2003).

University students are not immune to this problem. Each year college and university students, both on campus and off campus, experience hundreds of fire-related emergencies nationwide. The USFA (2008) and Campus Firewatch (2008) have identified 129 campus-related fire deaths in the United States since the year 2000, with 83% of them occurring in off-campus housing. Recent studies list impaired judgment from alcohol consumption among the top four causes of campus-related fire fatalities (Comeau, 2007). This is reinforced by the findings of a report by Davis and DeBarros

(2006) and USFA study (2003b) where in over half of the fatal fires studied at least one of the students that had died had been drinking.

Alcohol is a significant problem on many campuses, and it has a direct impact upon fire safety (USFA, 2008). In addition, the younger adult population seems to incur the greatest number of alcohol-impaired fire casualties (USFA, 1999). The increased mortality rate for those who have been drinking is a very important issue for young adults, who are perhaps less experienced drinkers than their older counterparts, and whose lifestyles traditionally provide more opportunities for consuming alcohol (Ball & Bruck, 2004).

In a 2007 North Carolina house fire, medical examiners confirmed that alcohol contributed to the deaths of six out of seven students (Smith, 2007). A fire in 2000 at the Tau Kappa Epsilon fraternity house at Bloomsburg University killed three students following a party where students had been drinking. In 1994, five Bloomsburg University students were killed at the Beta Sigma Delta fraternity house when flames erupted after a party. Autopsy results showed that each of the students had an elevated blood alcohol concentration (BAC) (Davis & DeBarros, 2006). In 1996, five occupants of a fraternity house in Chapel Hill, North Carolina died after a fire roared through their house. Each victim had an elevated BAC from a party that was held at the house earlier in the night (Godfrey, 2007).

In other cases, the campus-related fire victims had no alcohol in their systems when they were killed, but the individuals responsible for starting the fires were found to be intoxicated. In 2000, three students were killed and 58 others injured when two intoxicated partygoers set fire to a dormitory lounge at Seton Hall University (NFPA,

2003). More recently, a University of Maryland student was killed in 2005 when an inebriated freshman lit fire to the front of the house in retaliation for being thrown out of a party earlier the same night (Rich, 2008). Highlighting this problem, the USFA (1999) reports that alcohol is a significant factor contributing to the act of arson and hence, to fire casualties.

There are a number of additional media sources that provide a link between alcohol consumption and its role in fire fatalities. However, some of the research used in preparing these studies is quite dated, ranging from 1980 to 2000. The result is that, unfortunately, we do not have a current view on the connection between alcohol consumption and fire injury and fatality. Current scholarly research in this area is clearly warranted.

Procedures

The first component of the research process began with a comprehensive literature examination at the University of Maryland student library in College Park, Maryland. The examination included reviews of books, journals, reports, and other written materials, as well as a number of Internet searches. The objective of this literature review was to establish a basic foundation for the conduct of research and to obtain original documents that were necessary to perform a proper evaluation of the subject matter.

The literature review focused on university related fire fatalities from the year 2000 until present. An emphasis was placed on delineating between those fatalities in which alcohol consumption was identified as a factor and those in which it was not. To further understand the physiological impact of such research, medical texts and scholarly

articles that discussed the effect of alcohol on judgment, motor function, and cognitive thought processes were evaluated in depth.

After completing the literature review, discussions were held to determine the optimal method for evaluating the relationship between alcohol consumption and a college student's ability to escape from a fire environment. To conduct a comprehensive evaluation, it was necessary to collaborate with a number of different public safety organizations. Meetings were scheduled with representatives of the Maryland Fire and Rescue Institute of the University of Maryland College Park (MFRI), the University of Maryland Police Department (UMPD), the Prince George's County Fire and EMS Department (PGFD), and the Prince George's County Professional Fire Fighters and Paramedics Association to discuss how each of their respective organizations could assist with the research project.

The research topic was first presented to MFRI Director Steven Edwards, the manager of the Center for Firefighter Safety Research and Development at MFRI, Ms. Angela Bennett, and UMPD Captain John Brandt to determine the role that each organization would play in the conduct of research. MFRI agreed to allow the utilization of its headquarters facility, support staff, and the required safety equipment. UMPD agreed to provide an officer trained in the administration of preliminary breathalyzer examinations and the equipment required for blood alcohol concentration (BAC) evaluation.

Additional logistical support was then solicited from the PGFD and the Professional Fire Fighters and Paramedics Association. Bureau Chief Dennis Wood of the PGFD arranged to provide an Advanced Life Support (ALS) transport ambulance and

four paramedics to assist with the baseline medical evaluation. The Executive Board of the Professional Fire Fighters and Paramedics Association covered the expenses for purchasing alcohol, food, and miscellaneous equipment that was not available at MFRI.

The next procedure was to design and construct an environment that would be realistic enough to simulate a fire environment but that would not place subjects in an atmosphere that would be dangerous to life and health. With a MFRI partnership already established, a logical research location was the training tower located at the MFRI headquarters facility in College Park, Maryland. The training tower is a five story concrete structure utilized for non-live fire evolutions such as search techniques, ventilation methods, and technical rescue training. All levels are approximately 800 sq. ft. (74.32 m^2) with open floor plans that are easily manipulated to meet a variety of training needs. This facility was also an attractive location for the reason that all of the research stations could be based in one location, even in the event of inclement weather.

Taking into account the properties of smoke, in that it ends to rise, the fourth floor of the tower was selected for the evolution location. A 600 sq. ft. (55.74 m^2) mock dormitory (Appendix A) was created, consisting of two bedrooms, a common living area, a kitchenette, and two hallways. The walls were constructed of 2” x 4” (5.1 cm x 10.2 cm) wooden wall studs with a 3/16” (0.47625 cm) plywood surface. Standard residential doors separated each of the above-referenced dormitory rooms to further simulate residential compartmentalization. Each dormitory room and hallway had a centrally located window with an adjustable metal covering to allow for rapid opening.

The dormitory was furnished with bunk beds, dressers, tables, chairs, and various household appliances to simulate a residential living arrangement. Ceiling-mounted light

fixtures provided ambient light and a Kiddie Model 0915 battery-operated ionization smoke alarm capable of an 85 decibel sound output was mounted in the common hallway. Additional ground wiring was also positioned to allow for the operation of equipment that would later be required to simulate a fire environment.

After the physical research location and respective props were prepared, the focus shifted toward replicating a simulated fire emergency in a controlled environment. The components of smoke, heat, darkness, and noise were identified as desirable simulation elements to produce a realistic experience. A comprehensive product review was conducted to identify equipment that could produce the above-referenced elements without harming research subjects.

To produce a simulated smoke environment, two Symtron Systems model SM-3K-B smoke machines were utilized. A smoke machine is an electro-mechanical unit which produces clouds of smoke on demand. Smoke machines are used in theatres, nightclubs, film and television studios, theme parks and other entertainment applications to produce smoke or fog effects which create the illusion of fog, steam, or smoke from a fire. They are also used to create safe smoke for fire training scenarios.

Such devices emit a dense vapor that appears similar to fog or smoke. The Model SM-3K-B is suitcase style unit that creates fog by vaporizing a water and glycol-based fluid via atomization. The fluid is injected into a heated block where it is quickly evaporated. The resulting pressure forces the vapor out of the small ventilation opening at the base of the machine. Upon coming into contact with cool outside air the vapor forms a fog. In accordance with manufacturer recommendations, a non-toxic water-based fog solution was dispersed from each machine to create the desired effect.

To increase the air temperature of the entire research area, two Ramfan Model UB-20 in-line heating systems and associated ductwork were utilized. Designed for use in a tent, shelter, or other confined space, this indirect-fired heat exchanger provides up to ten hours of heat from a standard 20 lb (9.07 kg) propane tank. This particular heater model was selected due to its ability to raise the temperature in the research area without harming participants from the effects of burn injuries or carbon monoxide poisoning.

Since all research evolutions were scheduled for the daytime hours, it was necessary to create a dark environment in the research area. The simulated smoke produced from the referenced fog machines would significantly assist with creating this effect. To further produce an atmosphere of total darkness, all windows were sealed and darkened with a blackout film cover and overhead lighting was positioned in a manner that it could easily be turned off during each evolution.

The final desired component for replication of a simulated fire environment was the creation of noise that is commonly heard in an actual fire emergency. It was determined that the most common noise that could be easily replicated was that of a smoke alarm. The Kiddie Model 0915 smoke alarm was selected for its product reliability, ease of installation, and its ability to produce an 85 decibel audible alarm upon detecting smoke via an ionization sensor.

After the organizational partnerships were established, the research course was designed, and protocols for the conduct of research were developed, the next procedure was to seek project approval. The University of Maryland and its constituent institutions are guided by principles as set forth by the Belmont Report of National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1979).

Furthermore, all other federal, state, local laws and regulations that govern research must be strictly adhered to. To meet this mandate, an Institutional Review Board (IRB) reviews, approves the initiation of, and conducts periodic review of research involving human subjects. The primary purpose of the IRB review is to ensure the protection of the rights and welfare of human subjects. In accordance with this policy, all University of Maryland System research activities which involve human subjects, regardless of the level of risk, require review and approval prior to the initiation of the activity.

As the primary research investigator, it was necessary to submit an IRB application (Appendix B) that provided a comprehensive description of the proposed research. The research plan included provisions for the adequate protection of the rights and welfare of research subjects and ensured that pertinent laws and regulations were observed. Samples of informed consent documents and a pre-participation medical questionnaire were included with the protocols.

After receipt of IRB approval, a study date was established and an aggressive campaign was initiated to recruit research subjects from the University of Maryland community. An advertisement (Appendix C) was placed in The Diamondback, an independent student newsletter, for two consecutive days. In addition, a flyer (Appendix C) was distributed to several thousand students via campus email distribution lists. Members of the media, university faculty, and various fire and life safety organizations were also invited to observe the study.

The research subjects were selected based on their ages, medical history, and proximity to campus. Respondents were interviewed by telephone to determine if they were of legal drinking age, resided in close proximity to campus, and were available on

the project date. Several inquiries were received regarding whether participants would receive monetary compensation. Many prospective participants were not interested in participating given that compensation was not offered for the study. In addition, a number of respondents were deemed ineligible as a result of having previous fire training experience.

The minimum age for all research subjects was 21 years due to federal, state, and local laws governing the minimum age for alcohol consumption. The maximum age was capped at twenty six years as to ensure that the research does not extend too far beyond the age range of the typical student demographic. All candidates were required to present a valid driver's license, identification card, or passport to document proof of age. Candidates were instructed to eat a light meal consisting of fruit and cereal on the morning of the study.

Ultimately, 15 volunteer research subjects were recruited to participate and 10 were eligible to participate after the screening process. Research subjects were assigned an identification number and began by providing their informed consent and completing a pre-screening medical questionnaire. Female subjects were also required to take a home pregnancy test. All subjects had every aspect of the study explained to them verbally and were given the opportunity to ask questions concerning the study before being asked to read and sign the consent form and before participation in the study. Each of the test subjects completed the pre-participation questionnaire (Appendix D) and consent forms (Appendix E) and were briefed about the research procedures that would take place. These procedures served to minimize risks for psychological, social or physical harm to the participants.

In the pre-participation questionnaire, research subjects were asked to provide a detailed medical history. All research subjects were required to have a clean bill of health as a prerequisite for participation. Any candidate found to be pregnant or to have a history of alcoholism, illicit drug use, prescription drug use (excluding birth control and topical applications), heart disease, lung disease, liver disease, kidney disease, hepatitis, pancreatitis, cancer of larynx, esophagus, stomach and pancreas, claustrophobia, nyctophobia, antisocial personality disorder, mood disorders, anxiety disorders, or other similar or related illnesses were excluded from participation. An additional emphasis was made on recruiting subjects who identified themselves as social drinkers, had no immediate family history of alcoholism, and who had never received a criminal violation relating to alcohol consumption. The CAGE questionnaire, a screening tool, was utilized to identify signs and symptoms of alcoholism (Appendix F).

Research subjects completed a safety walk through of the research course and were issued safety gear prior to beginning the evolution. Subjects then completed a baseline medical assessment administered by licensed paramedics. This included an evaluation of heart rate and rhythm, blood pressure, respiratory rate, lung sounds, pulse oximetry, and weight. Any subject found to have an abnormal medical assessment or abnormal vital signs was not permitted to continue with the exercise. After the baseline medical assessment, subjects donned a protective ensemble including a helmet with chin strap, eye protection, elbow and knee protection, and heavy-duty gloves. The subjects were then taken to the fourth floor of the training building to the area furnished to simulate a dormitory apartment. Subjects began the exercise from a supine position on a bunk bed in the rear bedroom.

Upon activation of an audible smoke alarm, subjects were tasked with getting out of bed, crawling across the simulated dormitory room, descending the stairs to the third level via an interior enclosed stairwell, and completing the exercise on the third floor stairwell landing. The subjects were timed (in seconds) from the activation of the smoke alarm until both of their feet crossed a designated line on the third floor landing.

A safety officer was situated ten feet in front of each subject and a second safety officer was situated ten feet behind each subject at all times. A thermal imaging camera was used to observe all actions of the research subjects while in the simulated smoke environment. If at any point a subject became ill, injured, or in a state of duress, the exercise immediately ceased and the safety officers removed the subject to the exterior of the building. At the conclusion of the first exercise, the subjects entered a rehabilitation area for a post exercise medical assessment.

Following a mandatory rest period, the subjects were given their first alcoholic beverage, which they were asked to consume within 20 minutes. The beverage provided was Budweiser, a lager-style beer made from rice and barley malt. A 12 oz (354.88 ml) serving of Budweiser has exactly 0.6 oz (17.74 ml) or 5.0% alcohol by volume (Anheuser-Busch Corporation, 2008). Budweiser was the optimal beverage for this study because its alcoholic content equals that of a standard drink in the United States.

The volume of alcohol consumed by each subject was proportionate to his or her total body weight and was pre-calculated to result in a BAC of 0.03%. The alcohol impairment chart published by the National Highway Traffic Safety Administration (NHTSA) and listed in Appendix G was used to determine the exact measure of alcohol that was consumed by each subject.

An Intoximeter Alco-Sensor Model III was utilized to conduct a breath alcohol test of each subject prior to beginning the next evolution. This handheld unit provided a simple and accurate three digit percentage reading by utilizing an electrochemical fuel sensor to generate an electrical response that is proportional to the Breath Alcohol Concentration (BrAC) in exhaled air. The unit was calibrated by the UMPD immediately prior to the exercise utilizing an NHTSA-approved wet bath simulator.

Following a twenty-minute wait period, the same sequences of events conducted during the baseline evolution were repeated and the subjects were tasked with completing the fire escape drill under the influence of alcohol. Upon completion of the evolution, the subjects re-entered the rehabilitation area for a post exercise medical assessment and another brief period of rest and rehydration. This same sequence of events was repeated with breath alcohol concentrations of 0.06%, 0.09%, and 0.12%. Upon completion of the final evolution, the subjects were required to remain in a rehabilitation area until their BrAC's were below the legal limit of 0.08%. The subjects were then transported home by a designated driver.

All measurement devices, such as scales and timers, were calibrated prior to the research evolution. Due to the legal requirements surrounding private medical information, a summary of test subjects by candidate number is provided in the results section. All other information, releases, original testing records, and original laboratory data were maintained in the custody of the author.

Limitations and Assumptions

As with all research, there are limitations to the interpretation of the results and additional considerations that need to be taken into account when trying to generalize this

analysis to broader issues. During the course of this research, the author encountered several limitations that are worthy of mention.

Although great lengths were undertaken to simulate an actual fire environment, it was not possible to place intoxicated and untrained research subjects into a live fire evolution for fear of injury or death. Therefore, the elements of smoke and heat were produced in their safest forms. The hazardous elements associated with fire would more than likely diminish a subject's ability to escape from a fire environment even greater than this research is able to demonstrate. An additional limitation in this regard was the fact that familiarization of the course layout by repetition was not factored into the dataset. Since the layout of the research environment remained a constant and the evolution was conducted several times, research subjects had the ability to learn the floor plan of the structure and adapt accordingly.

Alcohol concentration tests also make several assumptions about the individual being tested. One critical assumption is the ratio of Breath Alcohol Concentration (BrAC) to Blood Alcohol Concentration (BAC). This ratio, called the partition ratio, equates the parts of alcohol found in breath to the correlating amount of alcohol found in blood. However, the actual ratio may vary by individual and can subsequently influence the accuracy of breath tests. In order to truly determine BAC, a closed blood sample must be obtained. Breath alcohol testing further assumes that the absorption of alcohol in the subject's body is complete. If the subject is still actively absorbing alcohol, his or her body has not reached a state of equilibrium where the concentration of alcohol is uniform throughout the body. Test results during this period may not be entirely accurate as the

amounts of alcohol in the breath may not accurately reflect a true concentration in the blood.

Certain additional assumptions must also be accounted for when evaluating the scope of this research. The research subjects comprised a convenience sample that may not be entirely representative of the university population and it is therefore assumed that the age, health, and alcohol tolerance of the sample group is similar to the entire community. These results should be framed as pilot data demonstrating a trend that warrants further research. Results from ten subjects can not be utilized to make conclusive statements. Finally, the data assumes that all samples were appropriately drawn, prepared, labeled, and analyzed and that all records and published findings are accurately recorded.

Definition of Terms

Blood Alcohol Concentration (BAC): a measurement of the amount of alcohol contained in a person's blood. It is measured as weight per unit of volume and is typically converted into a percentage.

Breath Alcohol Concentration (BrAC): The percentage of alcohol in a person’s breath, taken from deep in the lungs.

CAGE Questionnaire: a brief alcoholism screening tool asking subjects about attempts to cut down on drinking, annoyance over others' criticism of the subject's drinking, guilt related to drinking, and use of an alcoholic drink as an eye opener.

Claustrophobia: a fear of enclosed spaces.

Decibel: a logarithmic unit for measuring relative strength of a signal.

Equilibrium: a condition in which all acting influences are canceled by others, resulting in a stable, balanced, or unchanging system.

Immediately Dangerous to Life and Health (IDLH): a term used to describe an environment which is very hazardous due to a high concentration of toxic chemicals or insufficient oxygen or both.

Institutional Review Board (IRB): a University of Maryland panel tasked with reviewing and approving research involving human subjects. The IRB includes members from diverse fields including criminal justice, education, exercise physiology, medicine, psychology, public health, and second language acquisition. Members are drawn from within and outside the campus community and are comprised of 15-20 members.

Nyctophobia: a morbid fear of night or darkness

Preliminary Breath Test (PBT): a small handheld device that provides an estimate of blood alcohol concentration by measuring breath alcohol through a fuel cell.

Pulse Oximetry: a non-invasive measurement of the amount of oxygen in the blood.

Standard Drink (United States): equal to 0.6 ounces of pure alcohol. This usually equates to 12 ounces of beer, four ounces of unfortified table wine, or one ounce of 80-proof liquor.

Supine: lying on the back or face upward.

Thermal Imaging Camera: a handheld camera device that uses thermal imaging technology to detect the heat given off by objects and that can be used to see through smoke and darkness.

Results

Through a review of the data gathered, and with the supporting information found in the literature review, an answer to the research hypothesis was established. As Table 1 illustrates, the research hypothesis is supported in that overall egress time increased with a proportionate increase in a subject's alcohol consumption.

Table 1

Egress Time (seconds) at Increasing Breath Alcohol Concentration (BrAC) Levels

	BrAC Levels				
	0.00%	0.03%	0.06%	0.09%	0.12%
Subject 1	39.00	45.05	54.88	58.90	64.10
Subject2	56.86	40.20	48.85	52.67	59.01
Subject 3	46.25	55.08	59.85	63.65	74.81
Subject 4	31.99	36.50	47.75	57.19	79.37
Subject 5	32.12	34.05	47.34	49.08	51.07
Subject 6	32.54	38.10	41.87	43.09	49.83
Subject 7	61.80	63.91	68.68	75.34	87.82
Subject 8	28.40	33.05	36.90	41.66	59.38
Subject 9	25.66	33.75	40.80	43.03	49.75
Subject 10	45.28	53.50	66.44	79.08	----

Note. Subject 10 did not complete the evolution at BrAC 0.12%

Nine out of the ten subjects' egress times increased from their baseline time as their BrAC levels rose. Subject 2 was the only exception. Subject 2 posted a decrease from baseline in egress time with BrAC levels of 0.03%, 0.06%, and 0.09%. The other

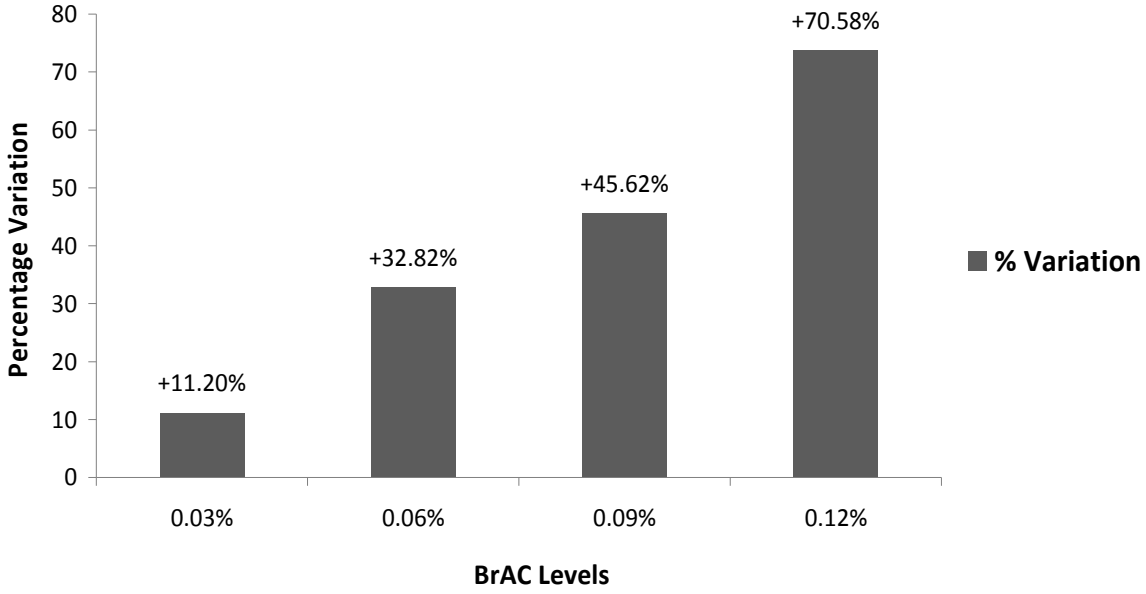
nine subjects posted increases over baseline in egress time for those same BrAC levels. However, Subject 2's egress times escalated from a BrAC level of 0.03% to 0.12% which was a consistent trend that was demonstrated. All of the subjects that completed the final evolution posted an increased time from baseline once a BrAC of 0.12% was achieved.

Subject 10 did not complete the final evolution due to sudden illness. However, Subject 10's egress time escalated in the same manner as the other subjects during the evolutions with BrAC levels of 0.03%, 0.06%, and 0.09%.

Percentages of increase in egress time from the baseline evolution to the examined BrAC levels were calculated for each subject. The mean of these averages was then calculated at each tested BrAC level (Figure 1).

Figure 1

Mean Percentage Variation in Egress Time



This percentage of increase from baseline was most remarkable at the highest BrAC examined. At 0.12% BrAC, the subjects posted a 70.58% averaged increase in egress time over their baseline times.

Discussion

The results of this study have been evaluated, correlated with the findings of others, and the implications for PGFD have been analyzed. This applied research project was designed to identify effects of alcohol consumption on fire escape time. As research participants became intoxicated, during the exercise portion of this study, it was anticipated that increased consumption of alcohol would have an adverse impact on the subjects' ability to escape from the simulated fire environment.

As indicated in the literature review, alcohol-related fire research within the fire service has been extremely limited. The only other research conducted regarding alcohol consumption and fire safety focused on auditory response to smoke detector activation while under the influence of alcohol. In the study conducted at Victoria University by Ball and Bruck (2004), students were given controlled amounts of alcohol to drink and then allowed to fall asleep in their own beds. Once asleep, students were exposed to gradually increasing levels of sound that simulated smoke alarms and their response was measured. Their response while sober was measured to determine a baseline response as well as their response at 0.05 BAC and 0.08 BAC. It was found that when students had been drinking it takes a much louder alarm to awaken them than needed when they are sober (Bruck & Ball, 2004). The meaning of this correlates to the findings of this research in that even at low to moderate levels, alcohol can significantly affect the ability to respond to an emergency.

During the controlled setting of this project, the test subjects all experienced increased response times in exiting the fire environment. Even at relatively low BrAC levels of 0.03% and 0.06%, a mean increase in exit times of 11.20% and 32.82% respectively were observed. The one exception to this rule, Subject 2, demonstrated a 29.30% reduction in escape time from the baseline evolution to the evolution conducted with a BrAC of 0.03%. However, response times for the evolutions conducted with BrAC's of 0.06%, 0.09%, and 0.12% increased in the same proportionate manner that occurred with the other test subjects. During a post exercise interview, the author determined that Subject 2 was the only participant who experienced difficulties exiting the environment during the baseline evolution, thus accounting for the atypical difference between the baseline evolution time and the time recorded at a BrAC of 0.03%.

Although fire service research on the topic is narrow, extensive findings demonstrating alcohol's impact on motor function exist and their findings complement the results of this applied research project. Research conducted by Volkow et al. (2008) illustrated that even small amounts of alcohol affect judgment, balance and motor coordination. Tzambazis & Stough (2000) demonstrated that alcohol consumption impairs the speed of information processing and affects attention. A meta-analysis conducted by the USFA (1999) for the further concluded that short-term physiological effects of alcohol have been shown to diminish motor coordination and balance as well as impair perception and judgment.

During the study, as alcohol consumption increased, research subjects were observed to have an increased difficulty completing simple tasks. Two specific course tasks were observed to result in a significant increase in time as evolutions progressed.

The first task was the manipulation of the bedroom door and the hallway exit door. With increased BrAC levels, test subjects were observed to have greater difficulty manually operating a standard residential knob on each door. The second task that resulted in increased course completion time was descending the interior stairs. All test subjects' demonstrated moderate to significant motor difficulties while completing this task, even with the assistance of a hand rail and the security of a safety officer to prevent hazardous falls.

The student demographic is particularly susceptible to effects of fire and alcohol. Students are more prone to alcohol problems because they are often inexperienced drinkers, and away from home for the first time (Comeau, 2007). A study conducted by Wechsler, Lee, and Kuo (2000) found that 44 percent of American college students binge drink at least once every two weeks, and many others drink heavily in short periods of time to lengthen the effects of intoxication. Runyan and Casteel (2004) note that there is a strong link between fire deaths and alcohol, noting that in more than 50 percent of adult fire fatalities, the victims were under the influence of alcohol at the time of the fires. The USFA also states that in cases where fire fatalities occurred on campus, alcohol was a factor (USFA, 2003b).

Throughout the course of research, additional observations were made of the behavior of the research subjects. As alcohol consumption increased, research subjects perceived that they were completing each subsequent course evolution faster than they had completed prior evolutions. In addition, subjects believed that the density of smoke and course darkness were greater with each passing evolution when in fact the control environment remained constant throughout all evolutions. Subjects learned how their

bodies reacted to alcohol and how even small quantities of alcohol could alter perception and impact the time that it takes to respond to an emergency.

The implications for the PGFD regarding student alcohol consumption and fire safety primarily illustrate the need to target university students as customers who require unique fire prevention programs. Even with two student fire fatalities since 2005, PGFD has been unable to develop effective solutions that target this at-risk demographic. Multiple sources (Comeau, 2007; Davis, & DeBarros, 2006; USFA, 2008) recommend that fire service organizations take a proactive approach to tackling the problems surrounding the deadly mix of fire and alcohol. As important as PGFD response capabilities are to the protection of the residents of Prince George's County, nothing is more important to the well-being of the community than the prevention of fires, accidents and illnesses. Therefore, the PGFD has incorporated a "prevention and planning before response" mindset into its key organizational objectives.

This study presents a compelling argument for the need to address the development of student fire safety programs during the budget and planning process. The student demographic is difficult to reach with fire safety information and requires innovative programs to capture its attention. Traditionally, students are not impressed with statistical information regarding fire safety (Overly, 2007). Effective solutions are dependent upon education and awareness between all of the parties involved. It is critical that each be aware of their responsibilities in fire safety and that they all work in concert with one another to provide as fire-safe an environment as possible (Comeau, 2007). Since the general public's perception of this problem may be low, it may be possible to minimize fire risk by increasing the awareness of those who drink and those who are

surrounded by regular drinkers. Educational campaigns warning the public of the dangers of drunk driving have been successful, and the same can be accomplished to shed light on the subtle dangers of alcohol and fire.

Recommendations

Based on this study, it is recommended that the PGFD undertake further analysis of the impact that alcohol consumption has on fire safety in campus related housing. This research provides a brief glance into a student's physiological responses to a simulated fire environment while under the influence of alcohol. Additional research should follow to determine the response that participants have in a variety of environments at additional levels of intoxication.

Second, efforts should focus on developing a permanent coalition of stakeholders to support future research in this area. This project was successful as a result of a collaborative partnership between the Prince George's County Fire and EMS Department, the Maryland Fire and Rescue Institute, the University of Maryland Police Department, and the Prince George's County Professional Fire Fighters and Paramedics Association. Without the combination of resources provided by partnerships, agencies may be unaware of the extent and range of customer needs and of the services and support offered by other agencies. In these instances, unfortunate gaps in service delivery may exist. The challenges and barriers that many members of our communities face are interactive and interrelated; therefore, our solutions and services must also be interconnected.

Third, future replication of research should include attempts to obtain additional funding through Federal grants and other private revenue sources. The research budget

limited the project to being held on a single date at one location and the number of research subjects to ten individuals. This research included an evaluation of a select number of University of Maryland students. The research subjects comprised a convenience sample that may not be entirely representative of the university population. Additional funding should be earmarked to ensure that future research utilizes a valid random sample.

Additionally, future research using the scientific method, control groups, and a more detailed analysis is indicated. This research did not contain a method for evaluating a reduction in evolution times as a result of course familiarization through repetition. Future research should include control groups who do not consume alcohol so that accurate baseline times may be established for each consecutive evolution. Furthermore, with the occasional debate regarding the ability of breath analyzer machines to accurately obtain BAC values, future research should make efforts to obtain closed blood samples from participants so that they may be analyzed and validated by a certified laboratory.

Finally, the results of this study should be made available to the entire fire service community so that they may be used as a guide for the development of effective strategies to address this problem within other jurisdictions. The information obtained from this project should be utilized to assist future readers with identifying and meeting the needs of their own communities.

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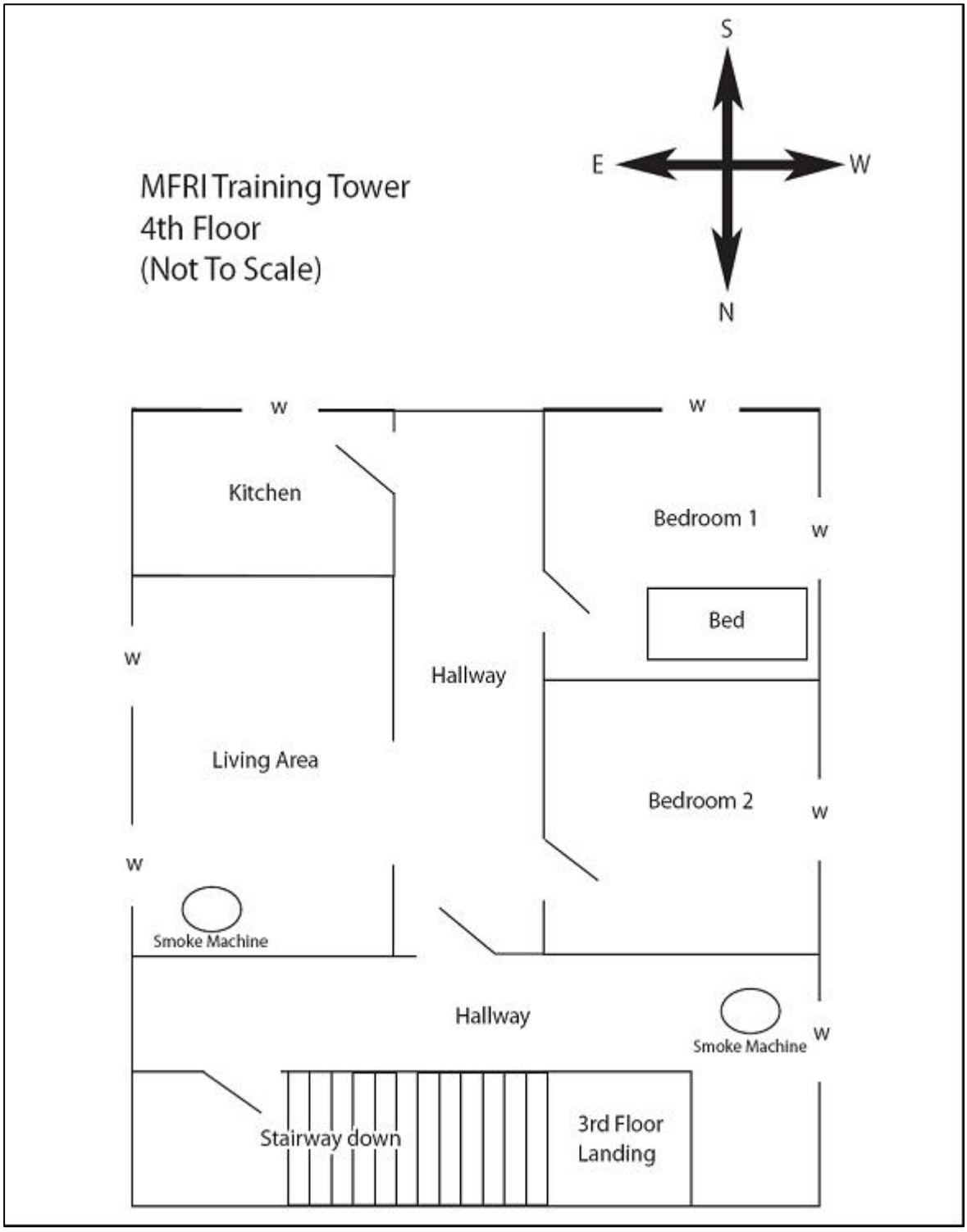
Appendix A

Research Dormitory Floor Plan



Appendix B

Institutional Review Board Application

UNIVERSITY OF MARYLAND, COLLEGE PARK
Institutional Review Board
Initial Application for Research Involving Human Subjects

Name of Principal Investigator (PI) or Project Faculty Advisor _____ **Tel. No** _____

Name of Co-Investigator (Co-PI) _____ **Tel. No** _____

E-Mail Address of PI _____ **E-Mail Address of** _____

Name and address of contact to receive approval documents _____

Name of Student Investigator _____ **Tel.** _____

E-Mail Address of Student Investigator _____@_____

Check here if this is a student master's thesis ☐ or a dissertation research project ☐

Department or Unit Administering the _____

Project Title _____

_____

Funding Agency:

ORAA Proposal ID Number:

Names of any additional Federal agencies providing funds or other support for this research project:

Target Population: The study population will include (Check all that apply):

☐ pregnant women ☐ neonates ☐ individuals with mental disabilities
☐ minors/children ☐ prisoners ☐ individuals with physical disabilities
☐ human fetuses ☐ students

Exempt or Nonexempt (Optional): You may recommend your research for exemption or nonexemption by checking the appropriate box below. For exempt recommendation, list the numbers for the exempt category(s) that apply. Refer to pages 6-7 of this document.

☐ **Exempt----List Exemption Category(s)** ***Or*** ☐ **Non-Exempt**

If exempt, briefly describe the reason(s) for exemption.

Date **Signature of Principal Investigator or Faculty Advisor**

Date **Signature of Student Investigator**

Date **REQUIRED** Departmental Signature
Name _____,
Title_____

(PLEASE NOTE: The Departmental signature block should not be signed by the investigator or the student investigator's advisor.)

For Internal Use Only (to be completed by the IRB Office) Application #:

Instructions for Completing the Application

The Departmental Signature block should be signed by the IRB Liaison or Alternate IRB Liaison unless there is a conflict of interest. If the Department or Unit does not have an IRB Liaison, the Department Head, Unit Head or Designee should sign the application.

Please provide the following information in a way that will be intelligible to non-specialists in your specific subject area.

1. **Abstract:** Provide an abstract (no more than 200 words) that describes the purpose of this research and summarizes the strategies used to protect human subjects. For HHS sponsored or funded research, you must submit a copy of your grant application for review.

2. **Subject Selection:**

   - **a.** Who will be the subjects? How will you recruit them? If you plan to advertise for subjects, please include a copy of the advertisement.
   - **b.** Will the subjects be selected for any specific characteristics (e.g., age, sex, race, ethnic origin, religion, or any social or economic qualifications)?
   - **c.** State why the selection will be made on the basis or bases given in 2(b).
   - **d.** How many subjects will you recruit?

3. **Procedures:** What precisely will be done to the subjects? Describe in detail your methods and procedures in terms of what will be done to subjects. How many subjects are being recruited? What is the total investment of time of the subjects? If subjects will complete surveys and/or other instruments on more than one occasion, state this in the procedures section. If you are using a questionnaire or handout, please include a copy within each set of application documents. If you are conducting a focus group, include a list of the questions for the focus group. If you plan to collect or study existing data, documents, records, pathological specimens or diagnostic specimens, state whether the sources are publicly available and if the information will be recorded in such a manner that subjects can be identified, directly or through identifiers linked to the subjects. If you are collecting or studying existing data, describe the dataset and list the data elements that you will extract from the dataset.

4. **Risks and Benefits:** Are there any risks to the subjects? If so, what are these risks including physical, psychological, social, legal and financial risks? Please do not describe the risk(s) as minimal. If there are known risks, please list them. If not, please state that there are no known risks. What are the benefits? If there are known risks associated with the subject's participation in the research, what potential benefits will accrue to justify taking these risks?

5. **Confidentiality:** Adequate provisions must be made to protect the privacy of subjects and to maintain the confidentiality of identifiable information. Explain how your procedures accomplish this objective, including such information as the means of data storage, data location and duration, description of persons with access to the data, and the method of destroying the data when completed. If the research involves audio taping, videotaping or digital recordings, state who will have access to the tapes or recordings, where the tapes or recordings will be kept, and state the final disposition of the tapes or recordings (i.e. Will the tapes or recordings be destroyed? If so, when will the tapes or recordings be destroyed?). Please note that as per the University of Maryland policy on records retention and disposal, all human subject files, including work done by faculty, staff, and students, must be retained for a period of no less than 10 years after the completion of the research and can then be destroyed. Human subject files include IRB applications, approval notices, consent forms, and other related documents. For more information on records retention, go to: http://www.dbs.umd.edu/records_forms/schedule.php (Faculty and Academic Records) or contact Michelle Solter Evers, Assistant to the Director of Business Services at 301.405.9277 or mevers@mercury.umd.edu.
6. **Information and Consent Forms:** State specifically what information will be provided to the subjects about the investigation. Is any of this information deceptive? State how the subjects' informed consent will be obtained. Will you obtain informed consent in a language other than English? If so, list the language(s) in which you will obtain informed consent. Provide consent forms in all languages that will be used. Refer to the attached consent form template, sample consent form and additional consent form guidance on pages 9 to 18. If a consent form has more than one page, please add a signature and date line and the number of pages (*e.g.*, "1 of 2," "2 of 2") to each page. Please allow a 2-inch bottom margin to accommodate the IRB approval stamp. If you plan to obtain consent over the telephone (e.g. consent for a telephone survey), include a copy of the consent script.
7. **Conflict of Interest:** Describe the potential conflict of interest, including how such a conflict would affect the level of risk to the study participants. Please consult the University of Maryland policy on conflict of interest as defined by the University of Maryland Policies and Procedures III-1.11and II-3.10. These may be viewed at: http://www.usmh.usmd.edu/Leadership/BoardOfRegents/Bylaws/SectionIII/III111.html. If there is no anticipated conflict of interest, please state "No conflict of interest." This section must be included in your application.
8. **HIPAA Compliance:** State whether you are using HIPAA protected health information (PHI). Currently, researchers employed by the University of Maryland Center or who are working within or under the auspices of the University Health Center are subject to specific HIPAA requirements regarding the creation, use, disclosure, or access of PHI. Please consult the University of Maryland's Summary of HIPAA's Impact on University Research. For more information on HIPAA, go to: http://www.hhs.gov/ocr/hipaa/ If you are not using HIPAA

protected health information, please state "Not Applicable." This section must be included in your application.

9. **Research Outside of the United States:** Provide responses to the following questions. Separate responses are required for each country where the research will be conducted. If you are not conducting research outside the U.S., please state "Not Applicable." This section must be included in your application.
   a) Did the investigator(s) previously conduct research in the country where the research will take place? Briefly describe the investigator's knowledge and experience working with the study population.
   b) Are there any regulations, rules or policies for human subjects research in the country where the research will take place? If so, please describe and explain how you will comply with the local human subject protection requirements. The United States Department of Health and Human Services, Office for Human Research Protections (OHRP) has an International Compilation of Human Subject Research Protections with a listing of the laws, regulations and guidelines of over 50 countries. This compilation can be accessed on the OHRP website: http://www.hhs.gov/ohrp/international/HSPCompilation.pdf
   c) Do you anticipate any risks to the research participants in the country where the research will take place, taking into account the population involved, the geographic location, and the culture? If so, please describe, including any physical, psychological, social, legal and financial risks. Do you anticipate that subjects who participate in this research will be placed at risk of criminal or civil liability? If so, please describe.

10. **Research Involving Prisoners:** Provide responses to the following additional IRB criteria for research involving prisoners. If you are not conducting research involving prisoners, please state "Not Applicable." This section must be included in your application.
   a) the research under review represents one of the categories of research permissible described below;
      i. study of the possible causes, effects, and processes of incarceration, and of criminal behavior, provided that the study presents no more than minimal risk and no more than inconvenience to the subjects;
      ii. study of prisons as institutional structures or of prisoners as incarcerated persons, provided that the study presents no more than minimal risk and no more than inconvenience to the subjects;
      iii. research on conditions particularly affecting prisoners as a class (for example, vaccine trials and other research on hepatitis which is much more prevalent in prisons than elsewhere; and research on social and psychological problems such as alcoholism, drug addiction, and sexual assaults); or
      iv. research on practices, both innovative and accepted, which have the intent and reasonable probability of improving the health or well-being of the subject.
   b) any possible advantages accruing to the prisoner through his or her participation in the research, when compared to the general living conditions,

medical care, quality of food, amenities and opportunity for earnings in the prison, are not of such a magnitude that his or her ability to weigh the risks of the research against the value of such advantages in the limited choice environment of the prison is impaired;

c) the risks involved in the research are commensurate with risks that would be accepted by nonprisoner volunteers;
d) procedures for the selection of subjects within the prison are fair to all prisoners and immune from arbitrary intervention by prison authorities or prisoners. Unless the principal investigator provides to the Board justification in writing for following some other procedures, control subjects must be selected randomly from the group of available prisoners who meet the characteristics needed for that particular research project;
e) the information is presented in language which is understandable to the subject population;
f) adequate assurance exists that parole boards will not take into account a prisoner's participation in the research in making decisions regarding parole, and each prisoner is clearly informed in advance that participation in the research will have no effect on his or her parole; and
g) if there is a need for follow-up examination or care of participants after the end of their participation, adequate provision has been made for such examination or care, taking into account the varying lengths of individual prisoners' sentences, and for informing participants of this fact.

SUPPORTING DOCUMENTS

Each copy of the application must include the IRB application cover sheet, the information required in items 1-10 above, and all relevant supporting documents including: consent forms, letters sent to recruit participants, questionnaires completed by participants, and any other material germane to human subjects review.

For research funded by the Department of Health and Human Services (DHHS), submit a copy of your HHS grant application. If there are discrepancies between the research proposed in your IRB application and your grant application, include a memo listing these discrepancies and the rationale for them.

NUMBER OF COPIES

Please send 1 original application including the signed cover sheet and 1 copy of the signed, original application unless your research requires full Board Review. For applications which will require review of the full Board, please submit 1 signed original application and seventeen (17) copies. Full Board reviews are required for initial applications involving greater than minimal risk to the subjects (i.e. more risk than subjects would generally encounter in their routine daily activities).
IRB Campus Mailing Address: 2100 Lee Building, Zip -5125.

Appendix C

Study Advertisement & Recruitment Flyer

MARYLAND FIRE and RESCUE INSTITUTE
MFRI

The University of Maryland Center for Firefighter Safety Research and Development is looking for UMD students to participate in a study of the impact of alcohol consumption on fire egress behavior. The study will take place on Sunday November 2nd and will last for approximately four hours. **Participants will be required to participate in a fire escape drill while under the influence of alcohol.** All study participants must be social drinkers at least 21 years of age but not greater than 26 years of age. All participants must complete a pre-participation health screening. Subjects will not be permitted to drive following the study. For more information and to sign up for the study, please contact 301-821-0367

Maryland Fire and Rescue Institute
University of Maryland

Presents

A Research Study on the Impact of Alcohol Consumption on Fire Egress Behavior

Date: Sunday, November 2, 2008

Time: 10:00 a.m. — 6:00 p.m.

Location: MFRI Headquarters
4500 Paint Branch Parkway
College Park, Maryland 20742

Presentation: The United States Fire Administration (USFA) has recorded that more than fifty percent of campus student fire fatality victims were under the influence of alcohol at the time of incident. Alcohol consumption often impairs perception and judgment and from this it can be assumed that alcohol impairment hampers fire evacuation efforts. However, there is no evidence to support that empirical data has been collected in a controlled environment to determine the impact of alcohol on fire egress behavior. This research study is designed to simulate the effect that alcohol consumption has on an individual when trying to escape a fire environment. **Participants will be required to participate in a fire escape drill while under the influence of alcohol.**

Sponsors: This program is being sponsored by the University of Maryland Center for Firefighter Safety Research & Development, the Prince George's County Professional Firefighters & Paramedics Association, University of Maryland Police Department, and the Prince George's County Fire & EMS Department.

Audience: All study participants must be social drinkers at least 21 years of age but not greater than 26 years of age. All participants must complete an on site pre-participation health screening. Subjects will not be permitted to drive following the study.

Registration: Registration is open to all persons who satisfy the above criteria, but will be limited to 30. Priority is given to University of Maryland students residing within close proximity to campus. If you have any questions or would like to register, contact Andrew Pantelis at akpantelis@co.pg.md.us

Appendix D

Pre-Participation Questionnaire

The Impact of Alcohol Consumption on Fire Egress Behavior

PREPARTICIPATION SCREENING QUESTIONNAIRE

ID Number: _____

Date: _____

Have you ever received any form of medical advice, treatment or medication for:

___ any heart-related condition including angina.
___ any blood circulatory disorder (cardiovascular condition) or stoke.
___ hypertension.
___ any diabetic condition.
___ any breathing condition including asthma.
___ cancer of any type.
___ any renal condition.
___ any mental illness including depression.
___ pancreatitis.
___ alcohol or illicit drug use.
___ any neurological deficit or disorder.
___ any musculoskeletal injury or disorder that currently limits mobility.

.

Have you ever experienced:

___ chest pain or discomfort during exertion.
___ unreasonable breathlessness.
___ dizziness, fainting or blackouts.
___ an adverse reaction to consuming alcoholic beverages.
___ feelings of claustrophobia.
___ feelings of nyctophobia. (fear of darkness)

Do you:

___ have a family history of alcoholism or illicit drug use.
___ take prescription medications.
___ believe that you are or could possibly be pregnant.

How often do you have a drink containing alcohol?

a. Never
b. Monthly or less
c. 2 to 4 times per month
d. 2 to 3 times per week
e. 4 or more times a week

How many drinks containing alcohol do you normally have on a typical day when you are drinking?

a. 1-2
b. 3-5
c. 6-8
d. 8-10
e. More than 10

Have you ever felt you needed to cut down on your drinking?

a. Yes
b. No

Have people annoyed you by criticizing your drinking?

a. Yes
b. No

Have you ever felt guilty about drinking?

a. Yes
b. No

Have you ever felt you needed a drink first thing in the morning to steady your nerves or get rid of a hangover?

a. Yes
b. No

Have you received a criminal violation related to alcohol consumption (DUI, DWI, public intoxication, etc.)?

a. Yes
b. No

Appendix E

Research Subject Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Project Title: **The Impact of Alcohol Consumption on Fire Egress Behavior – Page 1**

Why is this research being done? This is a research project being conducted by Andrew Pantelis and Angela Bennett at the University of Maryland, College Park. The study is being done to determine the impact of alcohol consumption on fire egress behavior (ability to remove oneself from a fire environment). Specifically the auditory response to a fire alarm and the time required to exit a simulated dormitory room in smoke conditions while under the influence of alcohol will be studied.

What will I be asked to do? The study will take place at the Maryland Fire and Rescue Institute at the University of Maryland College Park. Prior to participation you must complete a pre-screening questionnaire. This questionnaire is designed to identify pre-existing medical conditions that may make it unsafe for you to participate. The second part of the questionnaire focuses on alcohol use and includes an alcoholism screening tool. Female subjects must also demonstrate that they are not pregnant by taking a pregnancy test during the pre-screening process. Based on your responses on the pre-screening questionnaire and testing you may be deemed ineligible to participate in this study.

After completing all of the required screening, you will be asked to complete a fire escape drill from a simulated dormitory room. Prior to commencing the exercise, you will don a protective ensemble including a helmet with chin strap, eye protection, hand protection, and knee protection. You should be wearing comfortable clothing that allows for easy movement and does not present a trip hazard.

You will begin the drill in a supine position (lying on your back) in a fourth floor simulated dormitory bedroom. Lighting conditions will be minimal, temperature conditions will be established at average room temperature, and all surfaces will be dry and free of trip hazards. A series of fog machines will be utilized to introduce simulated smoke into the environment. A non-toxic water based fog fluid will be utilized to ensure that the environment does not pose any adverse respiratory or health effects.

Upon activation of an audible smoke alarm (approximately 85 decibels), you will be asked to get out of bed, crawl across the simulated dormitory room, descend the stairs to the third level via an interior enclosed stairwell, and report to a designated area on the third floor of the structure. You will then enter a rehabilitation area for a post-exercise medical evaluation, rehydration and a brief period of rest. This includes evaluation of including heart rate and rhythm, blood pressure, respiratory rate, lung sounds, and pulse oximetry. Any subject found to have an abnormal medical assessment or abnormal vital signs will not be permitted to continue with the exercise.

Following the period of rest, you will be asked to consume one alcoholic beverage. The volume of alcohol consumed will be proportionate to your total body weight as to ensure that you obtain a Blood Alcohol Level of approximately 0.03%. On average, this will equate to one 12 ounce beer for a 150 pound adult subject. University of Maryland police officers will administer a field sobriety breathalyzer examination to obtain blood alcohol data.

You will then be taken to the fourth floor simulated dormitory room and asked to complete the same fire escape drill described above. After this evolution you will return to the rehabilitation area for a post-exercise medical evaluation, rehydration and a brief period of rest. You will then be asked to consume an additional alcoholic beverage in order to elicit a Blood Alcohol Level of approximately 0.06%.
You will then be taken to the fourth floor simulated dormitory room and asked to repeat the fire escape drill. After this evolution you will return to the rehabilitation area for a post-exercise medical evaluation, rehydration and a brief period of rest. You will then be asked to consume an additional alcoholic beverage in order to elicit a Blood Alcohol Level of approximately 0.09%.

Project Title: **The Impact of Alcohol Consumption on Fire Egress Behavior – Page 2**

You will then be taken to the fourth floor simulated dormitory room and asked to repeat the fire escape drill. After this evolution you will return to the rehabilitation area for a post-exercise medical evaluation, rehydration and a brief period of rest. You will then be asked to consume an additional alcoholic beverage in order to elicit a Blood Alcohol Level of approximately 0.12%.

You will then be taken to the fourth floor simulated dormitory room and asked to repeat the fire escape drill. After this evolution you will return to the rehabilitation area for a post-exercise medical evaluation and rehydration. You will be required to remain in the rehabilitation area until your Blood Alcohol Level is less than 0.08%. You will then be transported home by a designated driver provided by the research team. It is estimated that the entire process will take approximately four hours, but detoxification time will vary based on your ability to metabolize alcohol.

What are the risks of this research? Alcohol is a central nervous system depressant, with a range of side effects. Initially, alcohol generally produces feelings of relaxation and euphoria; however, further consumption can lead to blurred vision and loss of motor coordination. In rare instances, after excessive consumption, unconsciousness may occur and extreme levels of intoxication can lead to alcohol poisoning and death.

The risk of serious health risks are reduced by the pre-participation screening process and the close monitoring of Blood Alcohol Level by the University of Maryland Police Department. The Blood Alcohol Levels elicited in this study will most likely result in feelings of euphoria or lethargy.

Euphoria (BAC = 0.03 to 0.12%).

- You may experience an overall improvement in mood and possible euphoria.
- You may become more self-confident or daring.
- You may experience lowered inhibitions and an increase in risk behavior.
- You may experience lowered reasoning ability and/or impaired judgment
- You may have trouble with fine motor movements

Lethargy (BAC = 0.09 to 0.25%)

- You may experience slowed reaction times and reflexes
- You may experience poor motor coordination
- You may experience blurred vision
- You may experience slurred speech.
- You may experience nausea and vomiting

There are no long-term effects associated with the quantity of alcohol that you will be asked to consume during this study.

Alcohol consumption can result in dehydration. This risk will be minimized by providing water and electrolyte fluids in the rehabilitation area. In addition, licensed paramedics will be on site with the ability to initiate intravenous fluid therapy if deemed necessary during the post-exercise medical evaluation.

There is also a risk of injury as a result of tripping or falling during the fire escape exercise. In the event of a trip or fall, the likelihood of injury will be minimized by the required personal protective equipment provided for your use. In addition, a safety officer will be positioned in front and behind you during the fire escape drill.

There are clear risks associated with driving while intoxicated. You will not be permitted to drive after consuming alcohol. You will be driven home after your Blood Alcohol Level is below 0.08% and cautioned against driving on your own after returning home.

Project Title: **The Impact of Alcohol Consumption on Fire Egress Behavior – Page 3**

What are the benefits of this research? As a result of your participation in this study you may obtain a greater appreciation for the impact of alcohol consumption on your ability to escape during a fire. Your participation in this study also allows the investigators to obtain empirical data on the impact of alcohol consumption on fire egress behavior and ultimately lead to the development of fire prevention and life safety tools.

Do I have to be in this research? Your decision to participate in this study is voluntary and you are free to ask any questions about this study before you decide whether or not to participate.

May I stop participating at any time? If you consent to participate, you are free to withdraw from participation at any time without penalty or coercion, or without any requirement to provide an explanation to anyone about your decision to withdraw. In addition, your refusal to participate will not involve a penalty or loss of benefit to which you would otherwise qualify.

What about confidentiality? We will do our best to keep your personal information confidential. To help protect your confidentiality, we will keep your confidential records in secure and private storage areas, use password protected computer files for all collected data, and use identification codes instead of your name on data files. If we write a report or article about this research project, your identity will be protected to the maximum extent possible. Any media recordings (video or still photo) will be maintained by the researchers and may be used for reporting purposes. Your information may be shared with representatives of the University of Maryland, College Park or Governmental authorities if you or someone else is in danger or if we are required to do so by law.

This research project involves taking photographs of you. These photographs may be used in the final report generated to illustrate the protocol or by authorized media outlets on the research site.. Only the investigators will have access to these photographs, which will be stored on the study computer. Consent to be photographed is not required to participate in the study.

___ I agree to be photographed during my participation in this study.

___ I do not agree to be photographed during my participation in this study.

Is any medical treatment available if I am injured? The University of Maryland does not provide any medical, hospitalization or other insurance for you in this research study, nor will the University of Maryland provide any medical treatment or compensation for any injury sustained as a result of participation in this research study, except as required by law.

Maryland licensed Emergency Medical Technician – Paramedics will be on the research site throughout the duration of exercise and will treat any illnesses or injuries that may be sustained to the level of their training and transport to the closest appropriate medical facility if necessary.

What if I have questions? This research is being conducted by Andrew Pantelis and Angela Bennett at the Maryland Fire and Rescue Institute, respectively, at the University of Maryland, College Park. If you have any questions about the research study itself, please contact Angela Bennett at 301-226.9923 or Andrew Pantelis at 301-674-3448. If you have questions about your rights as a research participant or wish to report a research-related injury, please contact: **Institutional Review Board Office, University of Maryland, College Park, Maryland, 20742; (e-mail) irb@deans.umd.edu; (telephone) 301-405-0678.** This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.

Project Title: **The Impact of Alcohol Consumption on Fire Egress Behavior – Page 4**

Statement of Age of Participant and Consent. Your signature indicates that you are at least 21 years of age, the research has been explained to you, your questions have been fully answered, and you freely and voluntarily choose to participate in this research project. In addition you agree not to operate an automobile or other heavy machinery for a period of eight (8) hours following your return home after participating in the study.

Printed Name of Participant: _____

Signature of Participant: _____ **Date:** _____

Appendix F

CAGE Questionnaire

Please check the one response to each item that best describes how you have felt and behaved over your whole life.

1. Have you ever felt you should *cut* down on your drinking?

☐ Yes

☐ No

2. Have people *annoyed* you by criticizing your drinking?

☐ Yes

☐ No

3. Have you ever felt bad or *guilty* about your drinking?

☐ Yes

☐ No

4. Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover (*eye*-opener)?

☐ Yes

☐ No

Appendix G

National Highway Transportation Safety Administration (NHTSA)

Alcohol Impairment Chart

For Males

Body weight (lbs)	1 drink	2 drinks	3 drinks	4 drinks	5 drinks	6 drinks	7 drinks	8 drinks	9 drinks	10 drinks
100	.043	.087	.130	.174	.217	.261	.304	.348	.391	.435
125	.034	.069	.103	.139	.173	.209	.242	.278	.312	.346
150	.029	.058	.087	.116	.145	.174	.203	.232	.261	.290
175	.025	.050	.075	.100	.125	.150	.175	.200	.225	.250
200	.022	.043	.065	.087	.108	.130	.152	.174	.195	.217
225	.019	.039	.058	.078	.097	.117	.136	.156	.175	.198
250	.017	.035	.052	.070	.087	.105	.122	.139	.156	.173

For Females

Body weight (lbs)	1 drink	2 drinks	3 drinks	4 drinks	5 drinks	6 drinks	7 drinks	8 drinks	9 drinks	10 drinks
100	.050	.101	.152	.203	.253	.234	.355	.406	.456	.507
125	.040	.080	.120	.162	.202	.244	.282	.324	.364	.404
150	.034	.068	.101.	135.	169	.203	.237	.271	.304	.338
175	.029	.058	.087	.117	.146	.175	.204	.233	.262	.292
200	.026	.050	.078	.101	.126	.152	.177	.203	.227	.253
225	.022	.045	.068	.091	.113	.136	.159	.182	.207	.227
250	.020	.041	.061	.082	.010	.122	.142	.162	.182	.202

The Time Factor

Hours since first drink	Subtract this from BAC
1	.015
2	.030
3	.045
4	.060
5	.075
6	.090