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Developing a Firefighter Emergency Incident Rehabilitation Guideline for the Seminole County

First Response System

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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, expression, or writings of another.

Signed: _____

Abstract

The Seminole County Fire Department operates under an automatic aid first response system with five city fire departments and one airport fire department. All fire department agencies in Seminole County operate from the Seminole County and Cities Incident Management System manual. The manual is compliant with the National Incident Management System's Incident Command System principals and is considered the standard operating procedures. The manual does not contain a comprehensive guideline for firefighter emergency incident rehabilitation. Without a comprehensive guideline, inconsistencies have occurred in the establishment and implementation of a firefighter emergency incident rehabilitation operation.

The purpose of this research was to develop guidelines for incident commanders as well as division or group supervisors to follow in order to consistently implement and enforce an adequate firefighter rehabilitation program during emergency incidents. Action research methodology was conducted in an effort to answer the following research questions and produce a guideline to be used for firefighter rehabilitation at emergency incidents. What recommendations and guidelines exist for the development of a firefighter emergency incident rehabilitation program? What is the recommended criterion for establishing firefighter rehabilitation on emergency incidents? What functions are associated with a firefighter emergency incident rehabilitation program? What are the current inconsistencies associated with firefighter rehabilitation establishment and delivery on emergency incidents? What are the benefits and consequences of a firefighter emergency incident rehabilitation program?

Procedures for this research project included a four month personal observation on significant emergency incidents. The purpose of the observation was to determine the consistency of implementation of firefighter rehabilitation on emergency incidents. A total of 68

incidents were observed and analyzed and the data obtained concluded that without a comprehensive guideline for firefighter rehabilitation, inconsistencies occurred on not only the establishment of firefighter emergency incident rehabilitation operations, but the functions of rehabilitation as well. The inconsistencies in the establishment of a rehabilitation operation occurred regardless of time, complexity, intensity, or climatic conditions such as extreme hot or cold weather.

A comprehensive rehabilitation guideline was developed as a result of the research. A review of other fire department agencies' rehabilitation guidelines were reviewed in an effort to create a well rounded procedure. Further research on the implementation of the comprehensive firefighter emergency incident rehabilitation program will need to be conducted.

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Introduction

The Seminole County Fire Department (SCFD) has been proactive in implementing a comprehensive firefighter wellness-fitness initiative program, which includes firefighter fit for duty standards. The enforcement of the program prompted the development of a medical monitoring guideline to be used at all firefighter training exercises requiring physical exertion. Though initially it received some negative response, firefighter rehabilitation medical monitoring during training exercises has become the norm for the SCFD. With emphasis placed on rehabilitation and medical monitoring at training exercises, the importance of this component on emergency incidents has been grossly underestimated. Inconsistencies in the implementation and delivery of firefighter emergency incident rehabilitation, by the incident commander and his/her designees, has the potential to negatively affect the firefighter's overall health and safety. The problem is the fire departments that make up the Seminole County first response system lack a clearly defined guideline on when and how to implement firefighter rehabilitation during emergency incidents. This could ultimately result in firefighter injury or death.

The purpose of this research was to develop guidelines for incident commanders as well as division or group supervisors to follow in order to consistently implement and enforce an adequate firefighter rehabilitation program during emergency incidents. Action research methodology was conducted in an effort to answer the following research questions and produce a guideline to be used for firefighter rehabilitation at emergency incidents. What recommendations and guidelines exist for the development of a firefighter emergency incident rehabilitation program? What is the recommended criterion for establishing firefighter

rehabilitation on emergency incidents? What functions are associated with a firefighter emergency incident rehabilitation program? What are the current inconsistencies associated with firefighter rehabilitation establishment and delivery on emergency incidents? What are the benefits and consequences of a firefighter emergency incident rehabilitation program?

Background and Significance

Seminole County consists of an area that is 345 square miles (Division of Emergency Management [DEM], 2009). The SCFD is one of the largest fire departments in Central Florida and operates emergency medical services (EMS) and fire resources from 18 stations located throughout the county in conjunction with five city fire departments and one airport fire department under a first response automatic aid system. Each city located in Seminole County along with Volusia and Orange Counties work together under the first response system concept in order to ensure the closest unit arrives to the scene of an emergency incident regardless of their jurisdiction. This system provides prompt arrival of units as well as efficient resource allocation (Seminole County Fire Department [SCFD], 2009).

In order to prevent emergency scene dysfunction with a variety of agencies responding together, the Incident Management System (IMS) manual was created. This was a joint effort between SCFD and the six fire departments within the county as a means to provide a standard operational approach to any type of emergency incident (Seminole County and Cities [SCC], 2002). The SCC IMS manual complies with the Homeland Security Presidential Directives issued by President George W. Bush, which includes the use of the National Incident Management System (NIMS). NIMS is a national framework enabling all governmental and nongovernmental organizations to work together on any type of incident. NIMS mandates the use of the Incident Command System (ICS), which provides a national systematic response

approach to any type of incident no matter the location or size (Federal Emergency Management Agency [FEMA], 2008). The SCC IMS manual includes response procedures for incidents, ICS position duties and responsibilities, and forms to be used on incident scenes. Information regarding firefighter emergency incident rehabilitation was briefly included in the manual in the area of rehabilitation group supervisor's duties and responsibilities. This manual did not contain information regarding guidelines for establishing and delivering firefighter rehabilitation during emergency incidents. Information pertaining to the activation of a rehabilitation group was vague and stated, "Activation: Any long-term incident or incidents in adverse weather conditions, where crew members are in need of replenishment of fluids, monitoring of vital signs, or rest periods" (Seminole County and Cities [SCC], 2002, 2.16). Implementation of an incident rehabilitation group was left to the discretion of each incident commander and has resulted in inconsistencies in initial establishment, duties, responsibilities, accountability, and procedures for all agencies involved. These inconsistencies have led to an inadequacy for the health and wellness of the firefighters. This was evident on one emergency incident where a SCFD firefighter complained of weakness and dehydration after working a structure fire during the second half of a 48-hour shift. He was given fluids intravenously, released from the rehabilitation area, and continued to work on the fire scene. No medical evaluation documentation was completed. Most often, rehabilitation consist of drinking water while sitting on the tailboard of the fire engine because no formal rehabilitation area was established. This has resulted in no medical assessment of the firefighters prior to releasing them from the scene. Though all the agencies working within the automatic aid agreement in Seminole County provide EMS under the same protocols and medical director, the inconsistencies in firefighter rehabilitation medical evaluation and treatment still exist.

In 2005, the SCFD experienced its' first line of duty death. The loss of a lieutenant with 20 years of experience in the fire service was a wakeup call for the SCFD to implement a firefighter wellness-fitness initiative program. Though the lieutenant died shortly after participating in a physically demanding training exercise, it was later noted he had an underlying cardiac condition. This condition was not detected during the pre and post vital sign assessment, which was required of all participants in the training exercise. Because the training exercise consisted of a physically demanding air consumption and endurance exercise, it was suggested, by a lieutenant with the training section, that a pre and post vital sign assessment of each participant be required. This was the first time in SCFD history where the mandatory assessment and recording of vital signs prior to a training exercise was required. Recommendations after the firefighter fatality investigation from the National Institute for Occupational Safety and Health included the implementation of a comprehensive rehabilitation program during training exercises and the implementation of a mandatory wellness and fitness program (National Institute for Occupational Safety and Health [NIOSH], 2006). For the next three years, after the line of duty death, recording of pre and post vital signs during training exercises remained inconsistent and sometimes did not occur.

The SCFD Wellness-Fitness Initiative was implemented February 13, 2007. With this initiative also came the implementation of the Fire Service Joint Labor Management's Incumbent Physical Ability Test (IPAT). The objective of the IPAT is to evaluate a firefighter's ability to perform physically demanding firefighting tasks (Seminole County Fire Department Training Standards [SCFDTS], 2007). The procedures for the IPAT included pre and post vital sign assessment as well as successful completion of nine firefighter related tasks. Parameters for pre and post vital sign assessments were taken from the Fire Service Joint Labor Management's

guidelines (2007). All firefighters not meeting the vital sign criteria of normal limits were placed on restricted duty status and evaluated by the county physician. All firefighters unable to successfully complete the nine-station evaluation were also placed on restricted duty status and remediated by a peer fitness trainer until successful completion could be achieved.

The firefighter fatality, in 2005, improved the way SCFD delivered training. By 2008, a guideline for vital sign assessments for training was established. Vital sign parameters were established by utilizing information from the Fire Service Joint Labor Management Wellness-Fitness Initiative and National Fire Protection Association (NFPA) 1582, 1583, and 1584 (Seminole County Fire Department [SCFD], 2008). This program received some negative reaction from the SCFD firefighters, as some of the personnel did not meet the vital sign requirements prior to performing the training evolutions. These firefighters were placed on restricted duty status, evaluated by a physician, and returned to regular duty status following their physician's recommendations. Though this guideline was implemented and mandatory for all physical demanding training exercises, implementation of a formal rehabilitation program including medical evaluations on emergency incidents was not identified as a priority. Establishing a rehabilitation group on emergency incidents remained inconsistent and varied from incident commander to fire department agency.

On larger emergency incidents, the assistance of the Seminole County Community Emergency Response Team (CERT) would be requested. CERT members are Seminole County volunteers who dedicate their time and efforts to assist the Seminole County Department of Public Safety during major emergencies (Seminole County Department of Public Safety [SCDPS], 2008). The Seminole County CERT took on an additional role by providing rehabilitation services to the firefighters within Seminole County when requested on emergency

incidents. CERT services included providing cold water and electrolyte replacement drinks, snacks, cool wet towels, chairs, tents, etc. Delayed responses for CERT activation occurs because members respond from their homes. Though this service is invaluable to all the firefighters of Seminole County, no medical evaluations or treatment is performed or recorded and no personnel accountability is enforced. Additionally, no fire department personnel have been assigned to ensure these functions are carried out.

A tremendous effort has been made to ensure the health and safety of SCFD firefighters during training exercises by providing a pre and post vital sign assessments and hydration as part of the training rehabilitation program. SCFD now implements vital sign assessments during training exercises to any person participating in department training not just SCFD personnel. However, the lack of a comprehensive rehabilitation program has resulted in serious inconsistencies in providing the same health and safety measures to firefighters on emergency incidents. Recommendations from the United States Fire Administration (USFA), Occupational Safety and Health Administration (OSHA), the International Association of Fire Chiefs (IAFC), NFPA, and other respected agencies include the development of a comprehensive firefighter emergency incident rehabilitation program. Implementation of such a program into the SCC IMS will assist in ensuring the safety and wellbeing of all firefighters working in Seminole County. The Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM) course included the use of ICS, risk assessment, emergency operations, legal mandates, and incident documentation (USFA, 2009). The research problem identified affects not only the SCFD firefighters, but all the firefighters working under the IMS. This relates to the EAFSOEM course as it is part of the ICS, it is an emerging issue, and has the ability to impact the fire department's overall operational readiness. Additionally, this research project relates to

the United States Fire Administrations operational objective to reduce the loss of life from fire of firefighters as well as respond appropriately in a timely manner to emerging issues (USFA, 2008, II-2).

Literature Review

An extensive literature review was completed which included books, magazines, journal articles and internet articles, NIOSH firefighter fatality reports, and other fire department agencies' policies on firefighter rehabilitation programs. The literature review began with the National Fire Protection Association (NFPA) 1584 Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises. NFPA stated that rehabilitation is an essential part of the overall health and wellness of firefighters and was important enough to address the subject in a standard instead of a recommendation (2007). The standard established the minimum criteria for developing and implementing a rehabilitation program within an incident management system. The standard includes information on preparedness, training and recognition, characteristics of a rehabilitation area, rehabilitation operations, and post-incident rehabilitation (2007). According to NFPA, "Rehabilitation operations shall commence whenever emergency operations or training exercises pose a safety or health risk to members" (2007, 6.1.1). There are times when firefighter rehabilitation occurs without a formal function area. This is done because firefighters take the initiative to do so, or the need for a formal rehabilitation area was overlooked by the incident commander. Considerations for establishing a formal rehabilitation area includes extended use of personal protective equipment, time on the incident, weather, mental or physical stress placed on a firefighter, use of a single 30-minute self contained breathing apparatus (SCBA) cylinder (2007). According to NFPA, it is mandatory to assess the work-to-rest ratios of the firefighters on scene. Additionally, documentation is

required for all firefighters entering and leaving the rehabilitation area, medical monitoring, and medical treatment (2007). NFPA (2007) recommends a copy of the medical care report be placed in the firefighter's health record.

In an effort to reduce firefighter fatalities, the USFA teamed with the International Association of Firefighters (IAFF) to provide a comprehensive report on firefighter rehabilitation (USFA, 2008). USFA, 2008, concluded that stress and overexertion plays a major role in firefighter injuries and illnesses. Even firefighters in peak physical condition can be at risk for thermal illness. USFA stated, "Again, it is clear that the fireground is the most likely place for a cardiac event to occur" (2008, 6). USFA suggested that effective firefighter rehabilitation on emergency incidents can assist in the overall safety of firefighters. Though ensuring the health and safety of firefighters on emergency incidents should be an ethical decision by performing rehabilitation efforts, many laws and standards have been implemented to provide guidance to fire departments personnel when developing procedures (2008).

USFA indicated heat stress and the factors that contribute to heat gain and loss during firefighting activities can pose a significant risk to firefighters. Structural firefighter protective gear consists of several layers which protect them from the physical hazards of the job. USFA explains, "Firefighter protective ensembles significantly impact the normal mechanisms of body heat loss that occur primarily through conduction and evaporation of sweat, given the encapsulation or near encapsulation of the firefighter's body" (2008, 28). USFA also concluded if heat remains inside the firefighter's gear, their core temperatures can reach dangerous levels. Therefore, on scene work rotations and limiting extended on scene times, and providing effective firefighter rehabilitation will assist with the overall health and safety of personnel. Ross, McBride, & Tracy (2004), explained that even moderate work in firefighting protective gear

creates metabolic heat, which is not easily dissipated. Because of the firefighter's moderate to heavy workloads, muscles require more oxygen causing vasodilatation. Coupled with the buildup of body heat and profuse sweating, an excess of strain on the cardiovascular system occurs (2004). A firefighter will lose a tremendous amount of water in a short period while fighting fire and this will affect their work performance and mental alertness. As firefighters sweat, they lose electrolytes such as potassium and sodium (Williams, 2006).

The State of Florida does not typically deal with the effects of ice and snow associated with cold, harsh winters. Periodically, freezing temperatures can take its toll on firefighters and citizens not acclimated to these types of conditions. Wind is a factor during Florida winter season. USFA concludes wind increases the transfer of heat off the firefighter's body and they lose heat faster than the actual temperature without the wind. A wind chill index was included in the book as well as the physiological responses to cold weather. The body burns more calories in cold weather than in warm or hot weather. This is due to the extra energy it takes the body to maintain a normal core temperature (2008).

Criteria used to establish a rehabilitation operation on emergency incidents was consistent throughout the literature reviewed. This criterion offers guidelines pertaining to when a formal rehabilitation group should be established and when firefighters should be required to go. Work to rest ratios are formulated in accordance to SCBA use as well as intense work using firefighter protective gear. USFA (2008) and NFPA (2007) both concluded that firefighters should report to the rehabilitation group if they use two 30-minute rated SCBA air cylinders or one 45 or 60-minute cylinder. Additionally, firefighters who are involved in strenuous and intense work for more than 40 minutes without using the SCBA will also report to the rehabilitation group. A review of the International Association of Fire Chiefs (IAFC) Guide for

Best Practices indicated that personnel should report to a rehabilitation group following the use of one 30-minute SCBA cylinder or at the end of a 20-minute work cycle (2009). USFA suggest that if the incident can be mitigated with the use of only one SCBA cylinder, a formal rehabilitation operation may not need to be established; however, a rest period is required and fluid replacement is still required (2008).

According to NFPA, a 10- minute rest period will be given to firefighters first entering into a rehabilitation sector. A 20- minute rest period will be given to firefighters who utilize two 30 minute SCBA cylinder or one 45 or 60 minute cylinder. The 20 minute rest period also applies to firefighters who perform strenuous or intense work for more than 40 minutes (2008). USFA (2008) also referenced the utilization of a rehabilitation area for fires in high rise buildings, hazardous material incidents, wildland fires, and urban search and rescue incidents. A heat stress index table is also referenced indicating that thermal stress affect firefighters when the temperature, humidity, and firefighter protective gear impact their core temperatures giving them the potential to reach dangerous levels. NFPA does not make recommendation to a specific heat index as an indicator to establish a formal rehabilitation sector at emergency incidents (2007). The need to establish a temperature benchmark for the formal initiation of a rehabilitation sector needs to be established by each fire department (USFA, 2008). Augustine, 2007, stated, “As a department develops functional rehab procedures, it must cover time, temperature and stuff falling out of the sky. With ongoing firefighter safety as the goal, the elements are selected to match needs” (Augustine, 2007, 2).

The rehabilitation section also has its’ place in the IMS. Depending on the size and complexity of an incident, the rehabilitation section could be assigned to the IC, the operations chief, or a logistic chief. The purpose of a rehabilitation group supervisor is to

provide accountability of assigned firefighters in order to maintain span of control (2008).

Recommendations from NFPA 1584 include a minimum of a medical and treatment area, fluids and food, climate relief, rest and recovery area, and accountability of firefighters (NFPA, 2008).

According to USFA, the five rehabilitation needs were broken down into seven functions that include physical assessment, revitalization, medical evaluation and treatment, continual monitoring, transportation, initial critical incident stress assessment and support, reassignment (2008).

Choosing a location for rehabilitation operation can be quite challenging. Depending on the complexity of the IMS, rehabilitation functions should be established far enough away from the incident scene so that firefighters can de-stress and rest. However, it should be easily assessable to the firefighters. Suggestions from USFA include locating near a staging or logistics area for easy access to supplies and/or equipment. Considerations must be made to the number of firefighters at the incident, time of the incident, climatic conditions, and how long the incident is anticipated to last (2008). Accountability systems should be used at all emergency incidents. There are many types of accountability systems that include passport systems, tags, bar coding systems, and possibly global positioning systems (2008). Personnel entering the rehabilitation area must report to a rehabilitation group supervisor and an accountability entry must be made and maintained. This is done due to the fact that a harmful event could occur at the emergency incident and an accurate accountability of personnel in the rehabilitation area will reduce the need to search and/or rescue them (2008).

Lindsey, 2009, noted that rehabilitation components should include food and fluid replacement. Hydration, electrolyte replacement and calorie replacement are all part of the

revitalization process of a rehabilitation operation (Bledsoe, 2009). Firefighters need simple sugars for energy when overworking their bodies. Verfuss stated,

The main point is that we are losing fluid volume in the blood, which inhibits our cooling. By replacing the water lost from the blood, we are replacing that cooling capacity and are also making it easier for the body to maintain blood pressure (2004, 4).

Firefighters may burn up to 600 calories per hour, of which at least 100 grams of carbohydrates are lost. Fitness waters cannot provide the calorie and carbohydrate intake that firefighters need after strenuous activity (2004). Agencies have different policies concerning food provisions. Suggestions from USFA included providing food to firefighters if the incident duration was more than 2 hours (2008). NFPA stated water is appropriate when firefighters are eating a meal. However, if they are involved in strenuous activity for more than one hour, the use of a drink with calorie and electrolyte replacement should be used (2007).

NFPA 1584 included a list of recommended resources that could be utilized at the rehabilitation area. This included fans, blowers, blankets, portable heaters, lighting, generators, misting/cooling equipment, potable water, large clock, logbook or forms, portable toilets, food, trash receptacles, and portable shelters (2008). Because heat stress is one of the contributing factors in firefighter injuries and deaths, a rehabilitation chair has become an effective way to actively cool firefighter's core temperature (Laquer, 2008). Active cooling is a process used to reduce the body's core temperature by using misting fans, forearm immersion, ice, or other external devices (Bledsoe, 2009). Negative results will occur if the IC leaves the decision to enter the rehabilitation group up to the individual firefighters (USFA, 2009).

There are many variables that add to the overall health and wellbeing of a firefighter on an emergency incident. It is unknown to the IC or rehabilitation group supervisor if the

firefighters, on scene, ate prior to responding or hydrated properly before arriving for duty (Augustine, 2007). New equipment being tested on firefighters is the hydration sensor. The sensor is a handheld device that can determine the hydration level of a person by sampling their saliva (Thompson, 2008).

Additionally, a thermometer pill was developed by the National Aeronautics and Space Administration (NASA) in an effort to reduce heat related illnesses and injury in astronauts. The technology found its way to civilian use as professional athletes utilize the pill to monitor core temperatures and heart rates in real time (NASA, unknown). Columbia Broadcasting System reported the pill cost an average of 40 dollars per pill and can take from two to five hours to receive transmissions. The pills are expelled through the gastrointestinal tract (Columbia Broadcasting System [CBS], 2009).

USFA, 2008, stated firefighters should receive an initial assessment upon entering the rehabilitation group. This medical evaluation should consist of a rapid visual assessment followed by the assessment of vital signs. Firefighters who require treatment based on this initial assessment should be sent to a treatment unit to stabilize or correct the problem. Firefighters in the treatment area may require transportation to an emergency department. Bledsoe, 2009, states, “Unlike medical monitoring, emergency medical treatment is provided according to local EMS triage, treatment, and transport protocols. While protocols may be specific to scene rehab operations, they are developed and implemented by the local or regional EMS medical director, often in concert with fire service physicians” (12).

One of the most important functions of a rehabilitation group is medically monitoring the firefighters (Lindsey, 2009). Lindsey stated, “Rest and relaxation are great, but it is critical to monitor the well-being of the personnel at the incident scene” (2009, 1). He explains that

firefighters must have a clear understanding of what medical monitoring consists of and the procedures that must occur when abnormal findings are noted. Jaslow, 2008, suggested that vital sign assessment should be delayed at the rehabilitation group if personnel have just completed a task requiring physical exertion. This is the body's response for an increased energy need. Jaslow stated, "What is abnormal is if these vital signs do not return to what we consider normal after a period of rest, hydration and release of heat stress, which is usually accomplished by shedding PPE once it is safe to do so" (Jaslow, 2008, 2). The term PPE refers to personal protective equipment. Maggiore stated the trend in firefighter deaths occurred during or immediately after incidents that required strenuous workloads (2008). NIOSH, 2008, recommends all firefighter have their vital signs rechecked prior to being released from a rehabilitation group.

The treatment of firefighters in a rehabilitation group requires personnel trained in departmental operational procedures. Maggiore, 2008, stated, "If a fire department doesn't have EMS, it's now required to develop mutual aid agreements with EMS agencies for provision of on-scene rehab" (2). She also stated, "EMS medical directors should outline medical protocols that address when firefighters should be transported to a hospital. Vital sign parameters should be clearly outlined" (2). Jaslow stated there is no literature that clearly defines when a firefighter should be transported to an emergency department because their blood pressure is elevated (2008).

Several articles were reviewed concerning firefighter's exposure to hydrogen cyanide. Medical monitoring should include documentation on chief complaints of headaches, dizziness and achiness. Rochford indicated symptoms like these use to be typical after firefighting activities (2008). However, cyanide poisoning also presents with the same type of symptoms

(Rochford, 2008). Prehospital management of cyanide poisoning includes removing the firefighter from the cyanide source, supplemental oxygen, cardiopulmonary resuscitation, and utilization of a new cyanide antidote called hydroxocobalamin. The antidote neutralizes the cyanide in the form of vitamin B12 (Rochford, 2008). “The primary concern regarding cyanide is its ability to cause fatal health issues with firefighters and the inability or unavailability of assessing for the problem” (Lee, 2009, p.6). Milkovits, 2006, explained how a Rhode Island firefighter collapsed at a fire scene while pumping the fire engine. He had worked a previous structure fire the same night in which he performed firefighting duties inside the structure. He and other firefighters were diagnosed with high levels of cyanide in their bloodstream (2006).

Documentation is another aspect of a rehabilitation group. Lindsey stated, “Medical monitoring should be well documented. Any findings should be listed on the form and referred to if the individual experiences any further signs or symptoms” (2009, 6). Accurate recording keeping can save lives (2009).

Lindsey, 2009, concludes that rehabilitation is the key to firefighter’s health and safety. Fire Chiefs have a legal obligation to provide the necessary resources for firefighters to perform safely at incidents (2009). He stated, “A lawsuit relating to rehab mostly likely would allege deprivation of rights under Section 42 U.S.C. 1983 of the Civil Right Act, claiming that the fire department failed to implement improvements identified in prior incidents” (Lindsey, 2009, 37). NIOSH, 2007, describes incident scene rehabilitation as a place where firefighters can remove their gear, replenish with food and water, and be medically monitored. Recommendations on when to establish a rehabilitation group includes, “While the fire at this incident was considered a routine residential fire, fire fighters performed heavy physical exertion while effecting fire suppression actives during elevated temperature and humidity” (NIOSH, 2007, 13. 6).

The literature review revealed copious amounts of information on the subject of firefighter rehabilitation. Recommendations from well-respected agencies throughout the United States produced sufficient information in order to develop a rehabilitation procedure for the Seminole County and Cities Incident Management System. Suggestions for when to establish an incident rehabilitation operation included time of day, temperature, climate, and length of the incident were noted. However, NFPA 1584 indicated it was up to the incident commander's discretion. NIOSH, 2007, stated, "The Incident Commander should consider the circumstance of each incident in determining the need for rehabilitation" (6).

Procedures

The use of descriptive and action research was used to answer the research questions in an effort to develop an emergency incident rehabilitant guideline within the Seminole County and Cities Incident Management System. In order to effectively develop a rehabilitation program, a needs assessment consisting of significant emergency incident observations was conducted. These observations took place from May 2009, through August 2009, and consisted of an emergency incident observation worksheet, utilization of the SCFD special incident reporting program, and a SCFD software program called Stencil. Stencil is a voice recording and retrieval system that is used by the Seminole County Communications Center. It allows authorized users to play back radio communications from emergency calls (Stencil Corporation, unknown). The SCFD special incident reporting program was developed as a means to effectively communicate pertinent information from significant alarms amongst command and general staff officers. It was developed by the Seminole County Information Technologies Department and implemented by the SCFD through the use of the intranet and email systems (SCFD, 2009). Information regarding implementation and delivery of firefighter rehabilitation

on emergency incidents that occurred after normal working hours were obtained by utilization of the Special Incident Program and the Stancil Program. Once a special incident form was received, Stancil was used to play back the incident radio communications to determine if a rehabilitation group was established. Often, a follow up phone call was performed to the incident commander to determine how much, if any, rehabilitation functions were delivered. The incident observation form was then completed. The incident observation form, Appendix A, consisted of incident questions such as how long crews were on scene, how many apparatus and agencies responded, time and temperature, was a rehabilitation group initiated, what functions did the rehabilitation group perform, were personnel accounted for in the rehabilitation group, were medical evaluations performed and documented, and what rehabilitation resources were used.

The observation was conducted over a four month period, which happened to be during the extremely hot months in Florida. The specific time of the observation was chosen only due to the 6 month period given to complete the research project by Executive Fire Officer Program students.

An extensive internet search of other agency's rehabilitation procedures was performed in an effort to collect data for the development of a comprehensive rehabilitation program. The collection of rehabilitation procedure data was compiled on a form, Appendix B, and information utilized for the rehabilitation procedure. Additionally, information from NFPA, USFA, and IAFC rehabilitation procedures was utilized in an effort to include all components of a rehabilitation program. A separate form was used to collect information pertaining to vital sign assessment guidelines. This form is located on Appendix D.

NIOSH firefighter fatality reports were also reviewed for all cardiac related deaths. This was done in an effort to compile and compare NIOSH recommendations that would prevent similar incidents. Recommendations such as firefighter annual medical evaluations and clearance to wear SCBA, annual physical performance assessments, use of a physician knowledgeable in the demands of firefighting, and development of a comprehensive wellness and fitness program were repetitive. A list of questions was developed from the NIOSH recommendations and sent to the five neighboring cities and airport fire department in Seminole County. This was done in order to acquire pertinent information on each department's stance on firefighter health and wellness. Questions were: 1) Does your fire department implement a formal health and wellness program? 2) If yes, does this program include a medical evaluation from a physician knowledgeable in the demands of firefighting? 3) If yes to question 1, does your department implement annual fitness assessments? 4) Does your fire department have any fit for duty requirements? If yes, explain. 5) What procedures are in place when a firefighter is injured while on duty? 6) What procedures are in place to ensure firefighters receive emergency incident rehabilitation? 7) If a rehabilitation operation is established, are medical evaluations part of the rehabilitation operations? 8) Does your department have any specialized equipment that could be utilized in an emergency incident rehabilitation program? 9) What is the rated duration of the SCBA air cylinders used by your department?

Results

The purpose of this research was to identify a need for a comprehensive firefighter emergency incident rehabilitation guideline and development of this guideline for incident commanders and division or group supervisors to follow in order to ensure consistency. The first research question asked what recommendations and/or guidelines exist for the development of a

firefighter emergency incident rehabilitation program. The literature review revealed firefighter rehabilitation has been a topic for many years. There was an abundance of journal articles and internet references in regards to firefighter rehabilitation. The most comprehensive documents included NFPA 1584 Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises, the USFA Emergency Incident Rehabilitation book, and the IAFC A Guide for Best Practices An Introduction to NFPA 1584. All three documents contained sufficient information pertaining to firefighter rehabilitation. The information obtained was used to answer research questions pertaining to establishment criteria and functions of a rehabilitation group. Additionally, NIOSH firefighter fatality reports were pulled from the internet and analyzed for information pertaining to firefighter rehabilitation. Documentation stated the development of a firefighter emergency rehabilitation program was found in many of the fatality reports in which the firefighter's cause of death was a result of cardiac related issues (NIOSH, 2008).

What is the recommendation criterion for establishing firefighter rehabilitation on emergency incidents? NFPA, 2007, stated firefighters who utilized two, 30-minute SCBA cylinders, or one, 45/60-minute cylinder will go to a firefighter rehabilitation area or at least be released from their assignment area. Additionally, firefighters who engaged in intense, strenuous work for approximately 40 minutes without the use of an SCBA would also be required to report to a rehabilitation area or be released from their assignment area. USFA, 2008, indicated crews meeting that above stated criteria should remain in the rehabilitation area for a period of 20 minutes. This would include rest, hydration, medical evaluation and possibly nourishment. Bledsoe, 2008, indicated firefighters should enter a rehabilitation area or be released from their assignments at the end of a single 30-minute SCBA cylinder or 20 minute work cycle without

utilizing an SCBA. NFPA includes information on self-rehabilitation in which firefighters take a break on their own on routine incidents. However, self-rehabilitation often takes place when an incident commander does not recognize the need to establish such a group (2008). According to NFPA, the rehabilitation guidelines based on the SCBA cylinder use was established because it was easy for firefighters to remember.

Though implementation of firefighter rehabilitation should begin anytime there is a risk to health and safety, it must be implemented in accordance to operational needs and the complexity of the incident (Bledsoe, 2009). “As discussed previously, resource demand is often highest early in fire suppression operations. Thus, initial rehab assignments might be somewhat delayed until additional resources arrive” (Bledsoe, 2009, 15). Incident commanders must assess each incident for time, complexity, and intensity (2009). NFPA indicated that due to limited resources at the incident it may be necessary to rotate crews to a less physically demanding tasks until they can a rehabilitation area can be established and crews can be rotated through it (2008). A review of 24 rehabilitation policies and guidelines from other fire department agencies throughout the United States revealed establishment criteria for certain weather conditions. Benchmarks such as apparent heat index greater than 90° Fahrenheit and wind chill index lower than 10° Fahrenheit were the most widely used temperature ranges.

With the implementation of a firefighter rehabilitation operation comes the question of what functions are associated with a firefighter emergency incident rehabilitation program. NFPA 1584 stated there are five emergency incident rehabilitation needs. These needs include medical evaluation, food and fluid replacement, relief from climatic conditions, rest with recovery, and accountability of all firefighters (2008). The five needs were broken down into seven functions that must be performed during any rehabilitation operation. The seven functions

include physical assessment, revitalization, medical evaluation/treatment, monitoring of physical conditions, emergency transport, critical stress assessment and support, and reassignment (2008). USFA concludes every firefighter must be given a basic physical assessment upon entering a rehabilitation area. A visual assessment must rule out any obvious signs or symptoms of injury or illness. Bledsoe, 2009, stated efforts for firefighter rehabilitation should include climate relief, rest/recovery, active/passive cooling or warming, rehydration, calorie/electrolyte replacement, medical monitoring, accountability, and release. Medical monitoring differs from medical treatment as monitoring identifies the need for treatment and medical treatment is provided according to local EMS protocols (Bledsoe, 2009). Medical monitoring should be accomplished by EMS personnel specifically trained to observe and recognized signs and symptoms of medical emergencies associated with extreme physical exertion and heat (Jaslow, 2008). Jaslow recommends delay in initial vital sign assessment of firefighters entering the rehabilitation area because most of the vital signs will indicate tachycardia, tachypnea, and hypertension due to their increased energy needs during extreme physical exertion. Jaslow recommends assessing vital signs after the firefighter has had a reasonable period for rest and rehydration unless it is apparent the firefighter is in need a medical treatment once the visual assessment is obtained (2008). However, recommendations from NFPA and USFA indicated that once a firefighter has doffed their personal protective gear an initial assessment must be performed to determine if the firefighter just needs rest and rehydration or medical treatment (2008). USFA suggested requirements for determining additional medical evaluations which included,

In general, the following criteria may be used, unless locally validated criteria are established

- Pulse in excess of 120 bpm;
- Body temperature in excess of 100.5 °F (38 °C)
- Diastolic blood pressure above 90 mmHg; and
- Systolic blood pressure above 130 mmHg.

Revitalization is to provide rest, rehydration, and nutritional support to firefighters entering the rehabilitation operation (USFA, 2008). Bledsoe, 2009, stated firefighters should consume enough fluids to satisfy their thirst. The goal is to match the fluid intake with what the firefighter lost during their physical exertion. Bledsoe stated, “Whenever firefighters don their protective gear, they are effectively entering a hot and humid environment and sweating begins almost immediately” (2009). Drinking too much in a short period, such as the 20 minute recommended time in the rehabilitation area, can lead to gastric distention (NFPA, 2008). NFPA recommends the following for activities in duration of one hour or more:

- (1) Ingest 30 g/hr to 60 g/hr of carbohydrate.
- (2) Drink 8 oz (1/4 L) of sports drink containing approximately 15 g of carbohydrate.
- (3) Consume other readily available carbohydrate sources such as fruit and meal replacement bars (2008).

NFPA also stated that consuming too much water can lead to water intoxication (2008). This is referred to as hyponatremia and occurs when individuals consume too much water too fast, which dilutes the amount of sodium in their blood. Sodium is one of the electrolytes found in the body. Hyponatremia usually can be prevented by drinking one sports drink containing sodium along with water. Bledsoe, 2009, recommends one sports drink for every 64 to 96 ounces of water. There has been controversy around whether or not to dilute sports drinks. Williams, 2006, concluded sports drinks are formulated to give the best results when consumed without dilution.

Dilution will not give the proper amount of carbohydrates and electrolytes needed for firefighting activities (2006). An article found in EMS Magazine online indicated that rehydration solutions should be mixed half sports beverage and half water (Van Dinter, July, 2008). It is suggested that beverages be served at 40° F (2008). Ice cold beverages can cause spasms of the esophagus and slow down a firefighter's heart rate (USFA, 2008). USFA stated, "The osmolarity of a fluid is a measure of the number of particles in a solution. The higher the osmolarity, the longer the time it will take to absorb the fluid and the harder the fluid will be to digest (2008, 144). Recommended osmolarity is 350 mOsm per kilogram (USFA, 2008). Calorie replacement is also achieved during the revitalization period in the rehabilitation area. Firefighters utilize a tremendous amount of calories during strenuous physical activities on emergency incidents. Typically, a response for food support is triggered by an incident with a three-hour or more duration (USFA, 2008). Food and calorie replacement depend on local resources and department's standard operating procedures. The Seminole County CERT was dispatched to four emergency incidents during the four-month personal observation period. According to the guidelines established by USFA, nourishment should have been available to firefighters in the rehabilitation area nine out of the 68 incidents recorded in the personal observation. Determining a firefighter's hydration level can be challenging in the rehabilitation area. Bledsoe comments, "High specific gravity values mean the subject's urine is very concentrated and the person's kidneys are working hard to preserve water" (2009, 29). Current testing for proper hydration includes measuring changes in body weight, urine dipstick testing and blood pressure monitors (Thompson, 2008). A new hydration sensor is forthcoming and looks like a tongue depressor. It collects saliva and displays a hydration measurement (2008).

Active and passive cooling or warming is also needed during the revitalization phase of rehabilitation. Bledsoe, 2009, describes passive cooling as a way of assisting the body's own cooling mechanisms. Firefighters entering the rehabilitation area must doff all their PPE to facilitate cooling. Additionally, passive cooling can be facilitated through the movement of cooler air (2009). Active cooling is described as the use of external devices to reduce body temperature. Active cooling is the preferred method a rapid cooling in a humid environment (2009). One method of active cooling includes the use of a cooling vest. The vest pumps ice and water through a hose in the vest. It is priced at 2, 295.00 dollars for a four person rehabilitation system (Cool Shirt, unknown). Another method a achieving active cooling is the cooling chair. This is a modified folding chair that holds plastic bags filled with cool water in the arm reservoirs. Heat is transferred from the firefighter's forearms to the cool water (Kore Kooler, 2009). Bull stated, "The common cold towel is an effective adjunct for core cooling (Bull, 2008, 1). In order to monitor a person's hydration levels a thermometer pill was developed by NASA. Astronauts perform strenuous activities such as space walks that cause a rapid rise in their core temperature. USFA recommends cold packs to the carotid arteries and the sides of the neck as an aggressive measure to reduce a firefighter's core temperature (2008). The thermometer pill was a device used to transmit and monitor pertinent vital sign information (NASA, unknown). The pill consisted of a quartz sensor wrapped in a silicone-coated capsule. It is ingested by the user several hours prior to transmission and provides pertinent information on heat stress including accurate core temperatures. It is passed through the person's digestive tract days later. The pill is now used for athletes since the deaths of several professional and college football players (NASA).

Florida is known for its warm climate year round. It is not uncommon to maintain average temperatures of 70-80° Fahrenheit in January. When cold or freezing temperatures occur, it usually has a big impact on agriculture and the citizens who are not accustomed to this type of weather (Zierden & Griffen, 2009). Florida firefighters usually do not have time to acclimatize to this type of weather conditions. Rehabilitation areas during cold weather months also demand aggressive measures. Firefighters will lose heat faster when the thermal gradient is lower than their own body temperature (Bledsoe, 2009). Rehabilitation supervisors must closely monitor firefighters in cold weather to ensure their core temperature does not exceed less than 95° F or they are considered hypothermic (2009). Passive warming can be accomplished by removing wet clothing and applying blankets to the firefighters in the rehabilitation area. Active warming can be accomplished by applying warm packs or blankets to the firefighters. Additionally, warm intravenous fluids can be administered to hypothermic and dehydrated firefighters under local medical protocols (2009).

Medical evaluations and treatment are also functions of a rehabilitation program as noted in USFA, 2008. Medical evaluations are considered an ongoing process in the rehabilitation area. Results from the personal observation concluded that inconsistencies existed in the implementation of medical evaluations. There was no set pattern when medical evaluations were and were not completed. It was up to the discretion of the incident commander. If no direction was given on the assessment of vital signs then the decision was left up to the rehabilitation supervisor. Lindsey recommends firefighters be given supervised rest periods with appropriate frequency (2009). Most often, if personnel did not want their vital signs assessed, it did not happen. One incident, during the four month personal observation period, resulted in a firefighter complaining of general weakness and dehydration prior to reporting to an established

formal rehabilitation area. Once the firefighter reported to the rehabilitation supervisor, he was administered normal saline intravenously and later released to continue working the incident. Medical practice parameters used by the Seminole County EMS system addressed environmental heat emergencies, but did not delineate between treatment of a patient and the treatment of a firefighter while working on an incident (Seminole County Emergency Medical Services System [SCEMSS], 2009). No clear rules of engagement concerning the treatment of firefighters was addressed. Vital sign requirements were addressed in NFPA, USFA, and IAFC documentation, but were recommendations not requirements. It was noted that all agencies stated locally validated criteria for acceptable vital signs was up to each authority having jurisdiction. SCFD developed vital sign criteria for training events that require physical exertion (SCFD, 2008). A questionnaire was sent to the five city fire departments and one airport fire department within the Seminole County IMS containing nine pertinent questions on firefighter health and safety issues for each respective department. Four out of the six questionnaires were returned via email. Only one out of the four responses indicated that their department has implemented a health and wellness program. Fit for duty requirements consisted of a doctor's clearance note to return to duty after an injury or illness. Three out of the four responses concluded that medical evaluations were done through the Seminole County IMS; however, there is no current standard operating procedure in place that mandates a medical evaluation of firefighters in a rehabilitation area during an emergency incident. The current Seminole IMS manual does provide a rehabilitation documentation sheet, but there are no guidelines on when to use it and no guidelines pertaining to vital sign criteria for release or medical treatment.

Continual monitoring was the fourth function of a rehabilitation area documented by USFA. Firefighters in the revitalization or treatment area must be continually monitored. If

firefighters do not show signs of recovery and require a greater level of medical attention, transportation to a medical facility should be evaluated (USFA, 2008). Lindsey notes,

In many instances, the firefighter who died was released from the rehab sector despite not feeling well, or the incident was wrapping up and rehab dismissed the firefighter only to return to the fire station to have a lethal result. If there are firefighters who are having symptoms or abnormal findings, they need to have follow-ups and in many instances treatment (2009, 1).

Documentation of accountability and medical evaluations were poor. The four-month personal observation revealed inconsistencies in documentation in all 68 recorded incidents. Though the Seminole County IMS manual contains a rehabilitation worksheet there is no comprehensive policy detailing who receives the paperwork and how long the paperwork is stored. Lindsey, 2009, stated, “Medical monitoring should be well documented. Any findings should be listed on the form and referred to later if the individual experiences any further signs or symptoms” (1).

All fire department agencies within the Seminole County IMS, with the exception of the airport fire department, provide transportation services to the citizens they serve. As part of the first response system, all rescue apparatus provide patient transport to hospitals regardless of jurisdiction. There is no current policy in place providing firefighter transport information or criteria. If a firefighter is in need of transport to an emergency department or medical center, they are treated as a patient under the Seminole County EMS system practice parameters. USFA stated, “The Transportation Unit within the rehab operation should not be confused or commingled with any Transportation Unit that is established in the Operations Section for incident victims” (2008, 124).

During the four month personal observation period, none of the incidents documented required the implementation of critical incident stress management (CISM). SCFD currently uses a private company to assess and support CISM. Additionally, the Seminole County Sheriff's Office has trained personnel to assist in certain situations. No other information was obtained concerning this function in the rehabilitation operation.

Reassignment was the last of the rehabilitation operational functions listed by USFA, 2008. Criteria from NFPA 1584 indicate there are three dispositions of firefighters who have been assigned to the rehabilitation area. Reassignment occurs if the firefighter is in suitable condition to continue working the emergency incident. Second, the firefighter may be in suitable condition to be reassigned to the incident, but their services are no longer required. Third, the firefighter is in need of further evaluation and possible treatment. During the four-month personal observation period, one firefighter who received normal saline intravenously due to a heat emergency was released from the rehabilitation area to continue working the emergency incident. After reviewing the incident on Stancil, it was determined the incident commander was not clearly informed by the rehabilitation supervisor on the firefighter's condition and treatment in the rehabilitation area. This resulted in the incident commander reassigning the firefighter to combat duties until notifications were made. Currently, there is no clear policy on the reassignment of firefighters who receive or respond to treatment in the rehabilitation area.

The fourth research question addressed the inconsistencies that currently occur in the Seminole County IMS associated with firefighter rehabilitation establishment and delivery on emergency incidents. USFA, NFPA, and IAFC literature all contained a heat stress index chart. The chart takes the current air temperature along with the relative humidity and calculates what the apparent air temperature is (USFA, 2008). The apparent air temperature reading is then

categorized into danger categories according to the heat injury threat to firefighters. The chart below contains the information on the apparent temperature danger category.

Apparent Temperature (°F)	Danger Category	Number Of Calls	Injury Threat	Number of Incidents that Met Rehab Establishment Criteria	Number of Formal Rehabilitation Operations Established
Below 80	None	22	Little or no danger under normal circumstances	10	3
80-90°	Caution	29	Fatigue possible if exposure is prolonged and there is physical activity	15	5
90-100°	Extreme Caution	17	Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity	9	7
100-130	Danger	1	Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity	1	0
Above 130	Extreme	0	Heat Stroke Imminent	0	0

Review of the personal observation data revealed there were 68 significant emergency incident responses within a four month period. The observation period just happened to be during not only the hot summer months, but also the months that receive the frequent thunderstorms. Increased emergency call loads for structure fires are indicative of frequent thunderstorms due to significant lightning strikes associated with the storms. “Florida is known as the lightning capital of the United States, with storms occurring approximately 100 days out of the year, compared to California’s low of only 5” (Crisp, 2009, 1). Summertime is the beginning of frequent thunderstorms in Florida. High heat and humidity coupled with rain clouds forming between the locations of the Gulf and Atlantic Oceans create thunderstorms that produce dangerous lightning (Crisp). The high heat and humidity alone creates a risk to the firefighter’s health and safety.

USFA, 2008, indicated that the thermal stress on a firefighter is increased by 10° Fahrenheit when their protective clothing is donned and an additional 10° Fahrenheit is added if

the firefighter is in direct sunlight. The USFA utilized a heat stress index chart which combines the temperature and relative humidity. The heat index injury chart was used during the personal observation period. Criterion for the establishment of a formal firefighter emergency incident rehabilitation operation was obtained from data stated articles and guidelines from NFPA 1584, USFA, and the IAFC. Establishment of a formal firefighter emergency incident rehabilitation operation should take place when a firefighter utilizes two 30-minute SCBA cylinders, a single 45 or 60 minute SCBA cylinder, or 40 minutes of intense work without using an SCBA.

The data obtained from the personal observation period was broken down according to the five heat injury categories associated with apparent temperature ranges. There were 68 significant emergency incidents that took place within the four month observation period. Out of the 68 incidents, 22 of them occurred when the apparent temperature was below 80° Fahrenheit. According to USFA, 2008, a reading below 80° Fahrenheit indicated there was little or no danger for heat stress injury under normal circumstances (USFA, 2008). However, this did not include the additional 10° increase Fahrenheit increase for utilizing firefighter PPE and an additional 10° Fahrenheit increase for firefighters working in direct sunlight. Though there was not a big concern for heat injury due to weather conditions, heat injury due to prolonged use of firefighting PPE was still a concern. The observation indicated 10 out of the 22 incidents met the requirements to establish a formal rehabilitation operation. Establishment criteria included on scene time, use of one 45 minute rated SCBA cylinder, and strenuous work for more than 40 minutes without using the SCBA. The observation revealed that rehabilitation establishment only occurred three times out of the 22 incidents in which the apparent temperature was below 80° Fahrenheit.

The next category of the heat index injury chart indicated firefighter fatigue was possible if they are exposed to prolonged activity in the 80-90° Fahrenheit apparent temperatures. The personal observation revealed there were 29 significant emergency incidents that occurred when the apparent temperatures were in this range. Out of the 29 significant emergency incidents during the four month period, 15 of them met the criteria to establish a formal rehabilitation operation. Again, this was due to extended on scene time, use of one or more 45 minute duration SCBA cylinder, and/or 40 minutes of intense work without using the SCBA. Only five out of the 15 incidents had a formal rehabilitation operation established. Even though a rehabilitation area was established five times, the consistency of the rehabilitation functions varied from incident to incident. No active cooling was administered during this time of increased apparent heat temperatures.

The next category of heat injury chart is the extreme caution category. NFPA stated there is, "Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity" (2008, 17). The extreme caution danger category of the heat index injury chart indicated firefighters were prone to the specified heat injuries when the apparent temperatures reached 90-100° Fahrenheit. The four month personal observation revealed there were 16 incidents that occurred during the observation in which nine of the incidents met the criteria for establishing a formal rehabilitation operation. This time a formal rehabilitation operation was established seven out of the nine times. Again, there were inconsistencies in the level of rehabilitation functions including medical evaluations, accountability, and documentation.

There was only one incident that occurred during the 110-130° Fahrenheit apparent temperature ranges. This range is considered dangerous and USFA, 2008, indicated that heat cramps, heat exhaustion, and heat stroke could occur if firefighters were exposed to those

temperatures during physical activity for prolonged periods. The significant emergency incident lasted approximately four hours and no formal rehabilitation was established.

The personal observation also revealed inconsistencies with the establishment of emergency incident rehabilitation as well as the functions of a rehabilitation area. This included performing medical evaluations, accountability, treatment, and documentation. A total of 68 significant incidents were documented on the personal observation form. Out of the 68 incidents, 35 incidents met criteria for establishment of a formal rehabilitation operation according to the guidelines/recommendations from NFPA, USFA, and IAFC. The observation concluded that formal firefighter rehabilitation was established on only 15 of the 68 incidents. Six of the 15 incidents stated medical evaluations were conducted and only one time was the medical evaluation paperwork completed or sent to the emergency medical services group of every department on the incident. Accountability was hard to document as without the rehabilitation paperwork it was unknown if all units were rotated through the rehabilitation group when it was established and no radio time stamp or benchmarks were noted while obtaining data through the Stancil incident playback system. Out of the 68 documented incidents, SCFD established and operated command 59 times. The remaining incidents were commanded by a city fire department incident commander because the incidents were deemed to be in their jurisdiction.

The last research question addressed the benefits and consequences of a firefighter emergency incident rehabilitation program. The literature review revealed sufficient articles on the topic of firefighter rehabilitation. USFA stated, "...approximately one-half of all firefighter fatalities and a significant percentage of injuries and illness are as a result of stress and overexertion on firefighters involved in emergency scene operations and training exercise"

(2008, 1). Sullivan explained that firefighter rehabilitation on emergency incidents provides coordination, direction, accountability, and adequate use of resources. He further explains the consequences of not performing rehabilitation functions can result in death and injury. The questionnaire sent to the fire departments who work within the Seminole County IMS revealed some of the departments do not mandate annual firefighter medical evaluations. Furthermore, some of these departments do not require any type of fitness assessment. Jaslow indicated rehabilitation has received a negative response from fire department personnel, as it has been associated with outpatient treatment programs and individuals with serious physical or mental illnesses (2007). He stresses each firefighter, no matter what physical condition they may be in prior to firefighting activities, will need rehabilitation efforts to recover (2007). Firefighters in less physical condition will require rehabilitation efforts sooner (2007). Verfuss explained that economics and society have changed and fire departments are expected to do more with less (2004). Budgetary cost associated with lack of firefighter rehabilitation includes medical expenses, expenses for covering absences on shift, early pensions and disability cost. Lindsey, 2009, explains fire chiefs have a legal and moral obligation to provide safeguards for personnel.

Consequences associated with vital sign parameters can result in medical absences of personnel, which ultimately results in additional budgetary costs. This was apparent when the Incumbent Physical Ability Test for the SCFD resulted in an increase in Worker's Compensation injuries and claims within the first year it was implemented. This number has decreased over the last several years.

The results of the action research indicated a need for a comprehensive firefighter emergency incident rehabilitation guideline. In order to ensure a well-rounded program was developed, a request to review other fire departments rehabilitation programs was done via the

internet. Over 24 rehabilitation guidelines were reviewed and procedures and functions from each agency were compiled on a spreadsheet. See Appendix B. The table below displays the total results of each rehabilitation function reviewed. Most of the agencies included roles and responsibilities as part of their standard operating procedures. Environmental and physical work capacity benchmarks were also observed. Criteria on vital sign assessment were noted on most policies. The majority of the baseline vital signs were comparable to the recommendations made by NFPA and USFA. Surprisingly, there was insufficient data relating to treatment protocols and emergency transport protocols on the emergency incident. No documentation was found on situations that occur with multi-agency responses.

Total # of Policies Reviewed	Establishment-Environment	Establishment-Work Capacity	Roles & Respos.	Location Criteria	Equipment Criteria	Rest Criteria	Revitalization	Medical Evaluation	Medical Eval Criteria	Treatment-Protocols	Medical Transport	Accountability	Documentation
24	10	12	17	16	11	15	17	19	17	4	2	12	12

A comprehensive firefighter emergency incident rehabilitation program was developed because of the action research. See Appendix C. This program includes a purpose, scope, implementation, responsibilities, and general operating principals.

Discussion

The purpose of the four month personal observation of significant emergency incidents was to document whether or not the Incident Commanders were consistently establishing firefighter rehabilitation on during emergency incidents without a written guideline. The observation demonstrated that regardless of time, temperature, or complexity implementation of firefighter rehabilitation was left to the discretion of each Incident Commander, which became inconsistent on each incident. Without a written standard operating procedure, implementation

or the level of implementation was different for each incident. Furthermore, because SCFD operates under the Seminole County IMS with six additional fire department agencies, functions associated with a rehabilitation operation on emergency incidents varied according to who was assigned to perform the rehabilitation operation. Sullivan stated, "It is difficult to overemphasize the importance of closely managing the rehab process. Without coordination and direction, rehab will not get done, this will result in too many to too few firefighter getting called to the scene" (unknown). Lindsey explains, "One of the most difficult tasks for the rehab personnel is keeping firefighters in rehab. As part of the training, the amount of time firefighter will be spending in rehab should be clearly explained" (2009, 1). Sullivan stated, "Asking firefighters if they need a break is sure to result in a negative response" (unknown, 1).

There were several factors that must be looked at with the data collected from the personal observation. First, the observation occurred during four of the hottest months in Florida. This period was not selected on purpose, but occurred only because of the time frame assigned to complete the research paper according to USFA. Though 22 of the incidents were documented when the apparent temperature was below 80° Fahrenheit, they still occurred during the hot summer months when humidity is at its highest. A closer analysis of the incidents revealed many of them occurred during the early morning hours or late evening hours when the heat stress index is much lower. Because heat is a factor for concern in relation to firefighter heat injury, it was apparent through the observation data collected that it was not a primary concern for Incident Commanders as to the establishment of a rehabilitation operation because it only occurred three times out of 22 incidents when the apparent temperature was below 80° Fahrenheit. The Incident Commanders did not take into account USFA indicated there is a 10° Fahrenheit temperature increase just donning firefighting PPE (2008). Additionally, there is

another 10° Fahrenheit increase for firefighters working in direct sunlight. Therefore, if the apparent temperature was 80° Fahrenheit and the firefighter was working in their PPE in direct sunlight the apparent temperature for the firefighter would be approximately 100° Fahrenheit. An apparent temperature of 100° Fahrenheit borderlines between the extreme caution and danger categories of the heat stress injury chart. This is indicative of heat cramps, heat exhaustion, and heat stroke if prolonged physical activity occurs (USFA, 2008).

With the implementation of the Incumbent Physical Ability Test in the SCFD came the assessment of vital signs prior to and post testing. This resulted in several firefighters exceeding the accepted normal limits and further evaluation by a department physician was necessary to declare them fit for duty. On a positive note, some of the firefighters were forced to correct a hypertensive condition in order to be cleared. Though, initially this resulted in a negative response from the SCFD firefighters, it has become the norm for training. Implementation of a formal rehabilitation program in the Seminole County IMS would include vital sign parameters for medical monitoring. It is anticipated by this researcher the same initial negative response for emergency incident rehabilitation will be observed. This response was noted on several of the incidents that were documented for the personal observation period. This negative response was not only noted from the personnel being assigned to enter the rehabilitation area, but also those personnel assigned to operate the rehabilitation area.

Lindsey stated, “Medical monitoring is the foundation of rehab. In the past, medical monitoring and emergency care were not emphasized as much as in the current standard. Rest and relaxation are great, but it is critical to monitor the well-being of the personnel working at the incident scene” (2009, 1). Bledsoe indicated, “A process should be incorporated into rehab SOGs to refer firefighters with sustained vital sign abnormalities for follow-up medical care and

further assessment” (2009, 33). The term SOG means standard operating procedures. Jaslow recommends delaying the initial vital sign assessment of firefighters entering the rehabilitation area because most of the vital signs will indicate tachycardia, tachypnea, and hypertension due to their increased energy needs during extreme physical exertion (2009). However, USFA and NFPA conclude that a visual assessment and initial vital sign assessment should be obtained immediately upon entry of the rehabilitation area as this creates a baseline for further medical monitoring and assists the rehabilitation personnel in determining if the firefighter is recovering in a sufficient period or if they need medical treatment. USFA, NFPA, and IAFC offer recommendations for acceptable vital sign parameters. Jaslow stated, “EMS providers must be convinced that simply acquiring vital signs, writing them down and letting the firefighter with uncontrolled hypertension walk away does no good for anybody” (Jaslow, 2008, 1).

It was noted by this researcher during a three alarm commercial structure fire that one firefighter had an elevated pulse after thirty minutes of rest and revitalization in the rehabilitation area. Because he worked for a fire department agency other than SCFD, his on duty battalion chief was notified for further direction on treatment and release. The firefighter was directed to return to duty without further medical evaluation. Because there are no written guidelines for all agencies to adhere to, uncertainties in firefighter care and liability exist. Though guidelines from reputable agencies such as NFPA, USFA, and IAFC exist, there is no documentation from these agencies stating how multi-agencies are to interact with each other during mutual aid responses. This becomes a challenge for all agencies involved, especially when firefighter health and wellness programs, annual medical evaluations, and fit for duty standards are not consistent from fire department agency to agency. This was evident from the questionnaire responses from the fire department agencies in the Seminole County IMS.

Because all the fire departments in the Seminole County IMS provide emergency transportation services, EMS transportation units are part of the assigned initial response on emergency incidents. This ensures that advanced life support equipment and procedures are available and used during firefighter rehabilitation efforts. However, implementation of a rehabilitation operation also requires hydration, electrolyte, and calorie replacement. Active cooling process can demand a tremendous amount of ice, water, rehab cooling chairs/vest, fans, towels and other needed items. Implementing a rehabilitation program means providing the necessary equipment to effectively run this operation. With current budgetary cuts from all agencies in Seminole County, responsibility for funding for such a program is a concern. It may require the utilization of an additional transport unit to emergency scenes. This would have to be approved by all agencies working within the Seminole County IMS.

Non-compliance in providing effective firefighter emergency incident rehabilitation will lead to increased liability on the Incident Commanders behalf and especially on the fire chief's behalf. It was noted on the research questionnaire that some of the agencies within the Seminole County IMS indicated that a rehabilitation policy exist. No documentation on such a policy was found. Lindsey stated, "There are two factors to consider when determining compliance with the revised NFPA 1584. The first factor is a department's legal obligation and second-and even more compelling – is chief's responsibility to provide safeguards for personnel" (2009, 1). Lindsey goes on to state that a lawsuit regarding firefighter rehabilitation would most likely be due to deprivation of rights under the Civil Rights Act (2009).

Agreement on medical evaluation guidelines, treatment, transport, and release from a rehabilitation operation must be accomplished if fire department agencies work under a first response automatic aide system.

Recommendations

The personal observation results clearly indicated that all agencies within the Seminole County IMS were not effectively implementing firefighter rehabilitation on emergency incidents. The only way to provide for firefighter health and safety on emergency incidents is to ensure a comprehensive firefighter rehabilitation guideline is followed for emergency scenes. A written standard operating procedure will provide systematic guidelines on when to implement firefighter rehabilitation and how functions are to be delivered.

Because the Seminole County IMS involves the participation from six fire department agencies, a consensus from the respective Fire Chiefs is required. All agencies must agree to implement the program and that will require input on medical evaluations, vital sign criteria, treatment and return to duty procedures, staffing, equipment and funding. Support from the Fire Chiefs is critical in order to obtain the buy-in from all the firefighters working within the IMS.

In order to ensure all agencies receive vital sign assessment on their personnel, a revision of the current Seminole County and Cities IMS manual rehabilitation log must be completed. The development of a new rehabilitation log should ensure all agencies receive pertinent information on their personnel in regards to vital sign assessment and accountability after each incident.

The development of the rehabilitation guideline introduced several levels of rehabilitation implementation. See Appendix C. Level II Rehabilitation includes the use of a rehabilitation bag that will be carried on all battalion chief's vehicles. Development of the rehabilitation bag is crucial to the rehabilitation operation as it will contain the necessary equipment needed to ensure every firefighters receive proper rehabilitation on emergency incidents. The Level III Rehabilitation includes the development of a rehabilitation trailer or unit which will store

rehabilitation chairs, cooling chairs, misting fans, ice, towels, and much more. The development and implementation of this unit is also crucial to ensure firefighters receive effective rehabilitation on emergency incidents.

As with any new program, an education and training period is essential. Because the Seminole County IMS deals with multi-agency response, multi-agency training is needed. In order to combat the negative attitudes geared toward firefighter rehabilitation, firefighters must be educated in the necessity of such a program. The training program should include education and training on the benefits of firefighter rehabilitation, proper hydration and nutrition, calorie and electrolyte replacement criteria while in a formal rehabilitation area, and procedures for medical evaluations and medical transports during emergency incidents.

Once the education and training phase is completed, implementation should begin. In order to ensure the program's effectiveness, an evaluation period must occur. It is anticipated that a period of approximately seven months will be used to effectively evaluate the program. Because the program will be implemented system wide, it is recommended that a computer based evaluation sheet be created for all incident commanders, rehabilitation supervisors, and company officers to complete after each incident. A formal evaluation worksheet should be discussed and agreed upon before the program is implemented.

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Appendix A

Personal Observation of Significant Emergency Incidents

Incident #	Date	Time	Type Of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was Rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of Paperwork
17510	08/05	0329	HIGH ANGLE	75/90	79	8	1	NO	NO	NO	NO	NO	NO	NO
17981	08/11	1155	COMM. FIRE	86/67	94	11	1	YES	:30 R32	NO	YES	?	NO	?
18274	08/14	1406	RESD. FIRE	93/47	99	13	1	NO	NO	NO	NO	NO	NO	NO
18345	08/15	1336	RESD. FIRE	91/57	100	9	1	NO	NO	NO	NO	NO	NO	NO
18399	08/16	0750	RESD. FIRE	78/90	88	9	:35	NO	NO	NO	NO	NO	NO	NO
18416	08/18	1325	RESD. FIRE	93/49	100	15	1:30	YES R37	:20	NO	YES	NO	?	?
18643	08/19	1555	TREE FIRE	89/61	100	:4	:30	NO	NO	NO	NO	NO	NO	NO
18678	08/20	0017	RESD. FIRE	80/79	86	8	1	NO	NO	NO	NO	NO	NO	NO
18746	08/20	2221	HAZMAT FIRE	75/94	79	10	1	NO	NO	NO	NO	NO	NO	NO
18918	08/22	1901	MVA	90/61	100	6	:30	NO	NO	NO	NO	NO	NO	NO
18955	08/23	0644	RESD. FIRE	76/91	79	17	1	YES	R24	YES	NO	NO	NO	NO

Incident #	Date	Time	Type Of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of paperwork
11302	05/19	0709	RESD. FIRE	66/94	71	8	2:00	NO	NO	NO	NO	NO	NO	NO
11558	05/21	1928	RESD. FIRE	74/82	71	8	1:40	NO	NO	NO	NO	NO	NO	NO
11638	05/23	0147	RESD. FIRE	70/93	71	8	3:20	NO	NO	NO	NO	NO	NO	NO
11832	05/26	1839	RESD. FIRE	75/82	78	11	1	NO	NO	NO	NO	NO	NO	NO
11469	05/20	2200	RESD. FIRE	72/91	71	14	1	NO	NO	SCCC Prompted	NO	NO	NO	NO
12071	05/28	1942	COMM. FIRE	81/77	85	8	00:30	NO	NO	NO	NO	NO	NO	NO
12239	05/31	1601	HAZMAT	87/33	78	6	2	NO	NO	NO	NO	NO	NO	NO
12290	05/31	0924	GAS LEAK	75/67	77	7	1:30	NO	NO	NO	NO	NO	NO	NO
12513	06/30	0041	RESD. FIRE	79/87	88	10	1	NO	NO	NO	NO	NO	NO	NO
12567	06/03	1804	MVA	84/56	81	7	1	NO	NO	NO	NO	NO	NO	NO
11556	05/20	1920	RESD. FIRE			9	1	NO	NO	NO	NO	NO	NO	NO

Incident #	Date	Time	Type Of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was Rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of Paperwork
12791	06/06	1339	RES.D. FIRE	73/87	79	7	00:40	NO	NO	NO	NO	NO	NO	NO
12828	06/07	0035	RES.D. FIRE	73/87	79	2	00:30	NO-MUT.AID	N/A	N/A	N/A	N/A	N/A	N/A
12856	06/07	1234	RES.D. FIRE	85/57	90	20	4:30	YES	40/R65	YES@50 MIN	NO	NO	?	?
12892	06/08	0205	RES.D. FIRE	72/91	71	11	00:40	NO	NO	NO	NO	NO	NO	NO
13060	06/10	0154	RES.D. FIRE	79/77	86	16	3	YES	?	?	?	?	?	DOC. ON SIR, NOT ON CAD
13138	06/11	0344	RES.D. FIRE	86/65	90	12	2	NO	NO	NO	NO	NO	NO	NO
13140	06/11	0258	RES.D. Fire	84/65	90	17	1:40	NO	40 MIN INTO ALARM CERT DISPATCHED. 6 UNITS JUST WORKED PREVIOUS FIRE. NO FORMAL REHAB ESTABLISHED, NO MED EVAL.					
13469	06/15	1430	COMM. FIRE	91/47	96	7	20	NO	NO	NO	NO	NO	NO	NO
13593	06/16	1908	RES.D. FIRE	75/89	79	16	3:30	NO	NO	NO	NO	NO	NO	NO
13908	06/20	1049	RES.D. FIRE	89/63	100	8	YES	:19 BY R32	NO	NO	YES	NO	NO	NO
14222	06/24	0637	RES.D. FIRE	75/94	79	7	2	YES	:30	NO	NO	NO	NO	NO

Incident #	Date	Time	Type of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was Rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of paperwork
13862	06/19	2017	GAS LEAK	88/65	100	4	1:32	NO	NO	NO	NO	NO	NO	NO
14270	06/24	1522	CONF. SPACE	91/47	96	13	1:40	YES	?	Request for Cert prompted by Seminole. No response by Command. No documentation found for medical eval.				
14337	06/25	1427	RESD. FIRE	78/81	86	12	1	NO	NO	NO	NO	NO	NO	NO
14373	06/26	0004	COMM FIRE	79/79	86	11	:30	NO	NO	NO	NO	NO	NO	NO
14597	06/28	1922	COMM FIRE	85/65	90	11	2	NO	NO	NO	NO	NO	NO	NO
15064	07/04	0324	RESD. FIRE	79/88	88	9	:30	NO	NO	NO	NO	NO	NO	NO
15016	07/03	1651	RESD. FIRE	79/72	85	10	1:30	NO	NO	NO	NO	NO	NO	NO
15383	07/08	1752	CI LEAK	79/83	86	4	1	NO	NO	NO	NO	NO	NO	NO
15689	07/13	0311	MVA	75/94	79	9	:40	NO	NO	NO	NO	NO	NO	NO
15924	07/15	2028	RESD. FIRE	75/94	79	4	:50	NO	NO	NO	NO	NO	NO	NO
16128	07/18	1348	MVA	78/81	86	7	1	NO	NO	NO	NO	NO	NO	NO

Incident #	Date	Time	Type Of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was Rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of paperwork
16271	07/20	1426	RESD. FIRE	82/62	82	11	1	NO	NO	NO	NO	NO	NO	NO
16529	07/20	1118	MVA	78/81	86	10	30	NO	NO	NO	NO	NO	NO	NO
16261	07/20	1143	HAZMAT	78/81	86	11	1:15	EMS GROUP	?	NO	YES	NO	NO	NO
16343	07/21	1133	RESD. FIRE	86/55	88	9	1	NO	NO	NO	NO	NO	NO	NO
16386	07/21	2317	RESD. FIRE	78/81	86	11	1	NO	NO	NO	NO	NO	NO	NO
16165	07/23	2251	RESD. FIRE	79/82	82	8	40	NO	NO	NO	NO	NO	NO	NO
16661	07/25	1002	RESD. FIRE	86/61	90	10	1:50	NO	NO	NO	NO	NO	NO	NO
16997	07/28	1904	ELEVAT. EVAC	72/89	73	4	1:15	NO	NO	NO	NO	NO	NO	NO
17221	08/10	1509	RESD. FIRE	71/50	96	12	1	YES	:30	R41 reassigned to rehab, but not documented on radio. B/P check done, but unknown if paperwork completed.				
17266	08/20	0736	GUN SHOT	80/85	86	5	:50	NO	NO	NO	NO	NO	NO	NO
16719	07/27	0603	RESD. FIRE	73/93	79	12	1	NO	NO	NO	NO	NO	NO	NO

Incident #	Date	Time	Type Of Incident	Temp & Humidity	Heat Stress Index	# Units On Scene	Length Of Incident	Was Rehab Established / Time	Time Units Entered Rehab	Was CERT Requested	Firefighter Medical Evaluations Completed	Firefighter Treatment / Transport	Rehab Log Completed	Location of paperwork
17510	08/05	0329	HIGH ANGLE	75/90	79	8	1	NO	NO	NO	NO	NO	NO	NO
17981	08/11	1155	COMM. FIRE	86/67	94	11	1	YES	:30 R32	NO	YES	?	NO	?
18274	08/14	1406	RES.D. FIRE	93/47	99	13	1	NO	NO	NO	NO	NO	NO	NO
18345	08/15	1336	RES.D. FIRE	91/57	100	9	1	NO	NO	NO	NO	NO	NO	NO
18399	08/16	0750	RES.D. FIRE	78/90	88	9	:35	NO	NO	NO	NO	NO	NO	NO
18416	08/18	1325	RES.D. FIRE	93/49	100	15	1:30	YES R37	:20	NO	YES	NO	?	?
18643	08/19	1555	TREE FIRE	89/61	100	:4	:30	NO	NO	NO	NO	NO	NO	NO
18678	08/20	0017	RES.D. FIRE	80/79	86	8	1	NO	NO	NO	NO	NO	NO	NO
18746	08/20	2221	HAZMAT FIRE	75/94	79	10	1	NO	NO	NO	NO	NO	NO	NO
18918	08/22	1901	MVA	90/61	100	6	:30	NO	NO	NO	NO	NO	NO	NO
18955	08/23	0644	RES.D. FIRE	76/91	79	17	1	YES	R24	YES	NO	NO	NO	NO

Appendix C

***SEMINOLE COUNTY AND CITIES INCIDENT MANAGEMENT SYSTEM
EMERGENCY INCIDENT REHABILITATION GUIDELINE*****PURPOSE**

The purpose of this guideline is to ensure the physical and mental condition of firefighters working on emergency incidents do not deteriorate to a point that affects the safety of each member or jeopardized the safety of the operation.

This guideline is to provide guidance on the implementation and delivery of emergency incident firefighter rehabilitation as a means to ensure the health and wellbeing of all personnel working under the Seminole County and Cities Incident Management System. It will ensure that personnel who might be suffering the effects of metabolic heat build-up, dehydration, physical exertion, and/or extreme weather conditions receive evaluation and rehabilitation during emergency incidents.

SCOPE

Firefighting activity demands a tremendous amount of physical and mental endurance. The inherent stresses of emergency incidents coupled with heat and humidity or extreme cold can have an adverse impact on emergency responders. Though, each firefighter may be in excellent physical condition prior to firefighting activities, they will still need rehabilitation efforts to recover. When emergency personnel become fatigued, their ability to make critical decisions diminishes and this in turn can jeopardize the overall safety during the incident. Members who are not provided adequate rest and rehydration during emergency incidents are at higher risk for illness and injury. It is believed that implementation of an emergency incident rehabilitation guideline will aid in overall scene safety, reduction of firefighter injury, and the potential to detect undiagnosed conditions that could result in the loss of life. This guideline was developed after extensive review of NFPA 1584 Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises, USFA Emergency Incident Rehabilitation manual, IAFC A Guide for Best Practices Rehabilitation and Medical Monitoring, and numerous rehabilitation guidelines from fire department agencies throughout the United States. In some cases, this guideline contains exact wording from other agencies' policies and is in no way intended to be the original work of one person. It is intended to be a comprehensive sum of research and data collected from the above mentioned sources in order to provide the most current guideline for the health and safety of our firefighters. This guideline meets and in some instances exceeds the recommendations of NFPA 1584 for firefighter emergency incident rehabilitation.

Establishment of a guideline alone will not correct the culture; it is essential for the health and safety of all members to be educated in not only the importance but also the proper methods for rehabilitation.

IMPLEMENTATION

1. Rehabilitation shall commence when fire/emergency operations poses a health and safety risk. Recognizing the need to establish a Rehab Group should be based on:
 - a. **Time:** Extended use of turnout gear; extended exposure to weather conditions
 - b. **Complexity:** Crime scenes, standoffs, search operations, mass gatherings/public events, hazardous materials incidents and so on; adverse environmental conditions
 - c. **Intensity:** Mental and/or physical stress on members such as major extrications, actual fire attack, or interior search and rescue.

2. The Incident Commander will establish a rehabilitation division or group when conditions indicate that rest and rehabilitation are needed for personnel operating at an incident scene. The IC should designate a licensed paramedic as the Rehab Group Supervisor. Command should consider assigning a chief officer to assist with rehab. The Rehab Group Supervisor should act within the ICS and report to the Medical Branch Officer or Logistics Chief if assigned. If no Medical Branch Officer or Logistics Chief is designated, the Rehab Group Supervisor is to report to the Operations Chief. If the Operations Chief has not been established the Rehab Group Supervisor should report to the IC. On larger incidents when multiple Rehab/Medical Units are in operation the IC or EMS Branch Director shall ensure that each unit has its own geographical name such as North Rehab and South Rehab.

3. The parameters recommended in this guideline were developed with the mindset that all operating firefighters have sufficiently prepared and conditioned themselves physically for firefighting and emergency operations. This policy is not intended, and cannot replace the objectivity of a company officer that may necessitate rehabilitation prior to the variable factors.
4. **Level I** rehab shall be established for all incident with a duration of <40 minutes. Level I rehab is considered “self-rehab” and supervisors are to monitor their personnel for signs and symptoms of heat or cold stress. If at any time personnel present with signs and/or symptoms indicative of illness or injury a medical evaluation must be completed by a paramedic on scene. Medical treatment and transport shall be available to all emergency personnel regardless of the duration of the incident. In the case that medical treatment and/or transport is indicated during Level I rehab, all Seminole County EMS Practice Parameters shall be followed.
5. **Level II** rehab is considered a tactical level operation and shall be established for any large scale incident, long duration or > 40 minutes, physically demanding incidents, and/or adverse environmental conditions. Additionally, NFPA recommends Level II rehab for the following criteria:
 - a. Climatic conditions were heat stress index > 90° F (See attached table)
 - b. Climatic conditions were wind chill index <10° F (See attached table)
 - c. Responders utilize (1) 45 minute or (1) 60 minute SCBA cylinder
 - d. Whenever a Level A or B chemical protective PPE is worn
 - e. Following 40 minutes of intense work with use of SCBA
6. The Incident Commander shall designate a Rehabilitation Group Supervisor when Level II rehab is established. The rehabilitation process shall include:
 - a. Rest
 - b. Rehydration
 - c. Cooling (active and passive)
 - d. Warming
 - e. Medical Monitoring and Treatment
 - f. Relief from Adverse Environmental Conditions (Heat, Cold, Wind, Rain, Hail)
 - g. Calorie and Electrolyte Replacement
 - h. Accountability
 - i. Reassignment
7. **Level III** rehab is a supplement to Level II rehab. Request for Level III rehab will initiate the dispatching of an additional rehab unit containing chairs, misting fans, tents, portable lighting, coolers with ice, additional cups, additional sports drink mix, some type of calorie replacement
8. **Level IV** rehab includes the dispatching and utilization of the Seminole County CERT in addition to the other levels of rehab. All guidelines pertaining to Level II rehab shall apply to Level III and Level IV rehab. It is imperative for the safety of all personnel in rehab that a designated Rehab Group Supervisor be assigned to Level IV rehab area due to the complexity of incident scene, accountability, and medical evaluations.
9. The Incident Commander may establish a Rehab Group during any other fire department activities at his/her discretion; climatic and environmental factors need not be the sole criteria or justification for establishing rehabilitation.

RESPONSIBILITIES

The Incident Commander has the responsibility and authority to implement and monitor all provisions of this operational guideline. The Incident Commander must take into account time, complexity, and intensity. He/she shall consider the circumstances of each incident and make adequate provision early in the incident for rest and rehydration for all members operating at the scene. Establishment of a Rehab Group with rehab unit equipment (other than medical equipment, documentation/accountability sheets, and cool water) may require additional time (30 minutes or more) to arrive on scene and set-up. Adequate provisions for the rehabilitation of personnel include

medical evaluation, treatment and monitoring, food and fluid replenishment, mental rest, and relief from extreme climatic conditions, accurate documentation, accountability, and other environmental parameters of the incident.

Other IC responsibilities include:

1. Rehabilitation incident/event size-up
2. Establishment of Rehab Group
3. Designate and assign a Rehab Group Supervisor to manage the rehab area
4. Ensure sufficient resources are assigned to the rehab area
5. Ensure personnel are available for emergency medical care of firefighters as required

Rehabilitation Group Supervisor:

1. Don vest if available
2. Obtain the “How to Guide” from the command vehicle for easy setup and checklist for rehab area
3. Retrieve Rehab Area Bag from Battalion vehicle
4. Shall be in radio contact or ability to accomplish face-to-face communications with the IC at all times
5. Work with the Incident Safety Officer and IC to establish long term plans for rehab where needed
6. Select rehab area location
 - a. Ensure area is large enough to accommodate number of members at incident
 - b. Have separate area for members to remove protective equipment
 - c. Be located far enough away from the incident that responders may safely remove all PPE
 - d. Ensure accessibility for EMS transport units/personnel should emergency care be required
 - e. Be removed from hazardous atmospheres including apparatus exhaust fumes, smoke, and other toxins
 - f. Provide for shade in summer and protection from inclement weather at other times
 - g. Have access to a water supply (bottled or potable) to provide for hydration and active cooling
 - h. Be away from spectators and media
 - i. Shall have a controlled entrance and exit area for responder accountability
 - j. Location should provide suitable protection from the prevailing environmental conditions:
 - i. Consider nearby garage, building lobby or other structure to combat the affects of adverse weather
 - ii. An open area or shaded area in which tarps, fans, and other equipment can be used to create a rehab area
 - iii. Several floors below a fire in a high-rise building
 - iv. A school bus or municipal bus
 - v. Back of a rescue or several designated rescue/transport units with climate control
7. Ensure there is only one entrance and one exit for rehab to ensure accountability
8. Ensure personnel in rehab “dress down” by removing their bunker coats, helmets and opening their bunker pants to promote cooling. It is preferred that all PPE be removed; however, if bunker pants are to remain on the member, they must be pulled down over the bunker boots while member is seated, to promote more affective passive cooling.
9. Provide the required resources for rehab including the following:
 - a. Potable drinking water for hydration
 - b. Sports drink (to replace electrolytes and calories) for long duration incidents (> 1 hour)
 - c. Active cooling where required
 - d. Medical monitoring equipment (blood pressure cuff, stethoscope, thermometer, cardiac monitor, pulse oximeter, carbon monoxide oximeter, cyanokits, trauma bag, O2 bag, drug box, rehab accountability/monitoring sheets)
 - e. Food where required and a means to wash or clean hands and face prior to eating
 - f. Blankets and warm, dry clothing for winter months
 - g. Washroom facilities were required
10. Time personnel in rehab area to ensure they receive at least 20 minutes of rest
11. Ensure members rehydrate themselves
12. Ensure they are provided a means to be actively cooled where required
13. Maintain accountability of members assigned to rehab
14. Remain within rehab area at all times
15. Document that all members entered, received revitalization and medical monitoring, treatment/transport if applicable, reassignment on designated form

16. Currently, there are no studies that quantify vital sign measurement with the length of rehabilitation or with the need to direct members to a treatment area. Visual signs and symptoms remain the best method to evaluate members in the rehabilitation area. In order to provide consistency amongst the responding jurisdictions and the providers who will staff the rehab area, the Seminole County and Cities IMS has adopted the following vital signs as their benchmarks. If the attending EMS provider feels there is any concern with a responder returning to work at any incident, he/she may hold that individual in rehab or recommend transport to a medical facility.
17. Inform the Incident Commander, Accountability Officer (resource status unit), and EMS personnel if a member requires transportation to and treatment at a medical facility. Due to the complexity of working within a multi-agency automatic aid response, every effort must be made to contact the affected agency when their personnel cannot be released back to the incident scene or reassignment. In no way should medical treatment/transport be delayed to any member if notification cannot be made.

Company Officers / Station or Unit Supervisors

1. Maintain awareness of each member operating within his/her span of control
2. Ensure adequate steps are taken to provide for each member's health and safety
3. Notify IC when stressed members require relief, rotation, or reassignment according to conditions
4. Ensure ICS is utilized request relief and/or reassignment of working crews
5. Be familiar with and monitor members for signs and symptoms of heat and cold stress
6. Provide for access to rehab area for company members as needed
7. Ensure their company is properly checked in with the Rehab Group Supervisor and/or Accountability Officer, Resource Unit Leader and remain intact as a company
8. Should remind crew of heat stress prevention strategies as the humidex level approaches 95° F to 102° F

Crew Members

1. Ensure sufficient rest and hydration is done prior to reporting to duty
2. Ensure pre-hydration on hot days
3. Ensure proper dress during cold days
4. Ensure that all PPE is in good working order
5. Know and adhere to personal limits
6. Advise supervisor when exposure to heat/cold is approaching a level that could affect themselves, crew members or the operation
7. Promptly inform supervisor when rehab is required
8. Maintain unit integrity
9. Remain aware of the health and safety of all members of their working crew

GENERAL OPERATIONAL PRINCIPALS

Level I Rehab

- Self-rehab is initiated by company officer / station or unit supervisor in which members shall have a rest and recovery period of at least 10 minutes for initial self-rehab
- This is for incidents in which the duration is < 45 minutes.
- The company officer shall ensure that members remain hydrated and that potable fluids are available.
- Avoid carbonated, high-fructose-content, and high sugar drinks exceeding 7% carbohydrate solution, foods with high fat and/or high protein content, excessive fluids, tobacco, creatine, ephedrine
- Company officers shall assess their crew at least every 45 minutes and more frequently when working in extreme conditions to determine their need for rehabilitation.
- The IC shall be permitted to adjust the time frames depending upon work or environmental conditions. The member shall not return to operations if he/she does not feel adequately rested, if EMS or supervisory staff present see evidence of medical, psychological, or emotional distress, or is the member appears otherwise unable to safely perform his/her duties
- Company officers / station or unit supervisors shall encourage members to continue fluid intake after the incident.

Resources

Potable water stored in apparatus prior to incident

Locate area free of hazardous atmospheres including apparatus exhaust fumes, smoke, and other toxins

Provide for shade

Level II Rehab

- Is initiated by the IC in which a Rehabilitation Group Supervisor shall be designated
- Is for incidents with a duration of > 40 minutes
- Establishment for members using (1) 45 minutes SCBA cylinder
- Establishment for members who perform 40 minutes of intense work without using SCBA
- Climatic conditions were heat stress index > 90° F (See attached table)
- Climatic conditions were wind chill index <10° F (See attached table)
- Whenever a Level A or B chemical protective PPE is worn
- Whenever emergency operations pose a risk to members exceeding a safe level of physical or mental endurance
- Functions of Level II rehab include:
 - Physical assessment
 - Revitalization
 - Medical evaluation and treatment
 - Continuing monitoring of physical condition
 - Transportation for those requiring treatment at a hospital
 - Initial critical incident stress assessment and support
 - Reassignment

Resources

Rehab Kit – located in the Battalion Chief's vehicle and contains the following:

- 1 large rehab kit bag
- Rehabilitation tracking and medical evaluation forms
- Patient care reports
- Clipboards
- Pens / pencils
- Clocks and stop watches
- Bulk quantity sports drink mix
- Rehab supervisor identification vest
- Several tarps
- Traffic cones
- Rad57 meter
- Disposable cups and towels
- Cyanokit
- Cold Packs
- Moist hand wipes

Supplies from Rescue/transportation unit:

- Fan
- Medical equipment
- Water coolers from on scene apparatus
- Lighting can be used from apparatus if not already used on the incident scene

Level III Rehab

Level III rehab is to supplement Level II rehab and will be initiated at the request of the IC (when available)

Resources

- Tents
- Misting fans
- Portable fans
- Core cooling chairs
- Portable lights
- Generators / extra fuel

- Folding table and chairs
- Towels and blankets
- Traffic cones
- Rehab signs
- Additional paperwork
- Clipboards with pens
- Coolers with ice
- Coolers with cool water
- Nourishment (protein bars)
- Additional EMS supplies
- CO and Cyanide monitors (to monitor air around rehab area)

Level IV Rehab

Level IV rehab is a supplement to Level III and Level II. It will be initiated at the request of the IC (when available) and is the requesting and dispatching of the Seminole County CERT. It can be used in conjunction with Level III rehab or utilized solely with Level II rehab. ***It is not to be used as a substitution for a rehab group.*** All check-in and checkout procedures along with accountability, medical monitoring, treatment, and transport must be completed through fire department personnel working under the Seminole County and Cities IMS.

PROCEDURES

1. Level of rehab shall be determined by the IC of the incident
2. Rehab supervisor shall gather equipment and resources and establish a rehab site based on criteria listed above
3. Rehab supervisor shall follow the duties/responsibilities as outlined in the Responsibility section of this document
4. Rehab supervisors must ensure there is a separate area for revitalization and treatment of members
5. Members shall be sent to rehab as required by this policy
6. Upon check-in, members shall doff all PPE and receive a visual assessment
 - a. Personnel initially presenting with the following will be assigned directly to the treatment area for further medical evaluation, treatment, and/or transport per Seminole County EMS Practice Parameters
 - i. Chest pain
 - ii. Shortness of breath
 - iii. Dizziness or headache
 - iv. Nausea and/or vomiting
 - v. Obvious injury
 - vi. Changes in gait, speech, or behavior
 - vii. Changes to alertness and orientation to person, place and time
 - viii. Changes in skin color
 - b. Members not presenting with any significant signs/symptoms shall have their pulse rate (Pulse Oximeter) and temperature taken and documented on rehab form
 - c. Members will also be given an initial 8oz water which must be fully consumed upon entry
 - d. Documentation on work-to-rest ratios must be completed
 - e. Responders in rehab shall rest for a minimum of 20 minutes prior to being released from the rehab area to return to duty status
 - f. Rehab personnel shall evaluate vital signs, perform rehab assessments, and make the proper disposition into one of three (3) categories
 - i. Immediate Transport to the appropriate health care facility
 - ii. Continued monitoring and treatment in the rehab area
 - iii. Release from the rehab area – return to duty status
 - g. The following vital signs ***will require an additional 10 rest period*** in rehab and further medical evaluation ***until documented within normal limits:***
 - i. **Systolic blood pressure above 160 mmHg**
 1. Blood pressure should increase as the level of physical exertion/stress increases. Blood pressure to low, too high, or failing to return to normal level while in

rehab can indicate a medical problem. A responders who blood pressure is greater than 160/100 should not be released from rehab.

- ii. **Diastolic blood pressure above 100**
- iii. **Respiratory Rate <12 or >20** – Respiratory rate is a vital indicator used to assess health status, stress, and can be a possible indicator of exposure to other hazards. A normal respiratory rate is 12 to 20 breaths per minutes. But the end of 20 minute rehabilitation period, the responder should have a respiratory rate within these parameters.
- iv. **Heart Rate in excess of 110** – Heart rate is a critical measure used to assess health status. Normal resting heart rates range from 60-100 beats per minute. Under stress and exertion, the pulse rate can and should increase frequently above 100 beats per minute. The level of increase depends on the amount of stress and physical conditioning. After resting in rehab, the responder’s heart rate should return to normal resting rates. A responder who has not achieved a heart rate less than 110 beats per minute by the end of 20-minute rehab period should not be released from rehab, but should be further monitored and medically evaluated in the treatment area.
- v. **Body temperature in excess of 100.6° F or under 97° F** - Body temperature is a vital piece of information to assessing individual with both heat and cold stress exposure. Normal core temperature range from 98.6° F– 100.6° F. Temperatures outside of this range should be reason for further evaluation. Tympanic temperature readings may be up to 2° F lower than true core body temperature. Oral temperature readings are subject to error in tachynepic or hyperventilating responders. Oral temperature readings may be off by 1° F. It is essential that a measured temperature in the normal range not be used to exclude the possibility of heat related emergency.
- vi. **Pulse oximeter reading <95%** - values must be above 95% or the responder will not be permitted to be released from the rehab area. Values below 95% will result in the responder being moved to the treatment area for further medical evaluation.
- vii. **COHb levels** - smokers normally are 5-10%; non-smokers normally are 0-5%. CO readings over 12% indicates moderate carbon monoxide inhalation. CO readings 25% indicates severe inhalation carbon monoxide. Responders with a reading over 10% but lower than 15% should be given the opportunity to breath ambient air for a minimum of 5 minutes prior to repeating CO assessment. If the level is still above 10%, the responder shall be transferred to the treatment area of rehab for further medical assessment following the Seminole County EMS Practice Parameters.
- viii. **HCN** – Whenever a responder is transported due to chest pain, cardiac problems, respiratory problems, or altered mental status, consider the possibility that the symptoms may be exacerbated by HCN toxicity and forward that information to hospital staff. These symptoms may be signs of “Cyanide Toxicity/Poisoning” and consider treating with a Cyanokits per EMS Practice Parameter 5.19 cyanide Toxicity / Poisoning.
- h. Members requiring additional time in rehab will receive active cooling measures
- i. Members requiring additional time in rehab will consume 12-32 oz of water per 20-minute rest period
- j. Members requiring additional time in rehab will be reassessed every 10 minutes until vital signs return to within parameters, transferred to the treatment area, or transported to a medical facility
- k. If member’s vital signs are not within normal limits after additional rest periods (not to exceed 1 hour) with active cooling, hydration with cool water (40° F), electrolyte replacement of 8 oz, and calorie replacement and is not complaining of any signs/symptoms will be transferred to the treatment section of rehab and notifications shall be made to their respective Battalion Chief, Division Chief, Assistant Chief, or Fire Chief for further clarification of treatment.
- l. At any time a member is not recovering and/or exhibits signs/symptoms they must be transferred to the treatment section of the rehab area and proper medical treatment and transport shall be performed per Seminole County EMS Practice Parameters
- m. Ideally, members should consume 1 quart of water per hour
- n. During high intensity, long duration activity the following is recommended:
 - i. Ingest 30-60 grams/hour of carbohydrates
 - ii. Drink 8 Oz of sports drink containing approximately 15 grams of carbohydrate
 - iii. Consume other readily available carbohydrates sources such as fruits and foods

- o. Critical Incident Stress Assessment and/or Debriefing – defusing is an informal process that is introduced by trained CISD team members in an effort to reduce the pressure and anxiety surrounding a critical incident. Responders identified to be suffering from mental stress maybe defused then returned to duty status or released from duty and referred for follow-up treatment. Dispatching of a CISD team will up at the discretion of the IC.
- 7. Refusal of Medical Assistance/Aid – In the event a responder refuses to participate in rehab or refuses medical aid/assistance while in the rehab area, the rehab supervisor shall be notified, followed by the EMS supervisor, duty Battalion Chief for his/her agency and the IC for direction on appropriate action.
- 8. Documentation - on all medical evaluations upon entry and during rehab revitalization shall be documented on the IMS form attached to this document. A separate check-in/check-out log will also be maintained for accountability purposes. The Rehabilitation Log Sheet includes information such as name, company and unit designation, chief complaint, date/time of entry and exit, vital signs, treatment area needed, transport needed, and initials of personnel performing the medical assessment. All documentation shall be forwarded to the Rehab Supervisor for review. Any responder reporting to the treatment area while in rehab shall have a patient care report completed per EMS Practice Parameters. If responder is later released to return to the emergency operation or back to station status, the patient refusal form must be signed and completed. If a responder is transported to a medical facility for further evaluation, all EMS reports (paper and computer) shall be completed per protocols and Seminole County Practice Parameters.
- 9. Accountability – all responders shall perform check-in procedures with the Rehab Supervisor or their designee. Entrance to the rehab area shall be documented on the Rehab Check-in/Check-out Log. All responders are the enter and exit the rehab area as a crew. Crews shall not leave the rehab area until authorized to do so by the Rehab Group Supervisor.

Heat Index Chart																	
		% Relative Humidity															
		15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
Temperature	110	108	112	117	123	130											
	105	102	106	108	113	117	122	130									
	100	97	98	102	104	107	110	115	120	126	132						
	95	91	93	95	96	98	100	104	106	109	113	119	124	130			
	90	86	87	88	90	91	92	95	97	98	100	103	106	110	114	117	121
	85	81	82	83	84	85	86	87	88	89	90	92	94	96	97	100	102
	80	76	77	78	78	79	79	80	81	82	83	84	85	86	87	88	89
Legend																	
80-89 degrees		Fatigue is possible with prolonged exposure and/or physical activity.															
90-104 degrees		Sunstroke, heat cramps and heat exhaustion are possible with prolonged exposure and/or physical activity.															
105-129 degrees		Sunstroke, heat cramps and heat exhaustion are likely. Heat stroke is possible with prolonged exposure and/or physical activity.															
130+ degrees		Heatstroke/sunstroke is highly likely with continued exposure.															

Wind Speed, mph	Temperature, °F												
	45	40	35	30	25	20	15	10	5	0	-5	-10	-15
5	43	37	32	27	22	16	11	6	0	-5	-10	-15	-21
10	34	28	22	16	10	3	-3	-9	-15	-22	-27	-34	-40
15	29	23	16	9	2	-5	-11	-18	-25	-31	-38	-45	-51
20	26	19	12	4	-3	-10	-17	-24	-31	-39	-46	-53	-60
25	23	16	8	1	-7	-15	-22	-29	-36	-44	-51	-59	-66
30	21	13	6	-2	-10	-18	-25	-33	-41	-49	-56	-64	-71
35	20	12	4	-4	-12	-20	-27	-35	-43	-52	-58	-67	-75
40	19	11	3	-5	-13	-21	-29	-37	-45	-53	-60	-69	-76
45	18	10	2	-6	-14	-22	-30	-38	-46	-54	-62	-70	-78

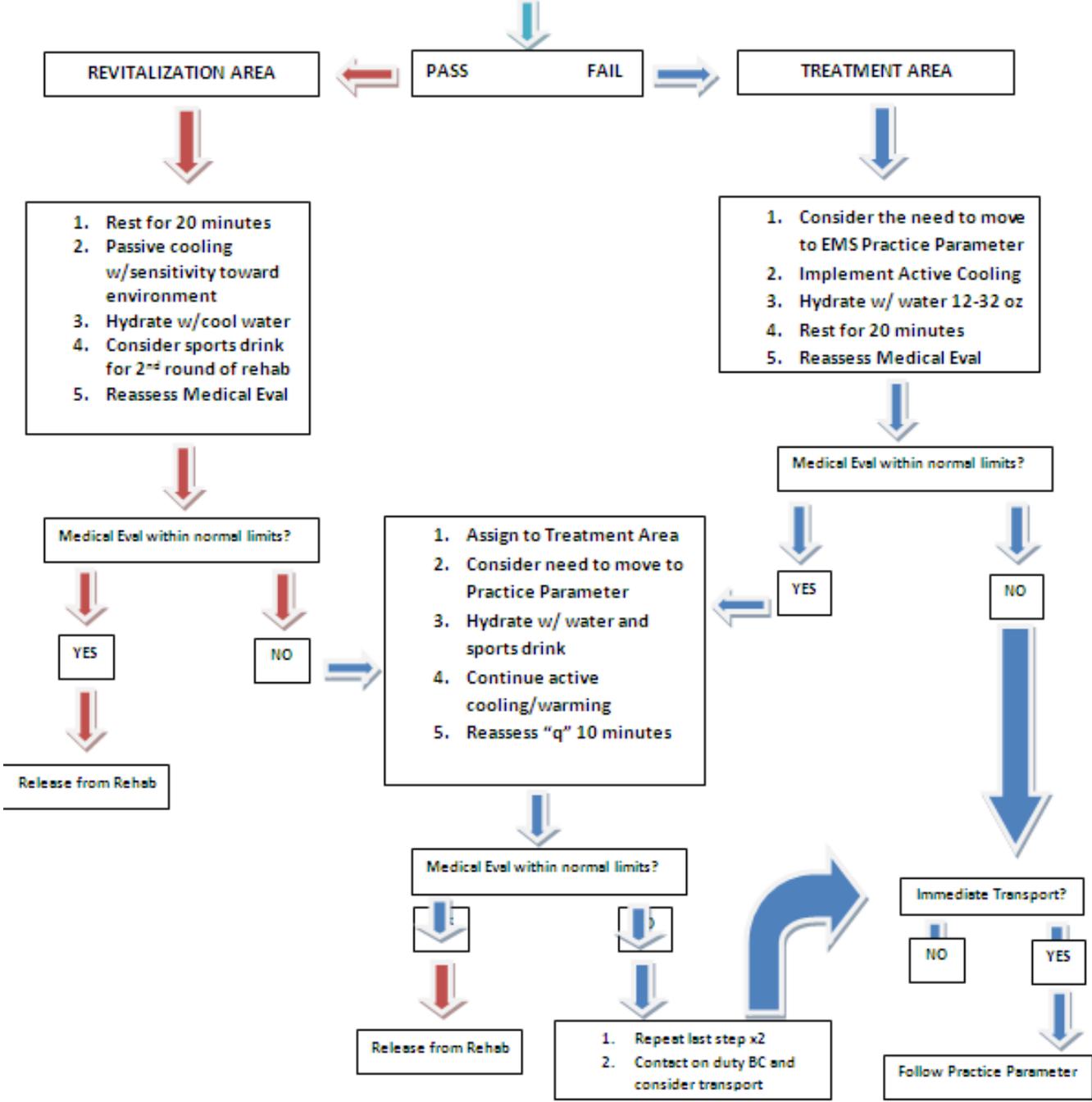
Wind Chill Temperature	Danger
Above 25 °F (-3.9 °C)	Little danger for properly clothed person Increasing danger; flesh may freeze Great danger; flesh may freeze in 30 seconds
25 to -75 °F (-3.9 to -59.4 °C)	
Below -75 °F (-59.4 °C)	

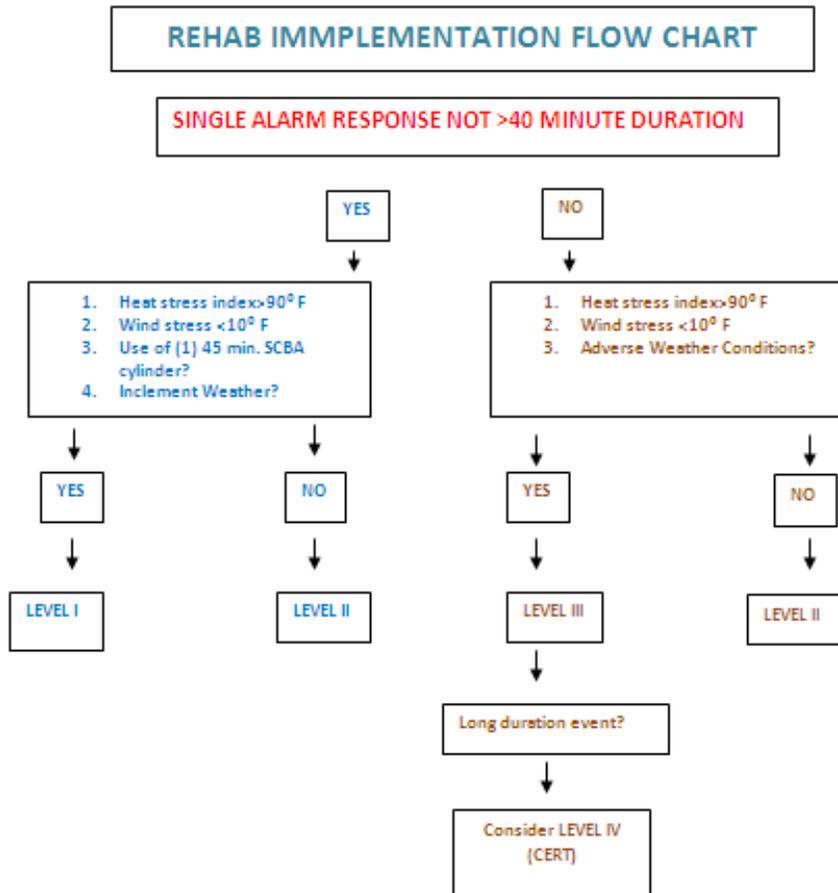
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REHAB FLOW CHART

1. Crew Rehab Entry
2. Document on Tracking Form
3. Remove PPE
4. Initial Baseline Assessment: Mental Status, Skin Condition, Gait,
5. Vitals: Pulse, Blood Pressure, Respirations, Temperature, COHb, SPO2
6. Drink (1) 8oz glass of water





Appendix D
 Comparison of Vital Sign Assessment Criteria

Agency	Systolic	Diastolic	Temperature	Heart Rate	Respiration	SP _{o2}	COHb
Southern Main Comm. College	N/A	N/A	N/A	N/A	N/A	N/A	N/A
River Falls Fire Department	N/A	N/A	100.6	120	N/A	N/A	N/A
Houston Fire Department	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Enchanted Circle Regional Fire	N/A	N/A	100.6	110	N/A	<92%	N/A
Sublimity Fire District	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Space Coast Fire Chiefs Assoc.	N/A	N/A	100.6	110	26	<92%	N/A
MABAS Division XII	150	90	20	110			
Clearwater Fire and Rescue	>200	>110	100.6	110	N/A	N/A	N/A
Columbia Fire Department	N/A	N/A	100.6	110	N/A	N/A	N/A
Noblesville Fire Department	180	100	100.6	110	24	N/A	N/A
Westminster Fire/Rescue	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spokane Valley Fire Department	160	90	101	120	N/A	N/A	N/A

Agency	<i>Systolic</i>	<i>Diastolic</i>	<i>Temperature</i>	<i>Heart Rate</i>	<i>Respiration</i>	<i>Spo2</i>	<i>COHb</i>
Rialto Fire Department	N/A	N/A	100.6	110	N/A	N/A	N/A
Henrico Fire Department	N/A	N/A	100.6	110	N/A	N/A	N/A
San Ramon Valley Fire Department	150	110	N/A	140	28	N/A	N/A
Summit Fire Department	160	100	99.5	120	20	92%	>8%
Janesville Fire Department	N/A	N/A	100.6	110	N/A	N/A	N/A
Palm Beach County Fire Dept.	180	100	N/A	100	N/A	N/A	N/A
Virginia Beach Fire Department	160	100	100.6	100	N/A	N/A	N/A
WPDPS-Fire Bureau	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Northwest Fire/Rescue	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rocky Mount Fire Department	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Northern Virginia Fire Departments	160	100	100.6	100	N/A	N/A	N/A