

Running Head: EMERGENCY INCIDENT REHABILITATION FOR FIREFIGHTERS IN
THE DENTON FIRE DEPARTMENT

Emergency Incident Rehabilitation of Firefighters in the Denton Fire Department

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CERTIFICATION STATEMENT

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

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ABSTRACT

This research project was designed to solve the problem of not having a standard operating procedure (SOP) for the rehabilitation of firefighters at emergency incidents in the Denton Fire Department (DFD) in Denton, Texas. The purpose of this project was to identify the components of an effective rehabilitation SOP, implement an SOP, and provide recommendations to improve the program. Research sought to answer the following questions:

Does an industry standard for emergency incident rehabilitation for firefighters exist?

How do similar industries address employee rehabilitation?

How are other area fire departments addressing firefighter rehabilitation at emergency incidents?

Does the DFD currently provide effective firefighter rehabilitation at emergency incidents?

Would DFD members support a comprehensive emergency incident rehabilitation policy?

An action research method was used to identify the existing national standard and the components of an effective SOP, develop a draft SOP, and make recommendations to further improve the program. Literature review, data analysis, and the author's first-hand experience established background and significance. A survey of North Central Texas fire departments provided insight into how area fire departments were addressing the issue. Finally, a survey of DFD personnel sought to determine if an SOP was needed and if DFD personnel would support such an SOP.

Research culminated in the development and successful implementation of an SOP, as well as of the following recommendations:

- 1) Complete the 30-day SOP review process and incorporate any suggested improvements to the rehab SOP, the command bus, and associated rehab equipment.
- 2) Develop a training program to address heat related injury and the importance of proper hydration and diet in the avoidance of heat related injury.
- 3) Research the fitness recommendations put forth in NFPA 1583 and develop a DFD fitness program.
- 4) Develop training curriculum to address the importance of fitness in the avoidance of heat related injury.
- 5) Research the cost effectiveness of the ingestible core temperature monitoring system, as an option for the DFD.

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INTRODUCTION

Problem Statement

The problem is the Denton Fire Department (DFD) has no SOP in place to address firefighter rehabilitation at emergency incidents. This puts firefighters at risk by returning them to duty before they have recuperated from the physical demands placed on them during prolonged incidents.

Purpose Statement

The purpose of this research paper is to identify the components of an effective emergency incident rehabilitation program, to ensure that firefighters are fully recovered before releasing them from the scene of emergency incidents. An action research method will be used to answer the following questions:

Does an industry standard for emergency incident rehabilitation for firefighters exist?

How do similar industries address employee rehabilitation?

How are other area fire departments addressing firefighter rehabilitation at emergency incidents?

Does the DFD currently provide effective firefighter rehabilitation at emergency incidents?

Would DFD members support a comprehensive emergency incident rehabilitation policy?

BACKGROUND AND SIGNIFICANCE

The City of Denton is located in north central Texas. The Denton Fire Department (DFD) is a medium-sized, career, municipal fire department with 145 sworn personnel. The department utilizes a three-shift, single-battalion, staffing methodology. The department staffs seven engine companies, one truck company, four ACLS ambulances, and one shift battalion chief. A minimum staffing level has been established to ensure that all engine companies are staffed with three firefighters, the truck company is staffed with four firefighters, and all ambulances are staffed with two paramedics. Ninety five percent of DFD personnel are paramedics. Through attrition, that number will soon be 100%

The DFD is responsible for providing fire protection and EMS services to 116,000 citizens over a 70 square mile area. The department also provides fire and EMS coverage to unincorporated areas of Denton County, through a contract with the county. On average, DFD personnel respond to approximately 10,000 runs per year, with 70% being EMS calls. The DFD provides additional services, which include: a swift water rescue team, a trench rescue team, a technical rescue team, a regional hazardous materials (HazMat) response team, and a regional explosive device response team.

In 2010, DFD personnel responded to 3,752 incidents which were not EMS related, 64 were structure fire calls, 55 motor vehicle fires, 73 grass/brush fires, 44 rescue calls, and 109 HazMat calls. In 2010, 229 incidents resulted in personnel remaining on-scene for more than one hour, 101 of those incidents occurred during the months of May through October. During the months from May through October, the average daily high temperature in the North Central Texas area is above 80°F, with a relative humidity between 66 -72%. (Climate)

The DFD does not have a specific rehabilitation (rehab) SOP in place. Until recently, a group of Citizen's Fire Academy Alumni, known as the Fire Cats, provided all DFD rehab functions. The Incident Commander (IC) would decide when, and if, rehab was needed and then notify dispatch. The Fire Cats were then notified to respond to the scene. The Fire Cats would respond to the central fire station in their private vehicles to ice down the drinks and buckets of ice water, used for wet towels, then go to the incident scene. At the scene, there was no designated rehab area, the Fire Cats would roam around the scene, offering firefighters drinks, snacks, and wet towels. That is no longer the case.

Due to recent events, the Fire Cats have been disbanded. The number of volunteers had begun to dwindle to the point that one or two volunteers were all that were available to provide rehab services. Due to budget restraints, the Citizen's Fire Academy program had been discontinued. This was the sole means the Fire Cats had of recruiting new members. According to DFD Deputy Chief Kenneth Hedges, the Fire Cats' performance of rehab functions had become "hit or miss" due to internal policy changes and personnel changes within the group. The department was forced to look for other alternatives. (K. Hedges, personal communication, June 15, 2011) It was now up to the individual engine crews to ensure they had drinks on their apparatus for rehab. The IC also had the option to call for the American Red Cross. When they have volunteers available, they will bring out their canteen and provide food and drinks whenever possible. (K. Hedges, personal communication, June 15, 2011) However, there are times when volunteers are not available and even the Red Cross does not respond.

There was no procedure in place to designate a rehab area, determine when a crew needed to report to rehab, or how long they should remain there. In addition, there was no system

in place to ensure accountability. Crews were left to decide when, if, and for how long, they chose to remain detached from the activities at the scene. Once the incident was under control the IC would consult with the company officers and start releasing crews. Once crews were released, they were available for the next call. According to DFD Battalion Chief Ken Gold, the company officer made the ultimate decision about when their crew was ready to be released from the scene. (K. Gold, personal communication on July1, 2011) This decision was made with no medical evaluation to ensure that crew members were fully rested and ready for the next incident.

Recently, on a day when the temperature was in excess of 100°F, DFD crews responded to a structure fire and no rehab was available. The IC called for additional crews to be sent to the scene to rotate crews. The first-in crew was relieved and assigned to another apparatus, then released from the scene. Their next call for service was a grass fire. They responded to that incident, already in a compromised state, tired and dehydrated. Fortunately, the grass fire was a small one and no one suffered any negative repercussions, although the potential was definitely present. (K. Gold, personal communication on July1, 2011)

The DFD does not currently have a vehicle dedicated to the rehab function. The department did have one, at one time. The vehicle was a refurbished bread truck, with a toilet, HVAC unit, and an SCBA refilling station. It was not the best piece of apparatus the department owned, but it had a place where personnel could get in, out of the elements, sit down, cool off, and even use the restroom. After this vehicle was removed from the fleet, firefighters were forced to grab a seat on the bumper of their apparatus, in the yard, or on the curb. Restroom facilities are not available on-scene unless there are public restrooms nearby.

The weather is hot in Texas. That is a fact of life for DFD personnel. Each year, the City of Denton hosts several special events that require DFD personnel to provide EMS coverage. This often means treating multiple patients for heat exhaustion. In June of 2010, at an air show sponsored by the Denton Municipal Airport, over fifty patients were treated for heat exhaustion at the scene and released. (K. Hedges, personal communication, June 15, 2011) Prior to the event, an inflatable tent was set up, with chairs, cots, and drinks for rehydration. A misting fan and buckets of wet towels were provided to aid in active cooling for those people who needed it. The DFD command bus was brought to the scene to provide air conditioning for those patients who might need additional cooling. (K. Hedges, personal communication, June 15, 2011)

While a special event, with months of prior notice and time to plan the perfect response, is not the same as a spontaneous emergency event, the results can be the same. Two years ago, at a motor vehicle accident involving a tractor trailer, four firefighters had to be transported to the hospital due to heat exhaustion. Firefighters spent an hour and fifteen minutes in full personal protective equipment (PPE), while extricating the truck driver. The temperature that day was over 105°F and the relative humidity was 69%. Three firefighters were treated for heat exhaustion and released from the hospital that day. One firefighter had to remain in the hospital overnight, due to severe dehydration and mild rhabdomyolysis and was released the following day. These were young, healthy firefighters who took pride in being in shape. They were shocked that something like this could “sneak up” on them. This situation could have been avoided had rehab been established.

Rhabdomyolysis is a condition where muscle tissue starts to break down and release its

contents into the blood. These contents are toxic to the kidneys and can lead to kidney failure. Severe cases often require the patient being placed on dialysis to aid the kidneys in their recuperation and to restore their function. The most common cause of rhabdomyolysis is overexertion while in a dehydrated state. (Wikipedia)

This researcher had a similar experience twenty five years earlier when suddenly, after working for four hours at a grass fire, I found myself on the ground suffering from the worst case of heat cramps I had ever experienced. Three firefighters were treated and released from the hospital that day. After multiple bags of intravenous fluids, all three firefighters were relieved of duty and sent home to finish their recovery. This was an eye-opening experience for a twenty five year old, ex-college football player, who took pride in his physical conditioning. The common denominator in these two incidents was the fact that rehab had not been provided at the scene. It was left up to the individual, or the captain's discretion, to decide when and if they needed a break, or fluid replacement. In both cases, failure to identify the need for rehab occurred and crew members suffered the consequences.

With most firefighter being young, type-A personalities, with egos as big as freight trains, they refuse to be the one to "slow down" their crew and ask for rehab. They would rather keep it to themselves and push on until the job is complete. No one wants to be "that guy" who slows up the crew or delays their being released from the scene. Add to that, the negative connotation that goes with the term "rehab", and it becomes obvious why firefighters often times find themselves overexerted and dehydrated. In the US, the term rehab tends to conjure up ideas that something is "wrong" with the individual. In sports rehab the individual is recovering from an injury. In drug rehab, the individual is recovering from an addiction. (Jaslow, 5/31/2007) No self-respecting,

type A, firefighter wants to be thought of as having something “wrong” with them. (Jaslow, 5/31/2007)

The DFD takes the necessary steps to plan for heat exhaustion when planning for a public special event. However, the department fails to do the same for its personnel. A special event is often times an all-day event, while the emergency incident is not. However, an emergency incident could easily, and often times does, escalate into an all-day event. Firefighters at an emergency incident will be engaged in labor intensive activities, while the public attending a special event will not. It is imperative that additional consideration be given to firefighters’ well being while they are engaged in the strenuous physical activities required at emergency incidents.

Each year an average of 100 firefighters die in the line of duty, 50% of those deaths are due to cardiac arrest. It has long been accepted that overexertion leads to cardiac arrest, especially to a heart that is already at risk, due to other risk factors. The DFD has been lucky and has never had a line of duty death (LODD) due to cardiac arrest. Based on the departmental demographics, 51 percent being over the age of 40 and an average age of 43 years old, there are members of the department who are getting old enough that cardiac disease is a concern. The DFD currently has members who have multiple cardiac arrest risk factors, as well as previous history of cardiac problems. This is not a problem that is unique to the DFD, the US work force is getting older. According to City of Denton Human Resources class Clash of the Generations curriculum, no one knows exactly why, but workers in the US are choosing to stay in the workforce longer.

Reducing the number of LODD is one of the strategic goals of the United States Fire

Administration. Establishing an effective emergency incident rehabilitation program would ensure that firefighters were properly rested after prolonged physical activities encountered during emergency incidents. It would also ensure fluid and electrolyte replacement, as well as make sure that firefighter nutritional needs were met. With proper on-scene medical monitoring, early warning signs of overexertion could be identified and treated if detected. All of this would reduce the risk of cardiac arrest from overexertion.

As discussed in the Executive Leadership curriculum, promoting a transitional change, such as this, is difficult. For the decision making process to be effective, all the pertinent information must be made available to the decision makers and buy-in from all stakeholder groups must be accomplished. The intent of this research is to gather the information and develop recommendations to put into place an effective emergency incident rehabilitation procedure to ensure the health and wellbeing of all DFD personnel. Doing so not only serves the DFD personnel, but also the citizens whom they are sworn to protect. This would result in the reduction of the risk of a LODD in the DFD, thus meeting one of the strategic goals of the US Fire Administration.

During the research phase of this project, the North Texas area was in the midst of the worst heat wave in more than two decades. Conducting a survey of DFD personnel resulted in an outcry from line personnel, demanding that something be done to address the fact that the DFD had no policy or procedure in place to address firefighter rehab at emergency incidents. The decision was made to postpone the completion of this ARP project until an effective, yet still not fully comprehensive, rehab policy could be developed and put into place.

A prototype SOP was drawn up, utilizing additional on-duty personnel to staff the

“Rehab Group”. The SOP contained components identified during the early stages of the research for this applied research project. To address the issue of not having a rehab vehicle, the DFD command bus was used. The command bus had been an ongoing project for more than a year. While it was not yet completed, the decision was made to press it into service as a rehab vehicle.

A need for additional rehab equipment such as coolers, misting fans, chairs and hydration supplies was identified. Ice chests and chairs were purchased. A search was conducted to find an affordable, commercially available misting fan, but to no avail. Firefighter ingenuity was used to construct a misting fan “system” utilizing a centralized supply reservoir and pump system. Four fans were then outfitted with patio misting tubing and quick-connect fittings. The entire system was constructed from parts purchased from a local hardware store. The central pump system could support up to four misting fans for the cost of a single commercial misting fan. This would allow additional funds to be spent on equipment purchases that might be identified later.

Due to the urgency of this issue and the outcry from line personnel, the decision was made to forego the customary 30-day SOP review process in favor of getting a procedure in place as quickly as possible. The 30-day review process would run concurrently and any feedback on procedural enhancements would be addressed at a later date. Doing so would provide immediate relief for the line personnel, operating during a period of extraordinary climatic conditions. The prototype SOP, though still not complete, was well received and appreciated by line personnel. This fact, in and of its self, demonstrates the significance of the need for a comprehensive emergency incident scene rehabilitation SOP in the DFD.

LITERATURE REVIEW

Every year, an average of 100 firefighters die and 50% of those deaths are due to cardiac arrest. According to the US Fire Administration data for 2010 and for the first half of 2011, greater than sixty one percent of firefighter deaths were due to overexertion. (USFA) Of those, twenty five out of thirty three were firefighters who were over the age of forty. (USFA) In addition to overexertion, numerous published studies have shown heart damage resulting from carbon monoxide (CO) poisoning is a frequent and significant predictor of mortality. This warrants appropriate screening for the detection of such injuries. (Bledsoe)

The activities involved with firefighting entail firefighters making life and death decisions. When emergency responders become fatigued, their ability to operate safely is impaired. As a result, their reaction time is reduced and their ability to make critical decisions diminishes. (USFA)

Over the last two decades, the construction industry has introduced more and more synthetic materials, such as plastics and other petroleum based products. The result has been fires that burn two to three times hotter, two to three times faster, and that produce more toxic products of combustion. (O'Brien) All of this adds up to a more dangerous environment that firefighters must work in. The dangers presented by the introduction of synthetics into the equation are complex. First, the toxic nature of smoke encountered in today's fires can cause negative health effects, both immediately and long-term. Secondly, since fires now burn hotter and faster, firefighters are encountering more stress while combating them.(O'Brien)

The fast burning, hotter fires equate to a more intense work load for firefighters. The increased work load means that firefighters will expend more energy and thus produce more metabolic heat as a result of their activity. Combine that with the insulating properties of modern

personal protective equipment (PPE) and the increased environmental heat from the burning of synthetic materials, and it results in a more rapid increase in the body's core temperature.

(USFA)

When the human body experiences stress due to exertion, it produces heat as a by-product. This metabolic heat accumulates and increases the body's core temperature. Frequent rest periods limit the accumulation of metabolic heat and allow the core temperature to decrease between periods of exertion. Combining rest periods with rehydration and active cooling will allow the release of body heat and the lowering of the body's core temperature. (Laws) It should be noted that during intense workloads, core temperatures continue to increase, even after the work is discontinued. (Laws)

There are two ways to reduce the body's core temperature; passive cooling and active cooling. Passive cooling involves allowing the body's sweat mechanism to act as its own form of temperature regulation. (Laws) As the body's core temperature rises, the sweat glands open up to release moisture which evaporates and cools the surface of the skin. The capillaries under the skin exchange heat, much like a car's radiator, and return the cooler blood to the internal organs. This can be accomplished by having firefighters remove their PPE and sit in front of a fan or smoke ejector, allowing moving air currents to enhance the body's natural cooling mechanism, dissipating heat through evaporation. However, when air temperature is greater than 104° F (40°C), increasing air motion may actually increase heat stress. (Laws)

Passive cooling to reduce the body's core temperature has a cost, in the form of dehydration, or excessive fluid loss. The human body is made up of 68% water, by mass. The following excerpt is from the Cantimer website.

The sensation of thirst becomes apparent when water loss approaches 1%-2% of total body mass (approximately 3.0 lbs for a 150 lb person). It follows, therefore, that a person is already mildly dehydrated by the time they feel thirsty. As dehydration progresses, symptoms become increasingly severe and susceptibility to dehydration-related conditions, such as heat exhaustion, and heat stroke, escalate. Signs and symptoms of mild dehydration (2-4% loss of body mass) include the initial onset of thirst, dry mucous membranes, mild fatigue, loss of appetite, headaches, loss of concentration, irritability, decreased blood pressure (hypotension), and dizziness or fainting when standing up (due to orthostatic hypotension). Moderate dehydration (4-7% loss of body mass) may result in lethargy or extreme sleepiness, nausea, confusion, tingling in the limbs (paresthesia), heat cramps, seizures, fainting and significant decreases in aerobic power and endurance. With severe dehydration (8-10% loss of body mass), muscles may become spastic, skin may shrivel and wrinkle, vision may dim, urination may become painful, delirium may begin and recovery without assistance may be impossible. A body weight loss greater than 10-12% is usually fatal. (Cantimer)

According to Robin Stacey, owner and CEO of Cantimer, the company is in the process of developing a handheld monitor used to determine if a patient is suffering from dehydration. The hand-held monitor will function much like a glucometer used by diabetics, requiring a single

drop of saliva and rendering a reading in one minute. (R.Stacey. personal communication on 8/24/2011) Their monitor, while showing real promise for the detection and monitoring of dehydration, is not currently available. According to Robin Stacey, Cantimer's owner and CEO, the company received grant money for the research and development of the technology. Cantimer has completed field testing and is awaiting FDA approval. They are in the process of identifying investment funding to begin production. (R. Stacey, personal communication on August 24, 2011) Research has shown that a firefighter, in full PPE, can lose a liter of water in twenty minutes of strenuous firefighting. (USFA) Cantimer's dehydration monitor, once available, will be an invaluable asset to the fire service.

Active cooling involves some sort of external source to help aid in the dissipation of body heat. This can include, but is not limited to, using ice packs, wet towels, air conditioning, misting fans, or forearm submersion. During a recent air show sponsored by the Denton Municipal Airport, over fifty patients were treated for heat exhaustion utilizing rehydration and active cooling techniques such as: misting fans, and applying cold, wet towels to the patients. All but one patient were treated at the scene and released. (K. Hedges, personal communication, June 15, 2011)

There is no question that taking care of firefighters is the right thing to do, both morally and ethically. Few fire departments need additional incentive to provide for the safety of their personnel. However, there are a variety of laws, regulations, and consensus standards to ensure that fire departments have procedures in place to address safety issues and provide a reasonably safe work environment for firefighters. One must first understand the differences in laws, regulations and standards.

Laws are rules of society that are adopted formally by some governmental agency, typically the authority having jurisdiction, or AHJ. AHJs are governmental agencies at the Federal, State, county, or local levels. Laws are enforced by agents of the government and often times carry with them criminal penalties for violations. Criminal penalties can include: fines, incarceration, or other forms of punishment. (USFA)

Standards are consensus positions developed by a group of people who have a common interest in the particular area or discipline. While standards do not carry the same force as a law or regulation, there are consequences for not following them. NFPA standards have routinely been recognized as nationally accepted practices. Failure to follow them could possibly result in civil liability for the fire department. (USFA) In a law suit situation, the fire department could be forced to pay monetary damages for not following an NFPA standard. However, no fire department is expected to carry out every detail in a consensus standard. As long as they can show a reasonable attempt was made to comply, their risk of liability is reduced considerably. (USFA)

The Occupational Safety and Health Administration (OSHA), a division of the Department of Labor, has two regulations that apply to firefighter rehabilitation, 29 CFR 1910.156, Fire Brigades, which provides regulations for fire departments and fire brigades. It does not contain specific requirements for rehabilitation, but it does address personal protective equipment that does affect the need for rehabilitation services. (USFA) 29 CFR 1910-120, Hazardous Waste Operations and Emergency Response, does specifically address the need for rehabilitation at all HazMat incidents. (USFA)

The National Fire Protection Association (NFPA) publishes fire service consensus

standards. As discussed earlier, these standards do not carry the same weight as laws of regulations, but they must be taken seriously. NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, does not provide specific details concerning emergency incident rehabilitation, but it does list a number of specific components that should be included. These fixed components include: rest, hydration, active cooling (when needed), basic life support (BLS) operations, food (when needed), and protection from extreme environmental elements. (USFA)

NFPA 1582, Standard for Comprehensive Medical Program for Fire Departments and NFPA 1583, Standard for Health-Related Fitness Program for Firefighters, do not address emergency incident rehabilitation, but they do address the need to begin the process with healthy, well-conditioned firefighters. Doing so greatly reduces the risk of firefighters suffering ill effects from overexertion, due to fire ground activities. (USFA) Both NFPA 1582 and NFPA 1583 are referred to in NFPA1584 in reference to the need for such programs to ensure firefighters are in good condition prior to beginning fire fighting activities. (NFPA 1584)

NFPA 1584, Recommended Practice on the Rehabilitation of Members Operating at Emergency Incident Scene Operations and Training Exercises, was released in 2003 as a “recommended practice” which does not carry the same weight in court as a consensus standard. The “standard” version was released in 2008 and carries with it the same weight as any other consensus standard. (USFA)

With the release of the 2008 version of NFPA1584, the national standard for firefighter rehabilitation at emergency incidents has been established. While it does not carry the same force as law, it is the nationally recognized standard that would be cited in court, should a fire

department choose not to provide rehab facilities at emergency incidents and a firefighter should succumb to heat injury while working at an emergency incident.

NFPA 1584 contains an example of a comprehensive SOP. The sample provided within the standard provides guidance for any fire department to create their own SOP. The document recommends the following components:

- Purpose statement: To identify what the overall purpose of the document is intended to address.
- Scope: To identify who the document pertains to, or who is affected.
- Rules: Identifies when the procedure is to be implemented.
- Responsibilities: Identifies the responsibilities of the individuals who will activate, set up, and operate a rehab operation.
- Procedures: Defines the work to rest ratio, recommends rest period duration, recommends medical monitoring, recommendations about when to transport firefighters to a medical facility.

In addition to the sample SOP, NFPA 1584 outlines recommendations including: the administration of a rehabilitation program, definitions that need to be understood, setting up a program, choosing a site to set up rehab operations, and the eight essential components of the actual rehab process. Chapter 6, Incident Scene and Training Rehabilitation, lists the eight essential components that must be addressed:

- 1) Relief from Climatic conditions
- 2) Rest and recovery
- 3) Active and/or passive cooling or warming as needed for incident type and

climatic conditions

- 4) Rehydration (fluid replacement)
- 5) Calorie and electrolyte replacement, for longer duration incidents
- 6) Medical monitoring
- 7) Member accountability
- 8) Release procedures

In addition, NFPA 1584 also provides three tools for identifying climatic conditions that pose a threat to firefighter safety, they include: the “Heat Stress Index”, “Wind Chill Temperature” chart, and the “Humidex” chart. The “Heat Stress Index” chart and the “Wind Chill” chart are both published by the National Weather Service. NFPA 1584 also includes a corresponding injury risk chart, based on the Heat Stress Index. The Humidex chart is the Canadian metric equivalent of the Heat Index. NFPA 1584 also contains a corresponding list of heat stress reduction recommendations, based on the Humidex chart. (NFPA 1584)

Heat injury does not occur only during emergency incidents. Injury can occur during training evolutions, as well. According to an article on Firefighter Nation.com, two firefighters died from heat exhaustion during training evolutions in 2008, one in Stillwater, Oklahoma and another in Woodbridge, Virginia. (Lindsey) Rehab needs to be established during training evolutions as well as emergency incidents. While training evolutions are addressed in NFPA 1584, the document does not go into any specific detail. Any time that personnel are to be exerting themselves in hot conditions, or for extended periods of time, rehab needs to be established. (Lindsey)

Perhaps one of the biggest obstacles to an effective rehabilitation procedure at emergency

incidents is the current attitude of the firefighters themselves. With type-A personalities being prevalent in the fire service, many firefighters resist the need to rehab, taking it to mean they are weak, or something is “wrong” with them. (Jaslow, 12/19/2007) They don’t want to be the reason their crew was held back from the action. Another issue is the negative connotation of the word itself. In general terms, the term rehab implies that something is wrong with the person; drug rehab, or physical rehab after an injury. (Jaslow, 5/31/2007) When it comes to staffing the rehab group, no one wants to be the “rehab police”. (Jaslow, 5/31/2007) Jaslow states, “clearly, an attitudinal shift and a paradigm shift is needed in the fire service so that medical monitoring and rest for firefighters is looked upon as a mechanism to preserve life and the ability to come back and fight the next fire. (Jaslow, 5/31/2007)

PROCEDURES

An action research method was used in this project. The purpose of this research paper was to develop a standard operating procedure (SOP) for firefighter rehabilitation at emergency incidents for the Denton Fire Department, located in Denton, Texas. Since there was found to be no such SOP in place, research sought to answer the following questions:

1. Does an industry standard for emergency incident rehabilitation for firefighters exist?
2. How do similar industries address employee rehabilitation?
3. How are other area fire departments addressing firefighter rehabilitation at emergency incidents?
4. Does the DFD currently release firefighters from emergency incidents before they are physically recovered?

5. Would DFD members support a comprehensive emergency incident rehabilitation policy?

Literature Review

A number of articles and websites were researched to answer research question number one and determine if an industry standard did exist. Research revealed that the national standard for firefighter rehabilitation is NFPA 1584. Additional guidance was found in the US Fire Administrations Firefighter Rehabilitation document that mirrors the requirements found in NFPA 1584.

In addition, literature review was utilized in an attempt to identify other industries that might be similar to firefighting and how the issue of employee rehabilitation was addressed.

Personal interviews

No industry was identified that exactly matches firefighting. However, when considering the physical aspects of the job and the outside environments where the work is performed, a reasonable comparison can be made between playing football and firefighting. Personal interviews were conducted Dustin Hill, Director of Sports Medicine at the University of North Texas, Megan Burki, Assistant Athletic Trainer at the University of North Texas, and Coach James Cantrell, the Athletic Director with the Mabank Independent School District, to determine what steps are taken by the athletic staffs to ensure that student athletes, particularly football players, are properly rested and hydrated during hot weather practices and games. A list of the interview questions can be found in Appendix B.

Telephone survey

A telephone survey was conducted to answer the research question, “What are area fire departments doing to address firefighter rehabilitation at emergency incidents”. Fire departments located in Denton County, Texas were contacted by phone to determine which departments had a rehab vehicle and which departments had written SOPs in place to address firefighter rehabilitation. A list of the survey questions can be found in Appendix C.

Personnel Survey

A survey was conducted of Denton Fire Department personnel to answer the research question, “Does the DFD provide effective rehabilitation for firefighters at emergency incidents”. Lastly, this survey sought to answer the research question, “Would DFD personnel support a comprehensive policy addressing firefighter rehabilitation”. A copy of the survey and the results can be found in Appendix A.

Limitations

The limitations that were encountered were: the non-existence of industries similar to firefighting. This author could find no evidence of an industry that requires personnel to wear triple layer, vapor-restrictive, personal protective ensemble and 30-40 pounds of additional equipment while performing strenuous physical activities in extreme environmental conditions, under emergency, life and death situations. While a poor comparison at best, football players seemed to be the closest reasonable facsimile. Three attempts were made to contact a local

professional football team, in hopes of ascertaining how the issue is addressed in that industry. All attempts to make contact failed.

Another limitation was the failure of some area fire departments to return phone calls concerning the departmental survey. As discussed earlier, the North Texas area was experiencing the worst heat wave and drought in more than two decades, with most area fire departments responding to numerous grass/ brush fires on a daily basis, they were understandably busy.

The final limitation was the lack of willingness on the part of DFD personnel to participate in an email survey. An initial survey was sent out by email, resulting in only a handful of responses being received. This limitation was overcome by conducting an in-person survey. Each on-duty crew was contacted directly and asked to complete the survey. The survey was conducted over a three day period to ensure that responses were received from personnel from all three shifts. While this method may have produced a slightly skewed response from members of the department who felt they were being somehow forced to participate, the results reflected only a small percentage, 2%, of personnel who felt that way.

RESULTS

The results of each procedure included in this research are presented in succession. The procedure used in each area will provide facts, as well as insight, into the stated problem and seek to answer the research questions stated in the introduction. The goal of the Denton Fire Department is to provide the best possible level of service to its citizens. To do so requires that procedures be in place to ensure an effective response to a myriad of scenarios. To accomplish this goal, the department must ensure that the line personnel are taken care of and that their physical needs are met. The DFD Command Staff consider line personnel to be the department's

most valuable asset and thus realize the importance of ensuring their health, well being, and that all safety issues are addressed. Providing an effective rehabilitation procedure would ensure that personnel would remain in optimal condition to perform the strenuous tasks, under adverse conditions, that are required of them during emergency incidents.

Literature Review

The number of articles and journals were reviewed to answer the following question: “Does an industry standard for emergency incident rehabilitation for firefighters exist?” Research revealed that an industry standard does exist. The National Fire Protection Association (NFPA) has published NFPA 1584: *Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises*. NFPA 1584 contains an example of a comprehensive SOP. The sample provided within the standard provides guidance for any fire department to create their own SOP. The document recommends the following components:

- Purpose statement: To identify what the overall purpose of the document is intended to address.
- Scope: To identify who the document pertains to, or who is affected.
- Rules: Identifies when the procedure is to be implemented.
- Responsibilities: Identifies the responsibilities of the individuals who will activate, set up and operate a rehab operation.
- Procedures: Defines the work to rest ratio, recommends rest period duration, recommends medical monitoring, recommendations about when to transport firefighters to medical facility.

NFPA 1584 also has sections dealing with the administration of a rehabilitation program, a section on definitions that need to be understood, setting up a program, a section on choosing a site to set up rehab operations, and finally the components of the actual rehab process. In Chapter 6, Incident Scene and Training Rehabilitation, NFPA 1584 lists eight essential functions that must be addressed:

- 1) Relief from Climatic conditions
- 2) Rest and recovery
- 3) Active and/or passive cooling or warming as needed for incident type and climatic conditions
- 4) Rehydration (fluid replacement)
- 5) Calorie and electrolyte replacement, for longer duration incidents
- 6) Medical monitoring
- 7) Member accountability
- 8) Release procedures

In addition, NFPA 1584 also provides three tools for identifying climatic conditions that pose a threat to firefighter safety, they include: the “Heat Stress Index” (Appendix D), “Wind Chill Temperature” chart (Appendix E), and the “Humidex” chart . The “Heat Stress Index” chart and the “Wind Chill” chart are both published by the National Weather Service. NFPA 1584 also includes a corresponding injury risk chart, based on the Heat Stress Index. The Humidex chart is the Canadian metric equivalent of the Heat Index. NFPA 1584 also contains a

corresponding list of heat stress reduction recommendations, based on the Humidex chart.

(NFPA 1584)

Literature review was also utilized in an attempt to identify other industries, similar to the firefighting, and how those industries address employee rehabilitation. Numerous job comparison sites were researched to determine if an industry, similar to firefighting, existed. Research was unsuccessful in identifying any such industry. No evidence was found of any job description that requires personnel to don protective clothing comprised of a triple layer, vapor restrictive ensemble, add to their person 30 - 40 pounds of additional equipment, and then perform strenuous physical activities, in an extreme physical environment, under emergency, life and death, circumstances. Based solely on the physical aspect of the job, the closest reasonable comparison was that of a football player.

Personal Interviews

Even though literature review found no profession exactly like firefighting, when considering only the physical aspects the two, a reasonable comparison can be made between firefighting and playing football. In an attempt to answer the research question, "How do similar industries address employee rehabilitation", attempts were made to contact the Dallas Cowboys training staff. When these attempts failed, the decision was made to seek information from the University of North Texas medical staff and the Athletic Director of the Mabank Independent School District.

A personal interview was conducted with Dustin Hill, Director of Sports Medicine and Megan Burki, Assistant Athletic Trainer with the University of North Texas (UNT). A copy of

the interview questions can be found in Appendix B. The National Collegiate Athletic Association (NCAA) is the governing entity for college level athletic programs. They provide guidance in the areas of program structure, game and practice schedules, etc., but not for player rehydration. How that issue is addressed is left up to the medical staff at each school. The NCAA recommends a two week acclimation period for players and mandates that teams cannot have two-a-day workouts on consecutive days. This allows for proper rehydration between two-a-day workouts and prevents chronic dehydration. (Hill)

The UNT medical staff does not use the WBGT method to monitor weather conditions. Mr. Hill stated, “It is just too complicated and time consuming to make all the necessary calculations. There are digital thermometers available that make it a lot easier”. (Hill) According to Ms. Burki, players’ vital signs are not monitored, as a rule. All training staff are trained in how to recognize a player who might be in distress and vital signs would be taken at that time. An “IV nurse” is always on hand at practices and games, should any player need intravenous fluids. (Hill)

The UNT medical staff do employ active cooling techniques at all football practices and games. They use misting fans and cold towels and sponges to aid in reducing players’ core temperatures. (Hill) Some of the football programs that have more funding available also use a high-tech method to monitor players’ core temperature in real time. The player swallows a one-time-use capsule that checks their temperature and transmits it to a receiver. This allows the training staff to keep a constant watch on all players at the same time. (Hill)

The most effective way to ensure that UNT football players are well hydrated is player

training. Each year before practices begin, all players are provided training on the importance of pre-hydration, hydration, nutrition, and physical conditioning and how it affects the prevention of heat related injury. (Hill) Part of that training involves the simple act of posting a color-coded chart at all urinals, so players can see for themselves, at a glance, if they are dehydrated, or not. (Burki) A copy of the wall chart can be found in Appendix D.

All UNT athletes are required to weigh prior to practice and all games. Players are weighed again, after the event. Any change in weight greater than 2% of their total body weight is cause for concern. (Hill) The 2% fluid loss marks the player's "drip weight". Any player who drops below their drip weight are placed on a rehydration regimen and weighed again the following day to ensure they are properly hydrated. (Hill)

According to Mr. Hill, all UNT African American players are tested for sickle cell trait, because of the serious complications the condition can have on a dehydrated player. Due to the malformed red blood cells that are associated with this condition, simple dehydration can quickly become a life and death situation for these players. At UNT, if a player with sickle cell trait shows any sign of dehydration, they are immediately removed from the practice field or game and measures are taken to ensure they are rehydrated and the player is monitored until the threat is resolved. (Hill)

A personal interview was conducted with Coach James Cantrell, Head Football Coach, and Athletic Director for the Mabank Independent School District (Appendix B). According to Coach Cantrell, each Texas high school football program handles the issue differently. However, they are all mandated to follow University Interscholastic League (UIL) rules, which govern all Texas high school athletic programs. UIL guidelines are published to ensure not only the

equality of the teams, but to provide a measure of safety for the students who participate in high school athletics. (Cantrell)

UIL rules limit the number of hours per week that teams can practice. Individual programs can choose how they meet that, but most choose to break it down so that they practice each day. This has the effect of eliminating practice sessions that are excessively long in duration. (Cantrell) The guidelines mandate checking the Wet Bulb Globe Temperature (WBGT) reading before, during and after practice sessions, and makes suggestions upon when to shorten practice sessions, move players to an indoor facility, or cancel practice sessions based on the findings. Below is the definition of the Wet Globe Global Temperature as stated on Wikipedia.com:

The **Wet Bulb Globe Temperature (WBGT)** is a composite temperature measurement, developed by the US Marine Corp, used to estimate the effect of temperature, humidity, wind speed (wind chill) and solar radiation on humans. It is used by industrial hygienists, athletes, and the military to determine appropriate exposure levels to high temperatures. It is derived from the following formula:

$$WBGT = 0.7T_w + 0.2T_g + 0.1T_d$$

Where

- T_w = Natural wet-bulb temperature (humidity indicator)
- T_g = Globe thermometer temperature (measured with a globe thermometer, also known as a black globe thermometer, to measure solar radiation)

- T_d = Dry-bulb temperature (normal air temperature)
- Temperatures may be in either Celsius or Fahrenheit

UIL guidelines make allowances for deviation of guidelines based on the fact that some athletic programs have more funding than others and not all have access to indoor facilities. (Cantrell) Coach Cantrell suggested researching the National Athletic Trainers' Association (NATA) website, as well as the UIL website for additional information.

The UIL guidelines mirror the recommendations of the NATA. The NATA makes several recommendations for the prevention of heat related injury. These recommendations include:

- Requiring all players to have annual physicals, clearing them of any health related illnesses.
- Educating players on the importance of hydration, pre-hydration and the importance of a well balanced diet.
- Educating athletic training staff of the signs, symptoms and treatment of heat related injury.
- Heat acclimatization (building up players' tolerance to environmental heat by gradually increasing their exposure over a 10 – 14 day period)
- Altering practice schedules, or even cancelling practice based on WBGT readings. Suspending practice or moving to an indoor facility if WBGT is above 82°F.
- Scheduling practice sessions to avoid the hottest times during the day.
- Providing an adequate supply of the proper fluids to allow for the maintenance of hydration levels.

- Checking the body weight of high-risk athletes before and after workouts or events.
- Minimizing the amount of equipment players wear.
- Allowing players to practice in the shade, whenever possible.
- Having players cleared by a medical doctor before returning to physical activities when they have suffered heat injuries. (University)

Telephone survey

A telephone survey was conducted of the fire departments located in Denton County, in an attempt to answer the research question, “How are other area fire departments addressing firefighter rehabilitation at emergency incidents”. According to the Denton County Emergency Services Department Resource List, out of the twenty five fire departments located in Denton County, six had a vehicle dedicated to rehab operations. One of these six vehicles is operated by the Denton County Emergency Services Department (DCESD), operated by the County Fire Marshal’s Office. Of the six entities which had a dedicated rehab vehicle, the five fire departments relied on volunteer groups to staff their rehab operations. Only the DCESD has dedicated staff to operate their rehab vehicle. None of the six entities have paramedics assigned to staff their rehab vehicle and provide the medical monitoring aspect of their rehab operation. All indicated that paramedics available on scene would be utilized to perform this function, if needed.

When asked if their department had an SOP for rehab, only three departments had such an SOP in place. One department did not know for sure if the volunteer group had a written procedure, but confirmed that the department itself did not possess an SOP. An attempt was made to contact the leader of the volunteer group by email, but no response was received. The

DCESD does not currently have an SOP for their rehab operation.

When asked if their department monitored vital signs of the firefighters assigned to rehab, two departments indicated that they did take vital signs. However, since they do not have medically trained personnel to staff their rehab unit, they rely on paramedic personnel at the scene to check vital signs if a firefighter presents in a compromised state, or they suspect there is a problem. This is also the case with DCESD. One department indicated that while they had an SOP in place, they did not monitor vital signs. However, they were working on an update to their SOP that would include medical monitoring.

Personnel Survey

A survey of DFD personnel was conducted to answer the final two research questions, “Does the DFD currently do an effective job of firefighter rehabilitation at emergency incidents”, and “Would DFD members support a comprehensive emergency incident rehabilitation policy”.

A copy of the personnel survey and the results can be found in Appendix A. An initial attempt was made to conduct this survey by email. Doing so resulted in only a handful of responses. Therefore, the decision was made to deliver the survey in person and wait for the surveys to be completed. This would ensure that a reasonable cross section of the department was surveyed. Due to some personnel being off duty, some members of the department were not surveyed. In addition, some crews were missed due to emergency runs. A total of 88 responses were collected. This represents more than 60% of the line personnel in the DFD.

Research revealed that the majority of DFD personnel surveyed, 97%, felt that the DFD does not provide adequate rehabilitation for its personnel at emergency incidents. On a scale of

1-5, 90% considered rehab to be an important issue in the DFD. Slightly less than half, 49%, believed that rehab begins at the start of their shift. Fifty Seven percent of those surveyed knew how much water the average person should consume on a daily basis. Seventy eight percent felt that vital signs should be assessed during rehab and 83% thought that firefighters should not be allowed to return to the fire ground until they met medically defined benchmarks. Eighty two percent of those surveyed agreed that they would support a comprehensive rehab procedure that required personnel to meet medically defined criteria before being released from rehab.

DISCUSSION

Research revealed that an industry standard for emergency incident rehabilitation for firefighter does exist. NFPA 1584 *Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises* is the accepted consensus standard. This standard outlines the necessary requirements to set up and administer a rehabilitation program. It identifies the scope, purpose, rules, responsibilities and procedures involved. It also identifies the eight essential components of an effective rehab program. All of these components were incorporated into the draft SOP that was implemented in the DFD while in the process of researching for this applied research project.

While the main focus of the initial research was concerned with emergency incidents, research revealed that rehab should also be implemented during training evolutions that are either labor intensive, long in duration, or both. This is something the DFD has never done before and would involve a cultural change. Two tools were found in NFPA 1584 to assist in identifying when weather conditions might have a negative effect on personnel safety and should

be included in any SOP that is implemented.

Research failed to identify any industry that matches the job description of a firefighter. However, if only the physical aspects of the job are considered, football players represent a reasonable comparison. Both professions require extreme physical exertion. While the actual tasks performed are different, the effects are the same, resulting in increased heat rate, and a buildup of metabolic heat, resulting from using muscles to perform the tasks required. The buildup of metabolic heat activates the body's natural heat regulation mechanism, sweating. The human body regulates heat by sweating, utilizing the latent heat of evaporation to dissipate heat at the skin's surface and returning the cooler blood to the internal organs. This process results in the loss of body fluids which in turn leads to dehydration, or an imbalance in the fluid ratio within the body.

While similarities existed in the physical aspects of the jobs, there was no real comparison in the personal protective equipment (PPE) worn. PPE for football players is designed to be light-weight, breathable, and non-restrictive of movement. On the contrary, firefighter PPE is heavy, vapor restrictive, and cumbersome to work in. Advances in firefighter PPE technology have been made to reduce the weight and make it less cumbersome. However, firefighting PPE is still difficult to work in.

Football players often times perform their tasks in the outside environment, as do firefighters. That is where the similarity ends. In addition to dealing with the heat and cold of the external environment, firefighters must enter hazardous environments with near-zero, or zero visibility, and with temperature exceeding 500°F. Lastly, firefighters are often times the stress of emergency, life or death conditions, football players do not.

Subsequent research revealed that at the college and high school levels there are guidelines in place to prevent heat injury that could be adapted to the fire service. Many of the National Athletic Trainers Association (NATA) and University Interscholastic Leagues (UIL) recommendations are not feasible in emergency situations, such as utilizing the Wet Bulb Global Temperature to determine when to alter practice and event schedules. There is no option for postponing or rescheduling an emergency incident. Fire fighters are forced to perform under whatever the conditions are at the time of the emergency. Rescheduling or cancelling training evolutions, based on environmental factors is something that should be considered. However, a less complex method, such as referring to the Heat Index (Appendix D) or Wind Chill Temperature (Appendix E) charts could be adapted to schedule, or re-schedule, training evolutions.

Both UIL and NATA recommend requiring all players to undergo annual physicals and training to alert them to the dangers of heat injury and the importance of hydration, nutrition, acclimatization, and physical fitness in the avoidance of heat injury. This could be useful in the fire service and should be considered by the DFD. Based on that fact, the DFD should actively seek out, or develop a training curriculum that addresses these issues. In addition, the DFD should stress to its members the importance of physical fitness in the avoidance of heat injury. Both NFPA 1500 and 1583 address the issue of establishing a departmental fitness program and this should be addressed by the DFD. The better an individual's level of fitness, the less likely they are to suffer heat injury during the extreme physical activities encountered in firefighting.

Research revealed that six entities operate vehicles dedicated to firefighter rehab within Denton County; five fire departments and the Denton County Emergency Services Department.

All five of the fire departments currently depend on volunteers to staff their rehab operations. Since the Fire Cats have been disbanded and the Citizen Fire Academy is no longer funded, this is no longer an option for the DFD. An alternative method must be devised to ensure that someone is always available to staff rehab operations, when rehab is requested by the Incident Commander. Since the run volume where rehab is required does not warrant a full time staff for rehab, the only way to do this would be to rely on on-duty DFD personnel. By assigning an additional engine crew to staff the rehab vehicle, on incidents where rehab is required, the DFD could ensure that appropriate staffing is available to establish an effective “rehab group”.

The two fire departments who indicated they monitor firefighter vital signs while in rehab, do so by utilizing paramedics that are already at the emergency incident. This might require reassigning them from other duties they were involved in at the incident. Since 95% of DFD personnel are certified paramedics, assigning additional on-duty crews to staff the rehab group would always ensure that qualified personnel were on hand to provide medical monitoring of firefighters while they were in rehab. In addition, personnel at the scene would not have to be reassigned; therefore, not reducing the staffing required to mitigate the incident. By assigning an engine company instead of a medic crew, there would be a company officer in charge of the rehab group. This would provide a measure of command presence to rehab operation and limit the number of firefighters who might be reluctant to follow the direction of a firefighter or driver from a medic crew who was pulled from the incident to staff rehab.

Research revealed that only two fire departments in Denton County currently provide medical monitoring during rehab operations. It is imperative that any SOP developed by the DFD must include the monitoring of firefighter vital signs. It is the only way to ensure that

firefighters are fully recovered from their activities and are ready to resume their duties, without the risk of injury. While a few firefighters expressed concern over monitoring vital signs during rehab, 79% of those surveyed indicated that it needs to be done and 83% of those surveyed indicated that they would support a procedure requiring such monitoring.

While personnel seemed receptive to monitoring vital signs, the DFD does not currently have an effective way to access hydration level and core temperature. The Cantimer hydration monitor is not currently available on the market, but hopefully it will be soon. The ingestible core temperature monitor that Mr. Hill, from UNT, mentioned, deserves further investigation, to determine if it would be cost effective option for the DFD.

As stated in the Background and Significance section, a rough draft rehab SOP was implemented during the research phase of this project. While the initial draft was incomplete, it was well received by line personnel and greatly appreciated, in part due to the extreme temperatures the North Central Texas area was experiencing at the time. The DFD Command bus was adapted to fill the need for a rehab vehicle and served that purpose well. Due to the cost of commercially available misting fans, firefighter ingenuity was utilized to devise a misting fan system that utilized a single pump and reservoir tank to supply up to four misting fans. The pump system and four fans were set up using supplies purchased at a local hardware store and all for the cost of a single commercial misting fan. Savings were used to purchase stackable chairs, ice chests, ice buckets, and towels.

By foregoing the normal 30-day SOP review process, line personnel were allowed to put the SOP, the command bus, and all associated equipment into use and were thus able to identify some shortcomings and make suggestions for improvements. By the time this ARP project was

completed, a number of suggestions had already been submitted and plans were under way to address them. This will ensure the acceptance of the SOP by line personnel and ensure that they actually follow the new procedure.

The Executive Leadership curriculum at the National Fire Academy discusses transitional change in an organization and the time required to make such a change. While the fire service at large may be slow to accept change in regard the issue of firefighter rehab, the DFD personnel have seemingly embraced it. The implementation of an effective SOP for the rehabilitation of firefighters at emergency incidents, even though not yet fully comprehensive, was well received and greatly appreciated by DFD personnel. That may be in part due to the fact that the SOP was implemented during a summer with record breaking heat. Regardless, due to this research project, DFD personnel currently have an SOP in place to address the issue and make their work environment somewhat safer. Additional changes are still needed, but the all-important first step has been made and was successful. Doing so has brought the DFD one step closer to addressing one of the US Fire Administration's strategic objectives; reducing the risk of line of duty death.

One of this researcher's high school football coaches used to say, "You play on Friday night, like you practice all week". This theory should hold true for the fire service as well. Setting up rehab operations at every extended training session and "practicing" the act of utilizing rehab, would result in firefighters becoming accustomed to the rehab process. It would thus become the norm. This point was reiterated at a firefighter rehabilitation class, presented by the Masimo Corporation, that this researcher attended during the research phase of this project. According to Jennifer Groves, the Masimo lecturer, training is the most important aspect of any rehabilitation program.

Research has revealed the existence of a national standard, identified the components of an effective firefighter rehabilitation program, resulted in the development and implementation of an SOP for the DFD, and resulted in the development of recommendations to take the DFD rehabilitation program to the next level; being fully comprehensive and effective. Doing so ensures the health and well being of all DFD personnel and addresses the USFA strategic objective of reducing the risk of firefighter line of duty death.

RECOMMENDATIONS

Based on information found during the course of this research, a list of recommendations was developed to assist in the ongoing process of developing an effective firefighter rehabilitation SOP for the DFD. Below is a list of those recommendations:

- 1) Complete the 30-day SOP review process and incorporate any suggested improvements to the rehab SOP, received as feedback from line personnel. Make any needed adjustments to the command bus and associated rehab equipment to ensure the system is user-friendly and functional.
- 2) Seek out, or develop, a training program to address heat related injury and the importance of proper hydration and diet in the avoidance of heat related injury.
- 3) Research the fitness recommendations put forth in NFPA 1583 and develop a DFD fitness program to ensure firefighters are in the best possible physical condition to help them avoid heat injury.
- 4) Seek out, or develop, training curriculum to address the importance of fitness in the

avoidance of heat related injury and how it benefits the individual firefighter in performing their job.

- 5) Research should be conducted to determine the availability and cost of the ingestible core temperature monitoring system, to determine if it is a cost effective tool that can be utilized by the DFD.

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Appendix A

Denton Fire Department Emergency Incident Rehabilitation Survey

1. For demographic purposes, are you
under 40 years old _____ 40 to 50 years old _____ over 50 years old _____
2. Does the DFD currently have an SOP that addresses emergency scene rehabilitation?
Yes 30 No 49 Unsure 8
3. What is the NFPA standard for emergency scene rehabilitation? 6
4. Does the DFD currently provide effective emergency scene rehabilitation for firefighters?
Yes 3 No 85
5. On a scale of 1 – 5, with (1) being “not important” and (5) being “very important”, how would you rate the importance of emergency scene rehabilitation? _____
4 or 5 79 3 1 1 or 2 4 no answer 3
6. When does rehabilitation begin?
 - a. At the beginning of the shift (41)
 - b. Upon arrival at the scene (10)
 - c. After the first SCBA bottle has been used (20)
 - d. After the second SCBA bottle has been used (0)
 - e. When the IC decides it is time (14)
7. How many ounces of water should the average individual consume during a normal day? _____ 64oz or more (50) less than 64 oz or unknown (37)
8. How many ounces of water have you consumed today? _____
More than 32 oz (32) Less than 32 oz or didn't know (55)
9. Should vital signs (BP, Respirations, Pulse, Core temperature, and CO level) be monitored prior to releasing firefighters from rehab?

Yes 69 No 17

10. Should DFD personnel be allowed to return to work if they do not meet medically defined rehabilitation benchmarks?

Yes 12 No 73

11. Would you support an “Emergency Scene Rehabilitation” policy that required DFD personnel to meet certain medical criteria before being released from rehab?

Yes 72 No 16

Appendix B

UNT Medical Staff/ Coach Cantrell Interview

1. What governing entities dictate your policies concerning player rehab?
2. What guidelines, or recommendations, do you follow to prevent heat injury?
3. Do you monitor players' vital signs?
4. Do you use the Wet Bulb Global Temperature when making decisions about practice and athletic events?
5. How do you address player acclimation?
6. Do you utilize active cooling techniques? And what techniques do you use?

Appendix C

Telephone Survey of Denton County Fire Departments

1. Does your department operate a rehabilitation (rehab) vehicle?

Yes 6* No 20

2. How does your department staff your rehab vehicle?

Full-time staff 1*

Part-time staff 0

Volunteers 5

3. Does your department have a rehab SOP?

Yes 2 No 4*

4. Does your department's SOP require firefighters to have their vital signs monitored during rehab?

Yes 2 No 4*

* Indicates the Denton County Emergency Services Department, operated by the

Denton County Fire Marshal's Office

Appendix D

Heat Stress Index

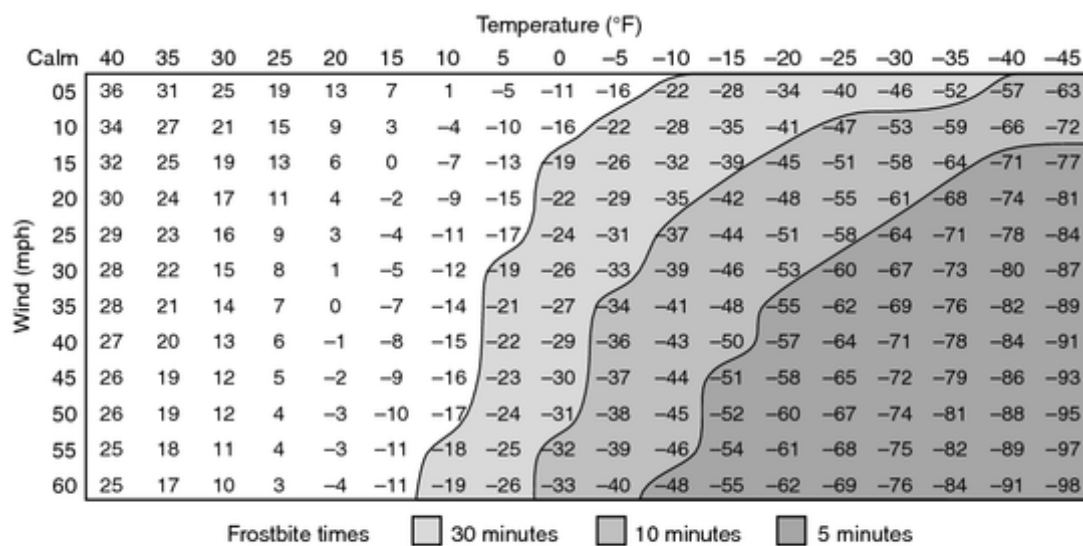
Relative Humidity (percent)	Air Temperature (°F)										
	70	75	80	85	90	95	100	105	110	115	120
	Apparent Temperature (°F)										
0	64	69	73	78	83	87	91	95	99	103	107
10	65	70	75	80	85	90	95	100	105	111	116
20	66	72	77	82	87	93	99	105	112	120	130
30	67	73	78	84	90	96	104	113	123	135	148
40	68	74	79	86	93	101	110	123	137	151	
50	69	75	81	88	96	107	120	135	150		
60	70	76	82	90	100	114	132	149			
70	70	77	85	93	106	124	144				
80	71	78	86	97	113	136	157				
90	71	79	88	102	122	150	170				
100	72	80	91	108	133	166					
Apparent Temperature (°F)		Danger Category		Injury Threat							
Below 80		None		Little or no danger under normal circumstances							
80–90		Caution		Fatigue possible if exposure is prolonged and there is physical activity							
91–105		Extreme		Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity							
106–130		Caution		Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity							
106–130		Danger		Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity							
Above 130		Extreme		Heat stroke imminent!							
Above 130		Danger									

Note: Add 10°F when protective clothing is worn and add 10°F when in direct sunlight.

Source: U.S. Fire Administration, FA-114, *Emergency Incident Rehabilitation*, July 1992.

Appendix E

Wind Chill



$$\text{Wind chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

$$T = \text{Air temperature (°F)} \quad V = \text{Wind speed (mph)}$$

Appendix F

AM I HYDRATED?

Urine Color Chart

1		
2		If your urine matches the colors 1, 2, or 3, you are properly hydrated.
3		Continue to consume fluids at the recommended amounts.
4		If your urine color is below the RED line, you are
5		<u>DEHYDRATED</u> and at risk for cramping and/or a heat illness!!
6		<u>YOU NEED TO DRINK MORE WATER!</u>
7		

Appendix G

Denton Fire Department Operations Manual

Special Considerations

606.03

Emergency Incident Rehabilitation

Issue Date: 08/2011

Last Revision Date: 08/2011

I. POLICY:

- A. It is the policy of the Denton Fire Department that all personnel expected to respond and function at an emergency incident will be provided emergency incident rehabilitation.

“Firefighter rehab is designed to ensure that the physical and mental well-being of members operating at the scene of an emergency (or a training exercise) don’t deteriorate to the point where it affects the safety of any other members. Firefighting is inherently dangerous in the best of circumstances, and any additional physical or mental stress increases the danger”. (USFA)

- B. Firefighter rehabilitation begins when personnel report for duty.

II. RESPONSIBILITIES:

- A. The On-duty shift Battalion Chief is responsible for announcing if there is a heat advisory in effect (**heat index at or above 90°F, see page 8**), based on the weather

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forecast at the beginning of each shift. He/she will provide a reminder to all company officers to ensure that crews are properly pre-hydrated throughout the day (beginning at the start of each shift).

- B. The Incident Commander is responsible for ensuring that a Rehab Group is established on any and all incidents that by their nature will be long-lasting in duration or labor intensive. This includes, but is not limited to: structure fires, HazMat incidents, rescue operations, MVAs requiring extrication and large grass/brush fires (any grass fire not controlled by initial crews assigned).
- C. The initial Incident Commander (first arriving officer) is responsible for announcing the following Benchmarks to Dispatch:
 - 1 Structure Fire:** “This is a working structure fire. Send additional apparatus to staff Rehab”.
 - 2. HazMat Incident:** “This is a working HazMat Incident, Send additional apparatus to staff Rehab”.
 - 3. Grass Fire:** “This is a large grass fire. Send additional apparatus to staff Rehab”.
 - 4. Rescue Operation:** This is a working rescue operation. Send additional apparatus to staff Rehab”.
- D. Any officer overseeing a training evolution will assume the same responsibilities as the Incident Commander of an emergency incident and will establish a Rehab Group if the evolution will last more than one hour, requires strenuous activity, or involves a live fire burn.

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- E. Dispatch is responsible for dispatching the next available engine company in the DFD response order, as specified in the CAD system, to staff the Rehab Group.
- F. The company officer on the apparatus assigned to Rehab Group will be responsible for overseeing all Rehab functions, including: personnel check-in and check-out, rehydration, feeding, active/passive cooling, medical monitoring, treatment and/or transport and release of personnel to return to active duty. Should any personnel require additional medical intervention, the Rehab officer is responsible for ensuring the member is transported to the appropriate medical facility and that the Incident Commander is notified.
- G. Each member is responsible for ensuring they are fit for duty and properly hydrated. This includes making a conscious effort to consume at least 64 ounces of water on a normal day and 128 ounces of water on days when a heat advisory is in effect. On days when a heat advisory is in effect, caffeinated drinks (sodas, coffee, tea, Monsters, etc.) and drinks with a high sugar content should be avoided and replaced with water, Gatorade, or some other commercially available sports drink.
- H. The crew assigned to Station One will be responsible for ensuring the Command/Rehab bus is maintained and stocked with water, Gatorade, food, ice chests, chairs, hand sanitizer, and plenty of hand towels.

III. ESTABLISHING REHABILITATION GROUP:

- A. If a heat advisory is in effect (**heat index at or above 90°F**), the On-duty shift Battalion Chief will notify dispatch to make a “Heat Advisory is in Effect” announcement at the beginning of each shift. (**See Appendix A**)

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- B. Dispatch will announce the following: “A heat advisory is in effect. Refer to the DFD SOP 606.03”
 - C. Station one crew will bring the Command/Rehab bus to station one and park it on Mulberry.
They will be responsible to ensure the coolers are full of drinks and hand towels.
Drinks should not be iced down until rehab is called for.
 - D. After the first arriving officer announces the initial sizeup and assumes command, if the incident appears that it will be long in duration or require extensive physical activity, the IC will announce the following benchmarks:
 - 1 Structure Fire:** “This is a working structure fire. Send additional apparatus to staff Rehab”
 - 2. HazMat Incident:** “This is a working HazMat Incident, Send additional Apparatus to staff Rehab”
 - 3. Grass Fire:** “This is a large grass fire. Send additional apparatus to staff Rehab”
 - 5. Rescue Operation:** This is a working rescue operation. Send additional apparatus to staff Rehab”
- NOTE: On days when a heat advisory is in effect, consider a second alarm upon arrival!**
- E. Dispatch will dispatch the next available apparatus to staff the Rehab Group.

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- F. The crew assigned to Rehab will respond to Station One to pick up the Command/Rehab bus.
The keys to the Command/Rehab bus will be kept on the board at station one. **The generator should be started before turning on the A/C units.** While the A/Cs are cooling down the unit, the crew should ice down the drinks, fill ice chests and misting fan with water and ice, then respond to the incident scene.
- G. Once on the scene, the Rehab Group Supervisor will consult with the IC to determine the best place to set up the Rehab site.
- H. Once the appropriate site has been chosen, deploy the chairs, awning, and misting fans. Establish a “one way in - one way out” corridor to ensure accountability.
- I. Deploy tarps near the entry point for personnel to place the SBCAs and gear. This area should also be accessible for personnel leaving rehab without interfering with “check-in” process.

IV. REHABILITATION PROCEDURE:

- A. On days when a heat advisory is in effect, a second alarm should be initiated upon arrival.
- B. In-coming mutual aid companies will respond to the scene instead of back-filling at station, to facilitate crew rotation as soon as possible. As soon as personnel are available, the IC will start rotating crews through the Rehab Group.
- C. Crews reporting to Rehab will dress down on the tarp provided at the “check in” location.
- D. Personnel will be “checked in” by Rehab Group personnel.
- E. “Time-in” and “Time-out” will be documented on the Incident Rehab Log.

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- F. Once “check in” is complete, personnel will proceed to the cool down area where they will be provided water and/or Gatorade. Active cooling will be provided by applying wet towels and sitting in area of “misting fans” to begin the “cool down” process.
- G. Personnel should remain in rehab 10 minutes after the first 30 minutes they have been working. **(10 minutes after the first SCBA bottle)** (USFA recommendation)
- H. Personnel should remain in rehab 20 minutes after the second 30 minute work period. **(20 minutes after the use of a second SCBA bottle)** (USFA recommendation)
- I. Before being released to return to the scene, personnel will be evaluated and released by a paramedic. Personnel must meet the following criteria before being released:
 - 1. Systolic BP: >100
 - 2. Diastolic BP: < 110
 - 3. Pulse: < 110
 - 4. Respirations: < 20 min
 - 5. Temperature: < 100
 - 6. Pulse OX: > 96
 - 7. Carbon Monoxide: < 10%
 - 7. Glucose: >100
- J. Firefighter vital signs will be documented on the Rehabilitation Log.
- K. Personnel who do not meet these criteria will remain in rehab for an additional 15 minutes. A 12-lead EKG will be performed to ensure the firefighter is not experiencing any Dysrhythmias. If dysrhythmias are noted, the on-scene medic crew will be notified and “patient” will be transported to the nearest medical facility, following standard DFD protocols.

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- L. After an additional 15 minutes in rehab the member will be re-evaluated by paramedics and a determination will be made whether or not additional medical treatment is needed. If so, the on-scene medic crew will be notified and “patient” will be transported to the nearest medical facility, following standard DFD protocols.
- M. Should any member NOT be released from rehab, the IC will be notified by the Rehab Officer and the remaining members of his/her crew will report to the IC and may be reassigned.
- N. When all members of a crew are released from rehab, by the Rehab Officer, they will report to the IC, or Staging, for reassignment as a crew.

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Heat Stress Index

Relative Humidity (percent)	Air Temperature (°F)										
	70	75	80	85	90	95	100	105	110	115	120
	Apparent Temperature (°F)										
0	64	69	73	78	83	87	91	95	99	103	107
10	65	70	75	80	85	90	95	100	105	111	116
20	66	72	77	82	87	93	99	105	112	120	130
30	67	73	78	84	90	96	104	113	123	135	148
40	68	74	79	86	93	101	110	123	137	151	
50	69	75	81	88	96	107	120	135	150		
60	70	76	82	90	100	114	132	149			
70	70	77	85	93	106	124	144				
80	71	78	86	97	113	136	157				
90	71	79	88	102	122	150	170				
100	72	80	91	108	133	166					
Apparent Temperature (°F)	Danger Category		Injury Threat								
Below 80	None		Little or no danger under normal circumstances								
80–90	Caution		Fatigue possible if exposure is prolonged and there is physical activity								
91–105	Extreme Caution		Heat cramps and heat exhaustion possible if exposure is prolonged and there is physical activity								
106–130	Danger		Heat cramps or exhaustion likely, heat stroke possible if exposure is prolonged and there is physical activity								
Above 130	Extreme Danger		Heat stroke imminent!								

Note: Add 10°F when protective clothing is worn and add 10°F when in direct sunlight.

Source: U.S. Fire Administration, FA-114, *Emergency Incident Rehabilitation*, July 1992.