The Elephant on the Fire Ground: Secrets of NFPA 1584 Compliant Rehab

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Disclosures

• I am on the speakers bureau for Masimo Corporation and Dey, LLP
• I am the Fire/EMS technical editor for Fire Engineering magazine.
• I do not intend to discuss any unlabeled or unapproved uses of drugs or products.

Firefighting

• Greatest short surge physiologic demands of any profession.
• 10% firefighter time spent on fireground
  ▪ 50% of deaths & 66% of injuries occur on scene.
Firefighter LODDs – Likely Culprits:
- Medical condition
- Fitness
- Rehab

Attempts to reduce FF deaths
- Medical condition
  - NFPA 1582 set medical requirements for firefighting
- Fitness
  - NFPA 1583 set fitness standards
- Rehab
  - The next logical step
  - For fit, medically qualified firefighters

What is Rehab?
- “Restore condition of good health”
- Mitigate effects of physical & emotional stress of firefighting:
  - Sustain or restore work capacity
  - Improve performance
  - Decrease injuries
  - Prevent deaths

Firefighter Rehab – NFPA 1584
- Every fire department responsible for developing and implementing rehab SOGs
NFPA 1584 Scope

Covered:
- Rescue
- Fire suppression
- EMS
- Haz Mat mitigation
- Special Ops
- Other emer svces incl. public, private, military & industrial FDs

NOT Covered:
- Industrial fire brigades (emergency brigades)
- Fire teams
- Plant emerg organizations
- Mine emerg teams

But we’re adults...

Firefighters should know as much as professional athletes about rest, hydration, and endurance.

Elements of Compliance

- SOGs outline how rehab will be provided at incidents and training exercises (where FF expected to work 1 hour or more)
- Minimum BLS level transport capable EMS on scene
- Integrated into IMS

Hydration and Prehydration

- Firefighters are often dehydrated
- Prehydrate for planned activities:
  - 500 ml fluid within 2 hours prior to event
- Hydrate during events:
  - Water appropriate most of the time
  - Sports drinks after first hour of intense work or 3 hours total incident duration
- Best to consume small amounts (60-120 ml) very frequently - Typical gastric emptying time limits fluid intake to no more than 1 liter per hour.
Sports Drinks
- Usually contain electrolytes and carbohydrates
- Osmolarity (concentration) formulated for maximal absorption
- Absorption limited by gastric emptying time (COH)
- Dilution will extend gastric emptying time and lead to nausea / vomiting

NFPA 1584 - Overview
1. Ongoing education on when & how to rehab.
2. Provide supplies, shelter, equipment, and medical expertise to firefighters where and when needed.
3. Create a safety net for members unwilling or unable to recognize when fatigued.

Who’s Responsible for What?
- Department: develop and implement SOGs
- Company Officer:
  - Assess his/her crew every 45 minutes
  - Suggested after 2nd 30-min SCBA bottle
  - Or single 45- or 60-min bottle
  - Or after 40 min intense work without SCBA
- Company Officers can adjust time frames to suit work or environmental conditions

Who’s Responsible for What?
- EMS staff must have authority to detain in rehab or transport when obvious indicators of inability to return to full duty are present
What about informal rehab?

- Perfectly acceptable in NFPA 1584
- Company or crew level rehab:
  - SCBA cylinder changes
  - Work transitions (firefighting to overhaul)
  - Small or routine incidents
  - When IC fails to recognize need for rehab

Informal Rehab Requirements:

1. Fluids
2. Shelter
3. Place to remove PPE
4. Seating for members

Nine Key Components of Rehab

1. Relief from climatic conditions
2. Rest and recovery
3. Cooling or rewarming
4. Re-hydration
5. Calorie and electrolyte replacement
6. Medical Monitoring
7. EMS tx according to local protocols
8. Member accountability
9. Release

1. Relief from Climatic Conditions

An area free from smoke and sheltered from extreme heat or cold is provided.
1. Relief from Climatic Conditions
   - Rehab unit with awning, tent, commercial misters...
   - Portable heaters, enclosed unit
   - Removed, but not too far from incident
   - Vestibule area for removal and storage of PPE

2. Rest and Recovery
   - Members afforded ability to rest for at least 10 minutes or as long as needed to recover work capacity

2. Rest and Recovery
   - Chairs or seating for each member in rehab area

3. Cooling or Rewarming
   - Members who feel hot should be able to remove their PPE, drink water, and be provided with a means to cool off.
   - Members who feel cold should be able to add clothing, wrap in blankets, and be provided with a means to warm themselves.
Heat Stress

- Body temp should remain 98.6°F ± 1.8°F (37°C ± 1°C)
- Heat stress = heat load imposed on body
- Internal
  - Exertion
- External
  - Ambient and radiant heat
  - Heat trapping (PPE)

Heat Strain

- Heat strain = the adjustments made in response to heat stress
  - Biochemical
  - Physiological: sweating, tachypnea, vasodilation, tachycardia, etc.
  - Psychological

Cooling Methods

1. Passive
2. Active

Passive Cooling: Evaporation

- Evaporation: water changing from liquid to vapor.
- Even warm water will cool if it evaporates quickly
- Increased humidity diminishes effect
Active Cooling: Convection

- Convection: air stream directed at an object
- Increased temp diminishes effect
  - Changes from cooling to heating above 95°F ambient air temp (the median skin temp)

Active Cooling: Conduction

- Conduction: skin contact with a colder material
- Cold ground, cold water, ice, snow
- Water can render PPE ineffective

Active Cooling: Radiation

- Radiation: loosing heat to a cooler environment
- Shade required
- Cooling suits or air conditioning units not typically available on scene

Active Cooling: Cold Drinks

- Cold Drinks
  - Serves dual purpose of hydration and cooling
  - Ability to cool may be limited on scene
  - Drinks usually stored warm - must be cooled or only benefit is hydration
  - Serves dual purpose of hydration and cooling
Active Cooling: Devices

- Commercial cooling devices:
  - Forearm immersion chair
  - Vacuum assisted palm cooling

- Limited by size, cost, need for multiple units, user support on scene

Active Cooling: Cold Towels

- Cold towels employ conductive cooling
- Effective in all temp and humidity levels
- Ice water and cold towels are the most effective method of treating exertional heat illness

Cold Towel – 3 Bucket System

- Bucket 1: sanitizing solution
  - ¼ cup bleach/gallon
- Bucket 2: rinse
  - Clear water removes any left over bleach
- Bucket 3: regeneration
  - Ice water restores cooling effect
4. Re-hydration

- Potable fluids to satisfy thirst on scene
- Carbonated, caffeinated, high carbohydrate drinks are NOT appropriate

4. Re-hydration

The truth about caffeine:

- Increases urine output
- Does not usually dehydrate (compensatory decline)
- Consumption < 800 mg appears safe for athletes

4. Re-hydration

- Fluid losses of up to 2 liters per hour are not unusual
- No reliable method of assessing hydration status on scene
  - Weights
  - Urine specific gravity
  - ? Saliva testing

4. Re-hydration

- Encourage continued hydration post-incident
5. Calorie and electrolyte replacement

- For longer duration events (exceeding 3 hours or when members are likely to work for more than 1 hour)
- Whenever food is available, means to wash hands and faces must also be provided.

Food

- Fruits, meal replacement bars, carbohydrate drinks...
- 30-60 grams carbohydrate per hour
- High fat foods inappropriate

Medical Monitoring vs. Emergency Care

**Medical monitoring:** observing members for adverse health effects (physical stress, heat or cold exposure, environmental hazards)

**Emergency Care:** treatment for members with adverse effects or injury.

6. Medical Monitoring in Rehab
6. Medical Monitoring in Rehab

Specifies minimum 6 conditions be screened:
1. CP, dizzy, SOB, weakness, nausea, h/a
2. General c/o (cramps, aches, pains…)
3. Sx heat or cold-related stress
4. Changes in gait, speech, behavior
5. Alertness and orientation x 3
6. Any VS considered abnormal locally

6. Medical Monitoring in Rehab

Local (FD) medical monitoring protocols:
1. Immediate EMS treatment and transport
2. Close monitoring in rehab area
3. Release

Vital Signs

• Many departments do not measure
• No evidence or published studies:
  – Determine when treatment necessary
  – Predict type or duration of rehab needed
• Vitals may help set parameters for monitoring, treatment, transport, release
• Must be evaluated in context
**Temperature**

- Core temp most accurate
  - NL = 98.6-100.6°F (37-38.1°C)
  - Best measured rectally or temp transmitter
- Oral or tympanic used in field
  - Oral 1°F (0.55°C), tympanic 2°F (1.1°C) less
- Multiple user & environmental potentials for error

- Elevated temps by measurement or touch suggest possible heat related illness
- **NOTE:** normal oral or tympanic temps do not exclude heat illness!

**Temperature**

- No danger level for core body temp
- FF temps continue to rise for 20+ min. of rehab even with active cooling measures
- No clear guidance on temp for release from rehab. Consider further eval for members above NL

**Pulse**

- NL = 60-80, many influences.
- Very important to interpret in context of individual.
- Recovery rate may be more significant than actual heart rate.
- If > 100 after 20 min rest, further eval needed before release
- Pulse ox offers accurate measure
Respiratory Rate

- NL = 12 – 20, should increase with fever and exercise
- Should return to normal with rest

Blood Pressure

- Most measured
- Least understood
- Very contextual
- Tremendous potential for error

Sources of error:
1. Cuff size
2. Arm placement
3. NIBP

Potential for cross contamination:
- Need to decon between each use

Blood Pressure

- NFPA suggests members with SBP > 160 or DBP > 100 not be released from rehab.
- Oddly, hypotension (SBP < 80) is probably of far greater concern than high blood pressure...
**Abandoned Tire Dump Fire**

- Saratoga County, NY (Waterford)
- June 2002 – 10 million tires in abandoned tire dump caught fire
- 15 departments on scene, 8 days
- Rehab for 2,882 firefighters
- Pulse ox at door, TPR/BP inside

**Restrospective Review**

- 100% of firefighters with abnormal temp, respirations or BP had abnormal pulse ox (O₂ sat or HR)
- Upstate NY rehab protocol now measures only:
  - HR
  - Oxygen saturation
  - Carbon monoxide (SpCO%)

**Pulse Oximetry**

- Non-invasive measurement of oxygen and blood flow
- NL = 95-100%
- Most oximeters cannot differentiate oxyhemoglobin from carboxyhemoglobin
- Members with SpO₂ < 92% should not be released from rehab

**CO Assessment**

- Carbon monoxide is present at all fires and a leading cause of death
- NFPA suggests any member exposed to CO or with CO s/s be assessed for CO poisoning
- Exhaled CO meter or pulse CO-Oximeter are two detection devices
CO Assessment in FF Rehab?

- Suggested in NFPA 1584
- CO induces death 2° VF in animal lab
- VF initial rhythm in 90% interior FF deaths
- Should not leave rehab if > 5% COHb

CO Poisoning Assessment

- Non-smokers = 0 – 5%
- Smokers 5 – 10%
- If > 15%, treat with high flow O_2
- Between 10 – 15%, assess for s/s, treat if necessary
- Release from rehab requires normal CO level per local protocol
**Triage & Treatment Algorithm**

**CO Triage and Treatment Algorithm**

- **Measure COHb (SpCO)**
  - **0 – 5%**
    - No further medical evaluation of SpCO needed.
  - **> 5%**
    - **SpCO > 15 or SpO2 < 90**
      - 100% oxygen & transport to ED
    - **SpCO < 15 and SpO2 > 90**
      - Symptoms of CO &/or Hypoxia
      - 100% oxygen & transport to ED

**NOTE**: If Cardiac Symptoms, add MI Protocol
If Asthma Symptoms, add Albuterol

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**Cyanide**

- Consider at all fire scenes
- All patients in cardiac arrest
- Any patient in shock, especially if low CO level
- Treat with cyanide antidote kit

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**Paris Fire Brigade**

**ROSC = 50%**

- Paris Fire Brigade
- ROSC = 50%

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**7. EMS Tx according to local protocol**

- Available on scene
- Monitoring documented in FD data collection system
- When tx or xpt, copy medical report to employee medical record
8. Member Accountability

- Track members assigned to rehab
- IC must know whereabouts (i.e.: when they enter rehab and when they leave)

Potential Solution:
Prior to leaving rehab, EMS must confirm that members are able to safely perform full duty.
Where to from here?

- NFPA 1584 released Q1 of 2008
- Organizations and departments need to review the Standard and decide how to proceed
- States may elect to incorporate all or parts of 1584 into rules or legislation

Rehab Research Needed...

Summary

1. Just Do It...
   - IC must establish a rehab sector
2. Define who will do what...
   - Medical monitoring
   - Emergency Medical Care & Treatment
   - Bring supplies (cooling, shelter, water)
   - Record keeping
   - Accountability

Thank You!

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