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FROM : National Wildfire Coordinating Group
REPLY TO : NWCG@nifc.gov
DATE : 07/02/2009
SUBJECT : SAFETY ADVISORY : Heat Illness Safety

Fit firefighters are safe firefighters: regular physical fitness training is a component of a professional wildland firefighter's work day. Unfortunately, physical training itself has its own set of hazards. In 1996 a hotshot crew member in Arizona died of heatstroke during a 4-mile physical training run. In 2009, wildland firefighters in both the U.S. Forest Service and Bureau of Land Management have experienced a number of serious heat-related illnesses during physical training activities. While some heat illnesses are less severe and are easily treated by resting, cooling down and drinking water, others can be life-threatening or lead to permanent disability. Periods of low fire occurrence can result in complacency regarding the everyday hazards encountered by wildland firefighters conducting Physical Training (PT) activities. Don't let this happen to you!

Heat Illness and Physical Training

In physical pursuits like training to be a wildland firefighter or participating in most sports, hydration matters. In some cases, actions taken by you on the previous day can set you up to be dehydrated during PT; your overall fitness level also plays a role.

According to the National Institutes of Health, heat emergencies fall into three categories of increasing severity: heat cramps, heat exhaustion, and heatstroke. If the problem isn't addressed, heat cramps (caused by loss of salt from heavy sweating) can lead to heat exhaustion (caused by dehydration), which can progress to heatstroke. Heatstroke, the most serious of the three, can cause shock, brain damage, organ failure, and even death.

These early symptoms may indicate the onset of heat illness:

- Profuse sweating
- Fatigue
- Thirst
- Muscle cramps

Later symptoms of heat exhaustion include:

- Headache
- Dizziness and lightheadedness
- Weakness
- Nausea and vomiting
- Cool, moist skin
- Dark urine

The symptoms of heatstroke include:

- Fever (temperature above 104 °F)
- Irrational behavior
- Extreme confusion
- Dry, hot, and red skin; sweating may cease
- Rapid, shallow breathing
- Rapid, weak pulse; possible decrease in blood pressure
- Seizures
- Unconsciousness

Other Serious Medical Conditions

In recent years, wildland firefighters have experienced two serious illnesses both as a result of physical training and firefighting: rhabdomyolysis and compartment syndrome. In some cases these conditions have led to the permanent disabling of young, healthy firefighters. Unfortunately some of the symptoms of these conditions have been misdiagnosed as heat illness.

Rhabdomyolysis is the breakdown of muscle fibers resulting in the release of muscle contents (myoglobin) into the bloodstream. Some of these are harmful to the kidney and frequently result in kidney damage. Risk factors for rhabdomyolysis include:

- Alcoholism (with subsequent muscle tremors)
- Crush Injuries
- Heat intolerance
- Heatstroke
- Ischemia or necrosis of the muscles (as may occur with arterial occlusion, deep venous thrombosis, or other conditions)
- Low phosphate levels
- Seizures
- Severe exertion such as marathon running or calisthenics

- Shaking chills
- Trauma
- Use or overdose of drugs, especially cocaine, amphetamines, statins, heroin, or PCP

Acute compartment syndrome may take several hours develop. Within the muscle compartment, swelling and/or bleeding creates pressure on capillaries and nerves. When the pressure in the compartment exceeds the blood pressure within the capillaries, the capillaries collapse. This disrupts the blood flow to muscle and nerve cells. Without a steady supply of oxygen and nutrients, nerve and muscle cells begin to die within hours. Unless the pressure is relieved quickly, this can cause permanent disability or death. Muscle groups in the arms, hands, legs, feet, and buttocks can be affected.

A combination of signs and symptoms characterize compartment syndrome. The classic sign of acute compartment syndrome is pain, especially when the muscle is stretched.

- The pain may be intensely out of proportion to the injury, especially if no bone is broken.
- There may also be a tingling or burning sensation (paresthesias) in the muscle.
- The muscle may feel tight or full.
- If the area becomes numb or paralysis sets in, cell death has begun and efforts to lower the pressure in the compartment may not be successful in restoring function.

Risk Mitigations for Physical Training and Hard Work

Hydrate before, during and after exercise. Limit your intake of alcohol and so-called “energy drinks” -- prior to prolonged periods of exertion.

Drink at least 1 quart of water per hour during strenuous exercise or work.

About one third to one half of the liquid consumed during a work shift should be a sports drink such as Gatorade, for the purpose of replenishing fluids, electrolytes and carbohydrates. “Energy drinks” such as Red Bull, Monster and RockStar are NOT sports drinks.

Monitor your hydration status by observing urine color: pale yellow or wheat color is normal. A lighter color is a sign of over hydration; dark yellow or brown urine is a sign of dehydration. Be aware of unusual body odor especially in the case when it smells like ‘ammonia’ – this could be a sign of rhabdomyolysis.

Monitor body weight pre- and post-exercise. Weight loss during activities is primarily water loss; any loss of greater than 2% of pre-exercise weight can be detrimental.

Practice good nutritional habits. Monitor salt intake during high heat stress conditions and

ensure electrolyte replacement. Eat several small meals a day rather than three large meals for higher energy and more optimal metabolism,

Ensure that your PT program is balanced and supports muscle balance. There have been cases of compartment syndrome related to overuse of certain muscles along with other factors. Always be sure to warm up and cool down appropriately, especially during any adverse weather conditions and monitor the Heat Stress Index when doing PT.

Be able to recognize the symptoms of heat illness in yourself and others – if you are feeling overexerted – STOP! Hydrate and try to lower your heart rate. Oftentimes feeling ‘thirsty’ means that you are already dehydrated.

If you still have symptoms, notify co-workers or supervisor immediately.

Immediately treat heat illness if it occurs. Conduct rapid medivac if needed...ignoring or delaying the need for medical attention could lead to permanent disability and even death.
