STATE of ALASKA
Department of Health and Social Services

State of Alaska

COLD INJURIES GUIDELINES

Photo by Ken Zafren

July 2014

These guidelines are dedicated to the memory of William J. Mills, Jr., MD, who contributed immeasurably to our knowledge of cold injuries and who was a generous mentor to many of the authors.
Dr. Mills was the first EMS Medical Director for State of Alaska.

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INTRODUCTION

The State of Alaska Cold Injuries Guidelines are intended for use by medical personnel in prehospital, clinic and hospital settings. These guidelines are not protocols. They are designed as a reference for the treatment of cold injuries and to assist in the development of local or regional standing orders. If no standing orders are available, they may be used to guide treatment of cold injuries. These guidelines are not intended to serve as a comprehensive teaching document on cold related illnesses and injuries.

The *2003 Alaska Cold Injuries Guidelines* were developed in April 2002 by an invited expert panel at the Southeast Region EMS Council Conference on Environmental Injuries in Sitka, Alaska. The 2003 *Guidelines* were revised by Ken Zafren, MD, State of Alaska Emergency Programs Medical Director, in 2005 with the help of the original panel. The *2014 Guidelines* are based on the *2003/2005 Guidelines* with revisions suggested by a new panel at the Southeast Region EMS Council Symposium in Sitka in April 2011.

The recommendations in this document are based on the best available evidence, including experimental data and clinical experience. The evidence will continue to change and evolve. There will be further revisions.

Photo by Ken Zafren

ACCIDENTAL HYPOTHERMIA

LEVELS OF HYPOTHERMIA

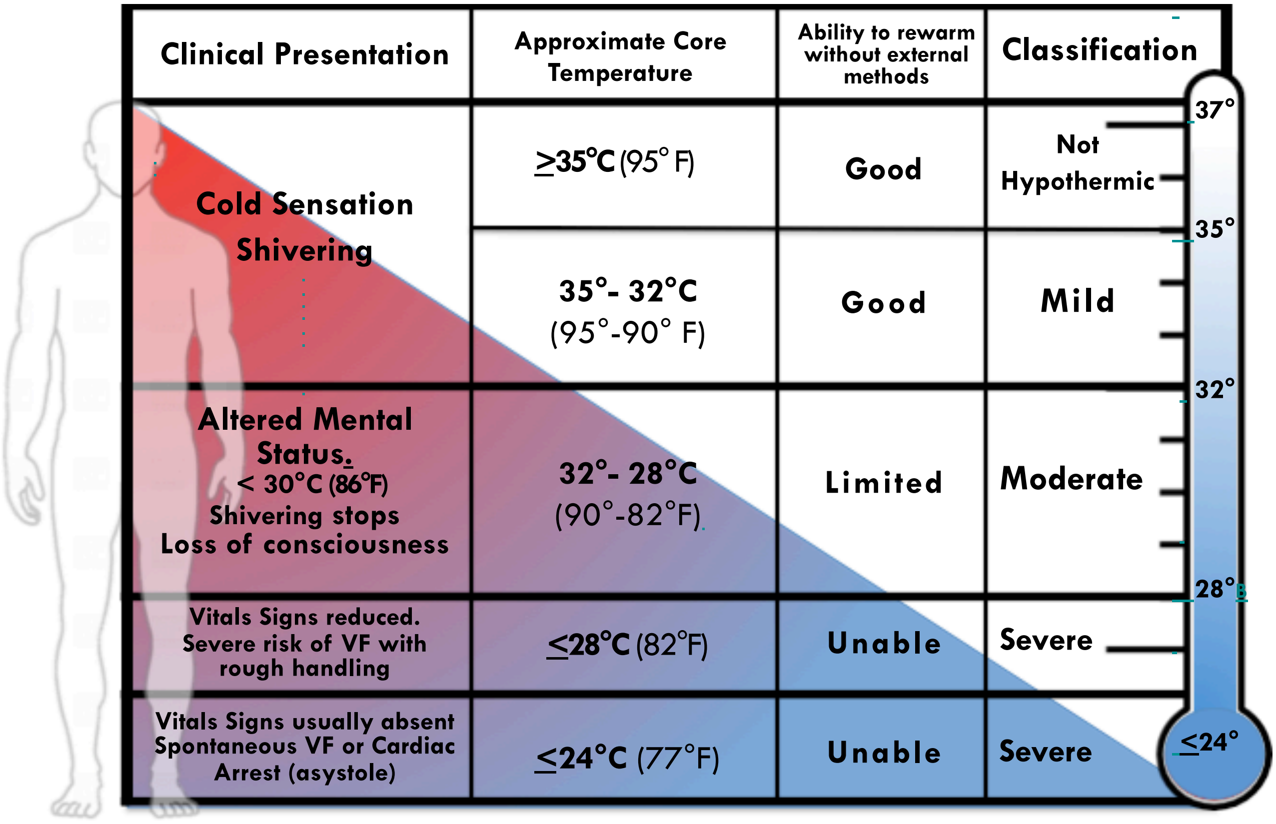
Accidental hypothermia is defined as the unintentional drop of core temperature to 35°C (95°F) or below. Hypothermia can be classified:

- **Mild 35-32°C** (95-90°F);
- **Moderate 32-28°C** (90-82°F)
- **Severe <28°C** (<82°F)

These categories are useful in guiding treatment. While obtaining a core temperature is important for assessing and treating hypothermia, there is tremendous variability in individual physiologic responses at specific temperatures. Initial treatment of accidental hypothermia should be guided by the condition of the patient in conjunction with the core temperature, if available.

TABLE 1. LEVELS OF HYPOTHERMIA

Clinical staging system. Adapted from the "Swiss System."



Clinical Presentation	Approximate Core Temperature	Ability to rewarm without external methods	Classification
Cold Sensation Shivering	≥35°C (95° F)	Good	Not Hypothermic
	35°- 32°C (95°-90° F)	Good	Mild
Altered Mental Status. < 30°C (86°F) Shivering stops Loss of consciousness	32°- 28°C (90°-82°F)	Limited	Moderate
Vitals Signs reduced. Severe risk of VF with rough handling	≤28°C (82°F)	Unable	Severe
Vitals Signs usually absent Spontaneous VF or Cardiac Arrest (asystole)	≤24°C (77°F)	Unable	Severe

Alaska Cold Injuries Guidelines 2014

CORE TEMPERATURE MEASUREMENT

Often, it is not practical to measure core temperature in the field. These guidelines are not based only on a patient's measured temperature. However, measured core temperature gives information that is helpful in managing hypothermic patients.

A rapid assessment to suggest a patient's core temperature may be performed by placing a warm ungloved hand against the skin of a patient's back, or chest. If the skin feels warm, hypothermia is unlikely.

Axillary and oral measurements are poor measures of core temperature, but may be used to rule out a diagnosis of hypothermia. Fever thermometers are useless in this setting. Special low reading thermometers, including electronic temperature probes, which are capable of measuring temperatures as low as 20°C (68°F), should be used.

Core temperature in an unconscious (intubated) hypothermic patient is best measured with an esophageal probe in the lower third of the esophagus. The use of heated, humidified oxygen can cause falsely elevated readings if the esophageal probe is not placed in the lower third of the esophagus. Some esophageal probes do not have markings. These probes should be measured visually next to the patient to avoid too shallow or too deep insertion.

If esophageal temperature monitoring is not available or if a patient is conscious, epitympanic temperature can be used to guide treatment. Epitympanic temperature probes are not the same as the commonly used infrared tympanic thermometers. Rectal and bladder temperatures, although commonly used to monitor hypothermic patients are less accurate than properly used esophageal or epitympanic temperatures and are contraindicated until the patient has been moved into a warm environment. Rectal and bladder temperatures are very slow to respond to changes in core temperature. During rewarming, core temperature may be rising while rectal or bladder temperature is still falling.

Epitympanic thermometers measure temperature at the tympanic membrane. They may give falsely low readings if a good seal is not obtained in cold conditions. Electronic thermometers and monitors are dependent on battery power and electronic circuits. Cold shortens battery life and may lead to failure of electronic circuits. Having extra warm batteries and backup units may be helpful in cold environments.

A new non-invasive device, the heat flux sensor, is currently under development and testing for use in cold conditions. If this device proves accurate, it may become the preferred method of measuring core temperature in the field.

So-called "temporal artery" thermometers do not provide accurate temperature readings and should not be used.

HANDLING OF HYPOTHERMIC PATIENTS

A patient with moderate to severe hypothermia should be handled **very gently** and **kept horizontal** if at all possible. When cold, the heart is very prone to ventricular fibrillation (VF) with any disturbance. Even cautious movement of a patient may induce VF. A patient who is moderately or severely hypothermic and not in cardiac arrest may experience severe cardiovascular stress if placed in a vertical position. A severely hypothermic patient may be in a state of **"suspended animation"** or in a **"metabolic icebox"**. Severely hypothermic patients have been known to survive neurologically intact for long periods of time even if they are in asystole.

Since cold skin is easily injured, do not apply hot objects or excessive pressure (e.g. uninsulated hot water bottles, blood pressure cuffs, etc.). Small chemical heat packs have insufficient heat capacity for rewarming. If the patient does not have frostbitten hands or feet, chemical hand and foot warmers may be helpful in preventing cold injury during transportation in patients who are mildly hypothermic. Extremity rewarming is contraindicated in moderate or severely hypothermic patients. Chemical heat packs should never be applied directly to skin. Some heat packs achieve a surface temperature >50°C (122°F), which is sufficient to burn even undamaged skin.

Injured extremities should be splinted in anatomically normal position with as little further manipulation as possible in order to protect cold-injured skin.

When moving hypothermic patients by helicopter, protect the patient from wind chill caused by rotor wash. Rotor wash can be eliminated if the helicopter shuts down while loading and unloading, but this is usually not practical in the field and is very time consuming. Package the patient carefully to avoid any additional loss of heat or skin exposure that can cause or worsen frostbite and hypothermia.

The interior of ground or air ambulances (fixed wing or rotorcraft) and resuscitation rooms should be warm enough to prevent further heat loss. The ideal temperature is 28°C (82°F), the thermoneutral temperature of humans in air, but this is usually too warm for the crew.

Severe cold injuries are encountered relatively infrequently. Responders should plan for the management of these conditions and be familiar with the equipment.

ASSESSMENT AND TREATMENT OF COLD PATIENTS

Members of the public should activate the emergency medical system. Call 9-1-1 if available.

INITIAL ASSESSMENT (SEE TABLE 1. LEVELS OF HYPOTHERMIA – PAGE 5)

- **Mild.** A patient with mild hypothermia should be alert, with normal or increased vital signs and shivering. A patient who is alert and shivering may just be cold and not hypothermic.
- **Moderate.** A patient with moderate hypothermia may have a slow heart, rate a slow respiratory rate and a decreased level of consciousness. Speech may be slurred and gait may be unsteady. Shivering may be vigorous until it becomes weak or absent below a core temperature of about 30°C (86°F).
- **Severe**. A patient with severe hypothermia will have a markedly decreased level of consciousness, with decreased or absent response to verbal or noxious stimuli.

A hypothermic patient should be assessed for coexisting injuries or illnesses that may mimic or conceal the signs and symptoms of hypothermia. The use of vital signs, mental status and presence or absence of shivering may be unreliable if the patient has another condition that coexists with hypothermia. Many conditions such as hypoglycemia, alcohol intoxication and exhaustion can cause altered mental status and can decrease or abolish shivering. A heart rate higher than expected for given level of hypothermia may be due to another cause such as traumatic blood loss.

INITIAL TREATMENT

Prevent further heat loss:

- Insulate from the ground.
- Cover the patient with a vapor barrier (such as a tarp, a large piece of plastic, large garbage bags etc.). Do not remove wet clothing until the patient has adequate shelter.
- Insulate the patient, including the head and neck.
- Protect from the wind; eliminate evaporative heat loss by removing wet clothing once the patient has adequate shelter.
- Move the patient to a warm environment as soon as possible.

TREATMENT FOR A PATIENT WHO IS COLD, BUT NOT HYPOTHERMIC *OR* FOR A PATIENT WITH MILD HYPOTHERMIA

An uninjured cold or mildly hypothermic patient may be treated in the field.

If it will take more than 30 minutes for the patient to arrive at a medical facility, rewarm the patient with one or more of the following methods:

Vigorous shivering is the most effective method for increasing heat production. Shivering should be fueled by calorie replacement with food or with fluid containing sugars (calorie content is more important than the heat in a hot drink).

Do not allow the patient to eat or to drink liquids unless the patient is capable of swallowing and protecting the airway.

Apply heat to areas close to the heart – the chest and upper back. This can be done in the field using chemical or electric heat pads or the *Norwegian (charcoal) Heatpac*. The Hypothermia Prevention and Management Kit (HPMK), developed by the United States military is an excellent method of preventing heat loss. These methods will not increase the core temperature of a shivering patient faster than shivering alone, but will decrease energy requirements by decreasing shivering and will increase thermal comfort.


Norwegian Charcoal Heatpac

Mild exercise, such as walking or stepping up and down on an object, will produce heat and may be helpful. This should only be allowed after the patient is dry, has had calorie replacement, and has been stable for at least 30 minutes. A patient with moderate hypothermia may collapse if allowed to exercise without adequate energy reserves. Exercise increases afterdrop, which is a decrease in core temperature that occurs before rewarming measures are effective. Afterdrop and vasodilation caused by exercise could provoke cardiovascular collapse.

Placing a patient alone in a sleeping bag will decrease further heat loss. Placing a patient in a sleeping bag and providing close skin-to-skin contact with a warm body will not speed core warming in a shivering patient and will decrease shivering. The advantage of placing a shivering patient in a sleeping bag with another person is to decrease the work of shivering and increase thermal comfort, however, placing a patient with another person in a sleeping bag should only be done when it will not delay transport.

Do not place a hypothermic patient in a sleeping bag with another individual who is hypothermic.

Do not put a cold patient in a shower or bath. A warm bath increases afterdrop. Vasodilation and increased afterdrop could provoke cardiovascular collapse or ventricular fibrillation.

Do not permit the patient to use alcohol or tobacco.

TREATMENT FOR MODERATE TO SEVERE HYPOTHERMIA

- **Handle a patient who is hypothermic very gently to avoid causing Ventricular Fibrillation. (VF).** Do not rub or manipulate extremities or attempt to remove wet clothes. Cut clothes off once the patient is in a sheltered environment.
- **Keep the patient horizontal.**
- **Prevent further heat loss as described in initial treatment, above.**
- **Apply heat as described in initial treatment, above.**
- **Use forced air heating with a heating blanket or cover, if available.** Forced air heating, which may be available in an air or ground ambulance, is effective at raising core temperature. Heat should be preferentially applied to the torso, especially the chest and upper back.
- ***Do not*** allow the patient to sit or stand until rewarmed.
- ***Do not*** put the patient in a shower or bath.
- ***Do not*** give the patient food or oral fluids.
- ***Do not*** attempt to increase heat production through exercise, including walking.
- Continuously reassess the patient.
- Transfer to a medical facility as soon as possible.
- Obtain core temperature in unconscious patients, if possible. Esophageal probes are within the scope of practice for paramedics in Alaska. Medical Directors who want EMTs, under their supervision, to use esophageal probes within Expanded Scope must obtain approval first from the State of Alaska EMS Unit.

OXYGEN AND AIRWAY IN HYPOTHERMIA

Hypothermic patients have decreased oxygen needs and do not generally require supplemental oxygen. If supplemental oxygen is used, it should be humidified and heated to 40-42°C (104-108°F). Heated humidified oxygen will decrease heat loss from the airway, but will not provide significant rewarming.

A non-breathing hypothermic patient can be treated with mouth-to-mask or bag-valve-mask (BVM) ventilations. Use heated humidified oxygen if available. Do not hyperventilate the patient. Hypocapnia can reduce the threshold for VF in a cold heart.

If end tidal carbon dioxide ($ETCO_2$) monitoring is not available, ventilate the hypothermic patient at 6 breaths per minute (one breath every 12 seconds), which is half the normal rate, in order to prevent hypocapnia, unless the patient is difficult to ventilate. If ventilations are difficult, give breaths at the normal rate of 12 per minute (one breath every 5 seconds). If $ETCO_2$ monitoring is available, keep the $ETCO_2$ between 35-45 mm Hg as for a normothermic patient.

USE OF ADVANCED AIRWAY DEVICES

The indications and contraindications for advanced airway devices are the same in both hypothermic and normothermic patients. Advanced airway devices include supraglottic devices. If control of the airway with an advanced airway device is required, it should not be delayed. The benefits of advanced airway devices are improved oxygenation and airway protection. There is little or no risk of precipitating VF with intubation or placement of a supraglottic device.

TREATMENT FOR HYPOTHERMIA WITHOUT SIGNS OF LIFE

Assume that a hypothermic patient can be resuscitated even if there is an absence of vital signs or any sign of life and the pupils are fixed and dilated. Hypothermic patients have been resuscitated without neurological damage even after asystolic cardiac arrest.

Hypothermic patients without obvious signs of life may still have a pulse. The heart rate can be very slow. Since metabolic needs are so low in severely hypothermic patients, a rate of only a few beats per minute is enough to provide adequate perfusion to vital organs. In such cases, it is better to attempt to maintain effective cardiac activity than to start cardiopulmonary resuscitation (CPR) and cause VF. Even if the patient has no pulse, delaying CPR by one minute to check for a pulse is not harmful, because the metabolic demands are so low.

Contraindications for CPR

DO NOT PROVIDE CPR IF

- Rescuers are exhausted or in danger;
- Victim has obvious fatal injuries, e.g. decapitation;
- Victim is frozen, e.g. ice formation in the airway;
- Victim has a chest wall that is so stiff that compressions are impossible;
- Victim has been buried in an avalanche ≥35 minutes and the airway is obstructed by snow or ice. (Refer to ***Avalanche*** section for resuscitation and further details); or,
- Victim has a valid Do Not Resuscitate (DNR) order.

Fixed and dilated pupils are not a contraindication to performing CPR in a hypothermic patient. The evidence regarding dependent lividity is less clear. At the current time, dependent lividity is not a contraindication to performing CPR in a hypothermic patient.

CPR should be started when there are no signs of life, no respiration, no pulse, if checked for up to 1 minute and CPR is not contraindicated. Compression depth and rate should be provided according to International Liaison Committee on Resuscitation (ILCOR) guidelines.
Continue CPR under the following conditions:

- **If no cardiac monitor or Automated External Defibrillator (AED) is available, continue CPR.**
- If a cardiac monitor/defibrillator is available and the patient is in ventricular tachycardia (VT) or VF, or if an AED is available and advises that a shock be given, attempt defibrillation (one shock) using the standard energy level and resume CPR for 2 minutes before checking for a pulse.
- If defibrillation is unsuccessful and the patient's core temperature is <30°C (86°F), do not make further attempts at defibrillation until the core temperature has increased to ≥30°C (86°F). Continue CPR and attempt to rewarm the patient (See **Table 2. Rewarming Methods – Page 16**).
- If the defibrillation is unsuccessful, and the patient's core temperature is >30°C (86°F), follow ILCOR guidelines for normothermic patients.
- If a cardiac monitor, including an AED with a monitor, shows asystole, continue CPR and do not shock.
- If the monitor shows signs of an organized, perfusing rhythm (any rhythm other than VT or VF), do not start or continue CPR, but continue to monitor.
- Although an organized rhythm may represent Pulseless Electrical Activity (PEA), this is an unstable rhythm that is most likely to deteriorate rapidly into asystole. If this happens, resume CPR.
- Ultrasound, if available, can be used to check for cardiac activity. If cardiac contractions are seen, do not start or continue CPR. Starting CPR is likely to provoke VT or VF. If no cardiac contractions are found, start CPR even if there is an organized cardiac rhythm on the monitor.
- As long as the patient does not have return of spontaneous circulation (ROSC) as evidenced by a pulse or other signs of life, continue CPR as feasible during transport and attempt to rewarm the patient or at least prevent further cooling. It is difficult to rewarm a patient in the field, even in a well-heated ground or air ambulance.
- Mechanical chest compressions in conjunction with ventilation using an advanced airway are likely to be effective with the patient in a moving litter or ambulance. Human delivered chest compressions, while the patient is in a moving litter or ambulance, are unlikely to be effective and should not be attempted.
- In patients with severe hypothermia who have no signs of life, delayed or intermittent CPR may be effective. Unavoidable interruptions should be as brief as possible. Severely hypothermic patients in cardiac arrest have survived neurologically intact when CPR was delayed for more than 30 minutes. This is possible because of low metabolic needs in severe hypothermia.
- If advanced life support has been provided in conjunction with rewarming techniques for more than 30 minutes without the return of spontaneous circulation or respiration, emergency medical technicians and paramedics may terminate the resuscitation in accordance with Alaska Statutes and local protocols. However, this should only be done in patients with a core temperature ≥32°C (90°F). Moderately or severely hypothermic patients should be rewarmed before terminating resuscitation.

ALASKA STATE GUIDELINES FOR PRONOUNCING DEATH (AS 18.08.089)

Alaska Statutes allow a Paramedic, Physician Assistant or an Emergency Medical Technician who is a member of a state-certified EMS agency to pronounce a person dead in the field if a physician is "not available for consultation by radio or telephone communication," if the provider has "determined, based on acceptable medical standards, that the person has sustained irreversible cessation of circulatory and respiratory functions" "Acceptable medical standards" means either that CPR is contraindicated, or that "properly administered resuscitative efforts" failed to restore "spontaneous pulse or respiratory efforts."

Properly administered resuscitative efforts are defined as:

(A) When a person authorized to perform advanced cardiac life support techniques is not available and the patient is not hypothermic, at least 30 minutes of properly performed cardiopulmonary resuscitation;

(B) When a person authorized to perform advanced cardiac life support techniques is not available and the patient is hypothermic, at least 60 minutes of cardiopulmonary resuscitation properly performed in conjunction with rewarming techniques as described in the current State of Alaska Hypothermia and Cold Water Drowning Guidelines published by the Division of Public Health, Department of Health and Social Services; or

(C) At least 30 minutes of cardiopulmonary resuscitation and advanced cardiac life support techniques properly performed by a person authorized to perform advanced life support services.

This legislation does not authorize Emergency Trauma Technicians and members of the general public to pronounce a patient dead.

CARDIAC ARREST IN HYPOTHERMIA

Although Alaska statutes allow termination of CPR after 30 or 60 minutes without return of spontaneous circulation, hypothermic patients without contraindications to CPR should have continued CPR and should not be pronounced dead until the core temperature has been measured to be at least 32°C (90°F), unless the temperature is thought to have been above 32°C at the time of cardiac arrest in cases of cardiac arrest before cooling. Causes of cardiac arrest before cooling include major trauma, witnessed normothermic cardiac arrest and avalanche burial <35 minutes.

The time limits apply only with continuous CPR when there is no return of spontaneous circulation (ROSC) during resuscitation. If there is ROSC that is later followed by loss of spontaneous circulation and there is no contraindication to resuming CPR, the clock is restarted at the time CPR is resumed.

INTRAVENOUS (IV)/INTRAOSSEOUS (IO) THERAPY IN HYPOTHERMIA

Fluid (IV/IO) therapy is seldom indicated in the field for patients with hypothermia. It may be appropriate to start an IV or IO in a well-heated ground or air ambulance. Do not delay transport, communications or therapy by starting an IV, as IVs are difficult to start in scold patients. If vascular access is needed, an IO is usually preferred.

Fluids are given for volume expansion, not to warm the patient. However, in moderately to severely hypothermic patients most of the blood volume is circulating in the core and to the head and neck. Cold or room temperature IV or IO fluids can cause significant core cooling and heated IV fluids can provide core rewarming. All IV/IO fluids should be heated to approximately 40-42°C (104-108°F). If given in cold conditions, the bag and line should be protected from cooling.

Most hypothermic patients are volume depleted and require aggressive fluid resuscitation as they rewarm. The recommended fluid for volume replacement is normal saline. IV/IO fluid should be given as boluses titrated to effect rather than as a continuous infusion. Adults can receive 500 ml boluses; for children give boluses of 20 ml/kg. As the patient rewarms, additional boluses can be given to normalize hemodynamic parameters. If time permits, the IV or IO should be saline locked between infusions rather than giving a slow infusion "TKO" (to keep open).

MEDICATIONS IN HYPOTHERMIA

Medications are ineffective and are poorly metabolized in moderately and severely hypothermic patients. In addition, due to delayed metabolism, giving repeated doses of medications to severely hypothermic patients can result in toxicity when the patient is rewarmed. There is insufficient and conflicting data regarding the efficacy of antiarrhythmic vasoactive medications in hypothermic patients. Medications should be withheld until the patient has a core temperature >30°C (86°F). Above 30°C, intervals between doses should be doubled. Once the patient has been rewarmed to 35°C (95°F), normal medication dosing can be used.

TRANSPORT OF HYPOTHERMIC PATIENTS

Mild Hypothermia

A patient with mild hypothermia can be treated in the field if there are no associated medical conditions or injuries that require hospital treatment. Otherwise, patients should be transported to a hospital with the capability to manage the associated conditions and injuries.

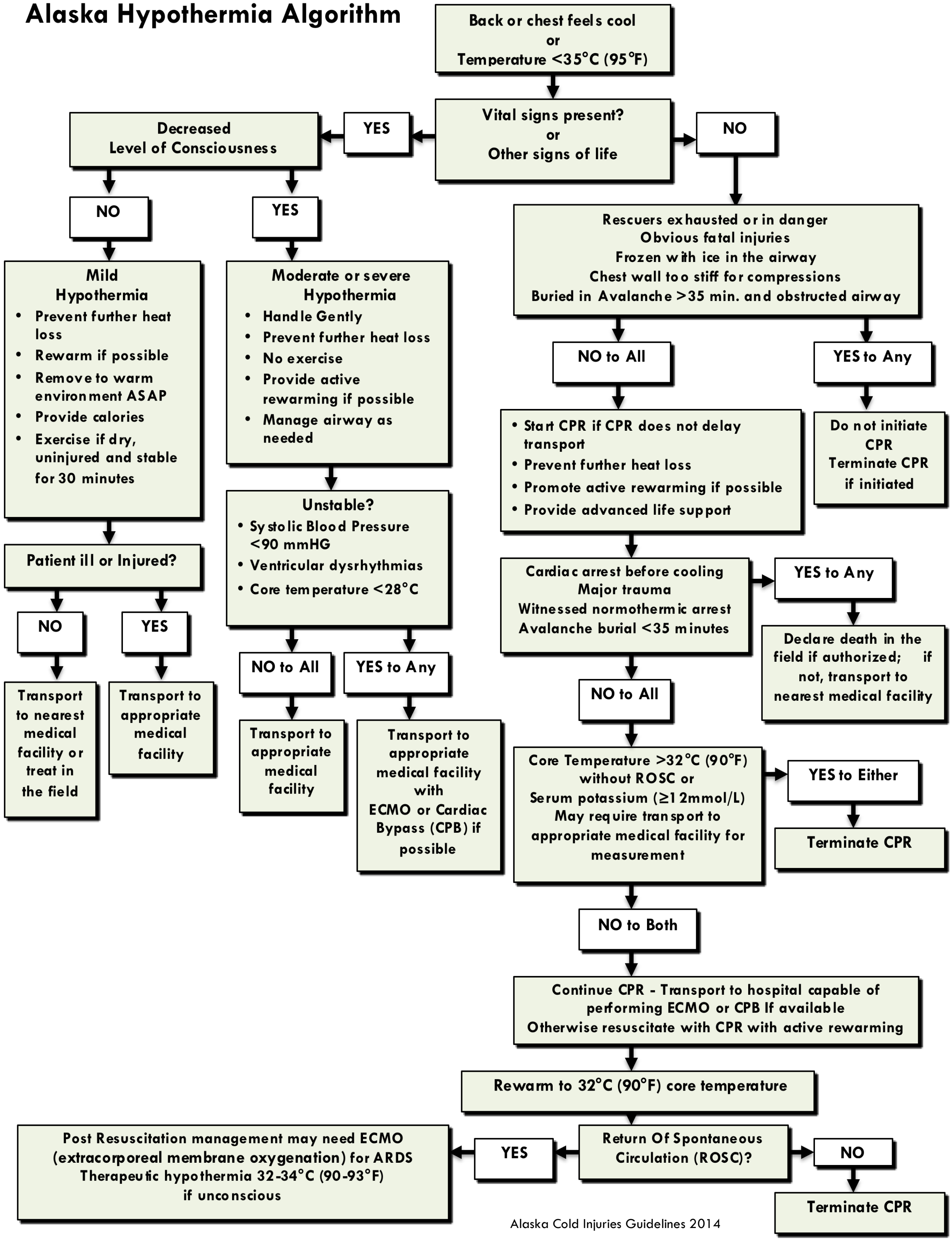
Moderate to Severe Hypothermia

A patient with moderate or severe hypothermia, who does not meet criteria for termination of resuscitation in the field, must be transported to a hospital. A stable patient with moderate hypothermia and systolic blood pressure >90 mm Hg who has no ventricular arrhythmias, should be transported to the nearest hospital with the capability to manage any associated medical conditions or injuries. Unstable patients should be transferred to a hospital with critical care capabilities, ideally a hospital with the ability to provide cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO). In most areas in Alaska, this is not feasible. A patient with moderate or severe hypothermia should be transported to the nearest hospital or, in some cases, regional clinic, capable of stabilizing the condition of the patient.

Prolonged CPR is not indicated for patients who had cardiac arrest before cooling, including patients with major trauma, patients with a witnessed arrest prior to becoming hypothermic and victims of avalanche burial for <35 minutes. A patient who meets any these criteria and who does not respond to CPR as specified above, can be declared dead in the field.

A patient who is thought to be in hypothermic cardiac arrest should continue to receive CPR during transport to the nearest hospital or clinic where core temperature can be determined, if not already determined in the field and where potassium can be measured. If core temperature is ≥32°C (90°F) without ROSC or potassium is >12mmol/L, CPR should be terminated. If the temperature is <32°C (90°F) and potassium is ≤12 mmol/L, CPR should be continued and the patient transferred to a hospital capable of providing ECMO (extracorporeal membrane oxygenation) or CPB **(Cardiopulmonary bypass)**. If this is not feasible, the patient should be resuscitated with CPR and active rewarming. This may require transfer to a hospital that can provide this care.

Alaska Hypothermia Algorithm



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CLINIC/HOSPITAL – MANAGEMENT OF PATIENTS WITH HYPOTHERMIA

The extent of evaluation and treatment in a clinic or hospital is based on the training of the personnel and on available equipment.

A patient who has a core temperature ≤28°C (82°F) should be transferred to a facility with critical care capabilities as soon as possible. If the systolic blood pressure is less than 60 mm Hg, place the patient on cardiopulmonary bypass or use high quality chest compressions to maintain a systolic blood pressure greater than 60 mm Hg. Use mechanical chest compressions if available.

Transfers of hypothermic patients should follow the same guidelines as any other patient transfer.

Interhospital transfer must follow all applicable regulations, including the Emergency Medical Treatment and Labor Act (EMTALA).

CRITICAL CARE FOR A HYPOTHERMIC PATIENT

Care for a critically hypothermic or ill patient may necessitate transfer to a facility that has adequate staff and equipment.

Critical care for a hypothermic patient is the same as for a normothermic patient with a few important exceptions:

- Temperature in unconscious patients is best monitored continuously using an esophageal probe.
- If arterial blood gases are obtained, use the **uncorrected value** not the "temperature corrected" value. The easiest method to ensure this is to report the core temperature to the laboratory as 37°C (98.6°F).
- Pulse oximetry (transcutaneous oxygen monitoring) may be unreliable due to peripheral vasoconstriction. The use of topical methyl salicylate (found in products like BenGay®) as a skin vasodilator may be helpful.
- Jugular and brachial central lines are contraindicated due to the possibility of causing VF. Femoral lines may be used cautiously to avoid disturbing the right atrium.
- All IV/IO fluid should be heated to 40-42°C (104-108°F).
- Ventilation gases should be humidified and heated to 40-42°C (104-108°F), measured at the mouth.

REWARMING METHODS (SEE TABLE 2. REWARMING METHODS)

There are many methods of rewarming hypothermic patients. Active external rewarming methods and active core rewarming methods, are presented in general order of preference and effectiveness. The choice of methods will depend on availability of equipment and the experience of the providers implementing the methods.

The decision to use thoracic (pleural) lavage versus peritoneal lavage is a controversial area that is especially dependent on the training and experience of the providers. These methods are not mutually exclusive and can be used together, especially when fluid exchange problems limit the effectiveness of peritoneal lavage. Other rewarming devices may become available. They will be evaluated for possible inclusion in The Alaska Cold Injuries Guidelines.

TABLE 2. REWARMING METHODS

Active External Rewarming Methods

Type of Patient	Method	Notes
All	Forced Air Warming	Preferred method
	Water filled (plumbed) blankets	Use only if forced air warming is not available
	Other external devices such as the *Norwegian Heatpac*	Primarily designed for prehospital use
	Warmed Blankets	Blankets from Warmer: Confirm temperature to avoid burns
Mild Hypothermia	Arterio-Venous Anastomoses (AVA)	The lower arms and hands (from just distal to the elbow) and the lower legs and feet (from just distal to the knees) are immersed in water between 42-45°C (107-112° F) This opens the arterio-venous anastomoses

Active Core Rewarming Methods

Type of Patient	Method	Notes
All	Warm IV/IO normal saline	40-42° C (104-108° F)
Moderate to severe hypothermia in a patient who is not rewarming with less invasive methods or who needs a chest tube.	Thoracic (pleural) lavage (via 2 chest tubes)	Preferred method 40-42°C (104-108°F) See: Danzl** for solution and rates
Moderate to severe hypothermia; may be less effective than chest lavage due to difficulty exchanging fluids. Two-catheter system recommended.	Peritoneal lavage	40-42°C (104-108°F) See: Danzl** for solution and rates
Severe Hypothermia with SBP ≥60 mm Hg*	Hemodialysis	Requires specialized equipment; widely available in referral hospitals.
Moderate – severe hypothermia without cardiocirculatory arrest	Heat exchange catheter (endovascular catheter)	Circulates warmed fluid contained within a catheter as heat exchanger. Requires specialized equipment
Severe hypothermia with SBP ≥60 mm Hg*	Continuous Arterio-Venous Rewarming (CAVR)	Requires specialized equipment with limited availability.
Severe hypothermia with SBP <60 mm Hg*	Extracorporeal Circulation (Cardiopulmonary Bypass or ECMO)	Requires specialized equipment generally available only in large referral hospitals.
Severe hypothermia with cardiac arrest in ED^	Thoracotomy with open cardiac massage and mediastinal irrigation	40-42°C (104-108°F)

* SBP can be maintained ≥60 mm Hg using mechanical chest compressions

^ Patients with out of hospital cardiac arrest may have a stiff heart; closed chest compressions may be effective, but open heart massage may be impossible.

**Danzl D. Accidental Hypothermia. In: Auerbach PS, ed. Wilderness Medicine, 6th edition. Philadelphia: Elsevier; 2012:116-142

Not recommended: Warm (tub) bath, small chemical heat packs, gastric lavage, rectal lavage, urinary bladder lavage

Alaska Cold Injuries Guidelines 2014

COMMON PROBLEMS DURING REWARMING

- **Dysrhythmias**
  Supraventricular dysrhythmias will usually convert spontaneously with rewarming. Do not treat supraventricular dysrhythmias; continue efforts to warm the patient. In VT or VF with a core temperature of < 30°C (86°F), give a single shock. Further shocks can be given once the core temperature reaches 30°C (86°F)
- **Volume Depletion**
  Replace volume with warm (40-42°C (104-108°F) normal saline according to vital signs.
- **Medication**
  Medications are poorly metabolized in hypothermic patents and are more highly protein bound than in normothermia. This makes them ineffective. Once the patient is rewarmed medications that were administered during hypothermia may cause delayed adverse effects and toxicity. Medication administration should be delayed until the patient has been rewarmed to 30°C (86°F). Medication intervals between doses should be doubled until the patient is rewarmed to 35°C.
- **Monitor potassium and glucose**
  Supplement as necessary. People who have been cold for a long time may have used up their insulin stores. A patient who is not shivering and has an elevated glucose level may benefit from a small dose of insulin to stimulate movement of glucose into the cells. Insulin is not effective <30°C (86°F)

INDICATIONS FOR STOPPING REWARMING EFFORTS:

A patient whose temperature does not rise despite aggressive rewarming is most likely dead. Serum potassium level >12mmol/L, especially if associated with asphyxia, (avalanche or drowning) is an indication of cell death.

Delayed complications of rewarming from severe hypothermia

After rewarming, the patient may have multiple complications:

- Multi-organ system failure
- Acute respiratory distress syndrome (ARDS) may benefit from ECMO. ARDS may cause delayed death.
- Other delayed complications including thrombotic and infectious processes: These can cause mortality of patients with severe hypothermia days or weeks after resuscitation. Therapeutic hypothermia may be beneficial in a patient who has return of spontaneous circulation but remains unconscious.

COLD WATER DROWNING

INTRODUCTION

Drowning kills about 50 Alaskans annually. Alaska has the highest rate of drowning in the United States. According to the State of Alaska Epidemiology Bulletin, “Drowning Deaths in Alaska” (June 2014), the statewide average drowning rate from 2000-2006 was 8.9 per 100,000 persons, over seven times the national rate of 1.2 per 100,000 persons during the same period. During 2007-2012, the Alaska Drowning Surveillance System (AKDSS) recorded 300 drowning deaths. The average annual age adjusted drowning rate was 7.1/100,000 persons. This was still the highest rate in the nation. Most drowning deaths are unintentional. Boating activities were the leading cause. About half of the boating victims were not wearing a personal flotation device at the time of the incident.

How to avoid drowning in Alaska*

1) Avoid alcohol use and always wear a PFD while boating.

2) Pay close attention to weather forecasts while boating.

3) Avoid bathing while using alcohol and other mind-altering drugs.

4) Never leave a child unattended around water.

5) Never hydroplane snow machines over open water.

* Alaska Epidemiology Bulletin – “Drowning Deaths in Alaska” June 2014

Drowning risk increases when a boat, motor vehicle or snow machine is involved. Cold weather sports clothing may be outfitted with flotation, serving a dual purpose as insulation and drowning protection.

The 2002 World Congress on Drowning defined drowning as “a process resulting in respiratory impairment from submersion/immersion in a liquid medium.” The cause of death or neurologic injury in drowning is hypoxia. Immediate restoration of ventilation and circulation is crucial to improving survival and neurologic outcome.

PHYSIOLOGY OF DROWNING

Immersion refers to being covered by water or other liquid. Immersion can cause drowning only if the face and airway are immersed. Submersion means that the entire body, including the airway is immersed in liquid.

Cold water is generally defined as water that is <21°C (70°F). The difference between warm and cold water is that in immersions longer than 6 minutes, the chance for survival in warm water is much less than in cold water. The colder the water, the better the chance for survival. The best survival is in water that is <5°C (41°F). In most cases, there is no difference between fresh and salt water drowning regarding treatment or outcome.

SURVIVING COLD WATER IMMERSION

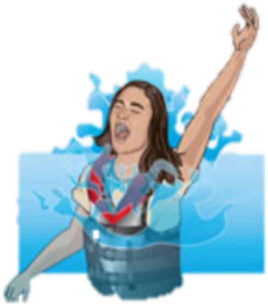
The following section is adapted from coldwaterbootcamp.com, a non-profit public service web site. Learning materials about cold water survival for can be found and downloaded without cost from the web site: *beyondcoldwaterbootcamp.com.* Cold water immersion can kill. People who are immersed in cold water will have better chances of survival if they understand the risks of cold water immersion and how to protect themselves.


Photo courtesy of CDC.gov

The 4 phases of cold water immersion are:

- **Cold shock response**
- **Cold incapacitation (Swim failure)**
- **Hypothermia**
- **Circum-rescue collapse (Post-immersion collapse)**

Cold shock response [up to 2 minutes]



Immediately on entering cold water, a person will gasp and start to hyperventilate involuntarily. If the head is underwater during the gasp, the person will inhale water and drown. Hyperventilation can be so severe that the person faints and then drowns. The person can consciously try not to panic and to bring the breathing under control. The person should be able to bring the breathing under control within 1 minute. Sudden death from cardiac arrest can occur during this phase in people with pre-existing heart problems. In a rescue, it is important to keep the victim's head out of water. A rescuer who has to enter the water should enter slowly and wear thermal protection if the water is cold.

Cold incapacitation (Swim failure) [2-15 minutes]

Local cooling of nerves and muscle fibers causes inability to swim if the person is unable to hold on to a floating object or the edge of the water (ice or shore). Thrashing around will cause increased heat loss and may lead to exhaustion followed by drowning. To delay the onset of hypothermia, individuals should use the H.E.L.P. position (Heat Escape Lessening Position) (torso vertical and knees drawn up). Groups should use the Huddle. A person should get out of the water or, if unable to get out completely, get out as far as possible. A person who is hanging on to a boat should stay with the boat. A person who is hanging on to a boat should generally stay with the boat.

H.E.L.P Position

Graphics courtesy of U.S. Coast Guard

Hypothermia [>30 minutes]

Even in very cold water, it will take at least 30 minutes for an adult to become hypothermic and longer to become unconscious. If the head goes under water (submersion), drowning will occur (30 to 120 minutes). If the head is above water because of a personal flotation device (PFD), cooling may lead to cardiac arrest with death in 90 to 180 minutes.

Circum-rescue collapse (Post-immersion collapse)

Circum-rescue collapse describes syncope or sudden death during or just after rescue. This may be syncope due to 'mental exhaustion' with decreased levels of stress hormones (such as cortisol and epinephrine) or because of sudden stress on the heart when the person is removed from the water and due to removal of pressure from the surrounding water.

To reduce the chance of circum-rescue collapse the immersion victim should be removed from the water in a horizontal position.

ESCAPE FROM A VEHICLE THAT ENTERS THE WATER

Occupants of a vehicle that enters the water should immediately roll down the windows and escape as quickly as possible. Vehicles entering the water sink rapidly. Electric windows will work for some time after the vehicle enters the water.

ESCAPE FROM FALLING THROUGH ICE

A person who falls through ice while traveling by wheeled vehicle, snow machine, dog sled, on foot, skis or snowshoes or by any other means should immediately attempt to swim to safety in the direction from which they came, since the ice was holding them until they fell in. In order to get onto the surface of the ice from the water, the person should get their body as horizontal as possible and kick with their legs near the surface of the water to slide onto the ice. Due to the weight of wet clothing, it is usually impossible to lift oneself onto the ice as if exiting a swimming pool. A person who cannot get out of the water should rest their arms on the ice and call for or await rescue. If the person becomes unconscious, clothing on the arms frozen to the ice may keep the head above water until rescuers arrive.

DROWNING RESCUE

THE USE OF PERSONAL FLOTATION DEVICES, PREFERABLY WITH THERMAL PROTECTION, IS MANDATORY AT ALL TIMES FOR EMERGENCY RESPONDERS WHEN WORKING IN, ON OR NEAR COLD WATER.

Anyone who is boating or who otherwise has a chance of falling into cold water should wear a personal flotation device (PFD) at all times. Bystanders should also be aware that they put themselves in danger of drowning in attempting to rescue a person in cold water if they are not wearing a PFD, increasing the risk to rescuers. Rescue personnel must utilize personal protective equipment at all times. Thermal protection is necessary if prolonged exposure is possible.

BYSTANDERS SHOULD ACTIVATE THE EMS SYSTEM AS SOON AS POSSIBLE FOR ANY DROWNING VICTIM

The first priority for any bystander or emergency responder rescuing drowning victims should be to their own personal safety. One mnemonic for rescuing a distressed person in the water is: ***Reach, Throw, Row, Go (with support)***. Attempt to rescue a conscious victim from dry land using a rescue aid such as a stick or pole or by throwing a rope. If rescue from dry land is not possible, a boat should be used. Anyone attempting to rescue a conscious person who fell through ice should take precautions not to fall through the ice themselves and should have a safety line in case they fall through the ice. Bystanders and rescuers should enter the water only if absolutely necessary. If entering the water, they must be wearing personal flotation devices and appropriate thermal protection. Rescuers should never dive head first into the water. For added safety, in organized rescue it may best to have two rescuers enter the water whenever possible.

Drowning victims should be removed from the water as quickly and as safely as practical. In order to decrease the risk of cardiovascular collapse, **attempt to maintain the body in a horizontal or near horizontal position during removal from the water and subsequent transport**.

Stabilize the cervical spine only if there are signs of a neck injury or a history of a high-risk mechanism of injury such as diving or falling head first into shallow water. Spinal stabilization is difficult to accomplish in the water and will delay rescue and resuscitation. Cervical collars can cause airway obstruction. If possible, limit neck flexion and extension while removing the person from the water.

BASIC LIFE SUPPORT FOR DROWNING VICTIMS (ADAPTED FROM ILCOR GUIDELINES)

Resuscitation should be attempted unless there are obvious fatal injuries or obvious signs of long submersion such as putrefaction, slippage of skin or significant animal predation. Triage considerations and risk to the rescuers must be factors in withholding or terminating resuscitation. Declaration of death in the field and contraindications to CPR are presented in the Hypothermia section of The Alaska Cold Injuries Guidelines.

Since hypoxia is the cause of death and neurologic damage in drowning, bystanders or rescuers should start rescue breathing immediately in any drowning victim who is not breathing. Supplemental oxygen should be used if available and if it will not delay rescue ventilation.

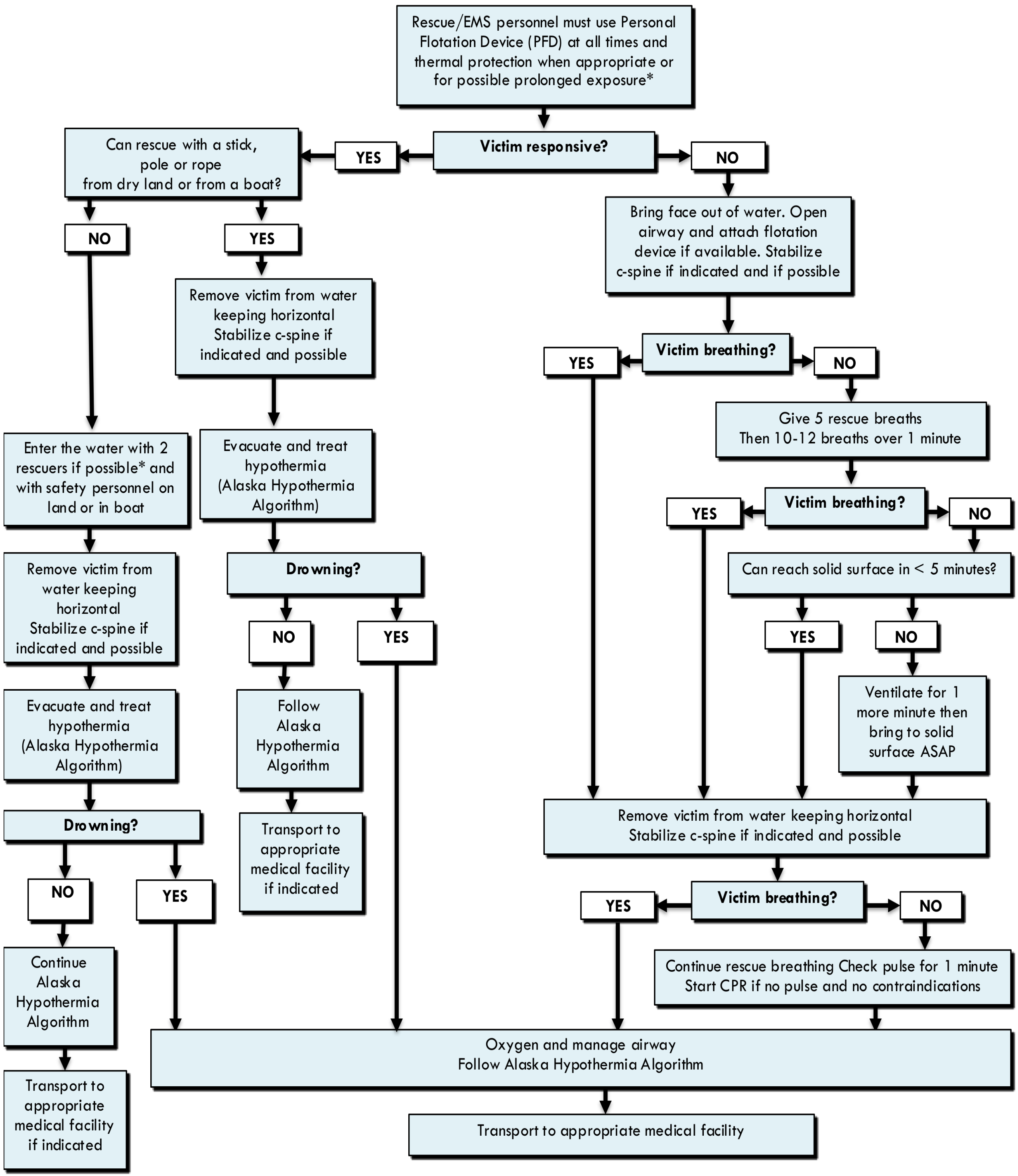
- Give five (5) rescue breaths in quick succession as soon as possible. These can be given in shallow or deep water by properly trained rescuers, especially if the patient can be buoyed using a flotation device.
- Consistent with ILCOR guidelines, give 10-12 additional rescue breaths over 1 minute. If the victim is not breathing after 1 minute of rescue breaths, ILCOR guidelines recommend continuing rescue breathing while towing a victim, providing that land (or a boat or solid ice) can be reached within 5 minutes. Otherwise, if it will take more than 5 minutes to bring the victim to a solid surface, give further rescue breaths for 1 more minute, then bring the victim to a solid surface as quickly as possible without further ventilation.
- **Keep the victim as close to horizontal as possible during and after removal from the water.**
- Once on a solid surface, continue or resume rescue breathing.
- If the victim remains unresponsive, continue rescue breathing and check for a pulse for 1 minute. If no pulse, begin CPR with rescue breathing.
- If an AED is available, dry the victim's chest, turn on the AED and follow the AED prompts. It is safe to deliver shocks even on wet docks or boat decks.

It can be challenging to ventilate a drowning victim, because of fluid in the airway and decreased lung compliance requiring high inflation pressures. Vomiting of stomach contents, including swallowed water is common during resuscitation from drowning. Victims who appear about to vomit or who are vomiting should be turned on their side and suctioned. If spinal injury is strongly suspected, the spine should be stabilized, if possible.

AIRWAY OBSTRUCTION

Do not administer abdominal or chest thrusts unless there is evidence of a solid foreign body airway obstruction. No maneuvers to remove water from the lungs are safe or effective. Using measures such as the Heimlich maneuver (abdominal thrust) on a patient without an airway obstruction due to a foreign body may cause regurgitation and aspiration.

Alaska Cold Water Drowning Algorithm



Alaska Cold Injuries Guidelines 2014

*** Rescuers must be trained in water rescue, follow all applicable safety standards and policies.**

ADVANCED LIFE SUPPORT (ALS) FOR A DROWNING VICTIM

For hypothermic drowning patients, follow the guidelines given in the section on hypothermia.

CPR FOR A DROWNING VICTIM

In a normothermic drowning victim, CPR should be given according to ILCOR guidelines. Post-arrest gasping may resemble the respiratory efforts of a recovering drowning victim. A patient with gasping respirations requires ventilatory support. It may be difficult to feel a pulse. Cardiac monitoring, including the use of an AED with monitoring capability may be useful to confirm the presence of VT, VF or asystole. If an AED without monitoring advises a shock, the rhythm is VT or VF and CPR with defibrillation is indicated.

AIRWAY AND BREATHING IN DROWNING

Alert and spontaneously breathing post-drowning patients should receive high flow oxygen, preferably by nonrebreather mask with a reservoir, as soon as it is available. If adequate oxygenation, measured by pulse oximetry, is not achieved with high flow oxygen or the patient is in respiratory distress, non-invasive ventilation with continuous positive airway pressure (CPAP) can be started. A patient with decreased level of consciousness and alert patients who are unable to achieve oxygen saturation of ≥90% with high flow oxygen or non-invasive ventilation should have the airway controlled with a supraglottic device or with endotracheal intubation. A patient in cardiorespiratory arrest should have the airway controlled as soon as possible. Supraglottic devices may not be effective in patients with decreased lung compliance requiring high inflation pressures.

Endotracheal intubation should be done by rapid sequence intubation (RSI) with adequate preoxygenation. RSI medications are not necessary if the patient is in cardiac arrest. Visualization of the vocal cords may be limited by pulmonary edema fluid, requiring vigorous suctioning.

It is not necessary to achieve 100% oxygenation after intubation. The fraction of inspired oxygen (FIO_2) can be titrated to achieve an oxygen saturation by pulse oximetry (SpO_2) of 94-98%. Positive end expiratory pressure (PEEP) should be set to 5-10 cm H_2O, with higher levels if necessary, if oxygen saturations remain <94%.

FLUID MANAGEMENT IN DROWNING

Hypovolemia can be caused during prolonged immersion due to hydrostatic pressure and by cold diuresis. IV or IO boluses of normal saline boluses should be given to correct hypovolemia.

TERMINATION OF RESUSCITATION IN DROWNING

Indications for terminating CPR in drowning patients are the same as those for withholding CPR that are mentioned above in the section on basic life support. These include obvious fatal injuries or obvious signs of long submersion including putrefaction, slippage of skin or significant animal predation. Triage considerations and risk to the rescuers may also be factors in withholding or terminating resuscitation.

Some victims who have drowned in very cold water at ≤5°C (41°F) have survived neurologically intact after immersions of an hour or more. Most of these victims have been children whose brain was protected from hypoxia by becoming hypothermic very quickly. It is difficult to predict good survival after drowning. Cold water drowning victims without contraindications should have CPR continued and should be transported to a clinic or hospital for further evaluation and any indicated treatment.

TRANSPORT OF DROWNING VICTIMS

Any patient who was submerged and unconscious should be transported to the nearest medical facility for further evaluation. Accumulation of fluid in the lungs (noncardiogenic pulmonary edema) may develop 6 to 24 hours after submersion. Any drowning patient with associated medical problems that may have caused the drowning or with associated significant injuries should be transported to a clinic or hospital capable of managing the medical problems or injuries. A drowning patient who has ongoing CPR should be transported to the nearest medical facility capable of measuring core temperature and serum potassium.

CLINIC/HOSPITAL – MANAGEMENT OF DROWNING VICTIMS

For hypothermic drowning patients, follow the guidelines given in the section on hypothermia. There is no proven benefit of cardiopulmonary bypass or ECMO in the resuscitation of drowning victims who are not severely hypothermic.

POST-RESUSCITATION CARE OF DROWNING VICTIMS

Trauma care should follow applicable trauma guidelines. Lung injury may be present whether the drowning was in salt water or fresh water. Washout and degradation of pulmonary surfactant may lead to alveolar damage and atelectasis, causing hypoxemia. Drowning victims may develop acute respiratory distress syndrome (ARDS) due to noncardiogenic pulmonary edema. Patients with ARDS should be cared for in a hospital capable of providing critical care.

Pneumonia may also occur after drowning. Prophylactic antibiotics are not indicated unless the drowning was in very contaminated water, such as sewage.

The extent of the evaluation and treatment in a clinic or hospital is based on the training of the personnel and the available equipment.

Transfers of drowning patients should follow the same guidelines as any other patient transfer. For hypothermic drowning patients it may be preferable to bypass a closer hospital to transport to a hospital that has critical care or cardiac bypass capabilities, including ECMO. The general indications to transfer the patient from a clinic or hospital to a tertiary care facility are lack of appropriate staff or equipment to provide proper care for a critically ill patient.

Interhospital transfer must follow all applicable regulations, including the Emergency Medical Treatment and Labor Act (EMTALA).

FOLLOW-UP CARE OF DROWNING VICTIMS AND FAMILIES OF DROWNING VICTIMS

Many drownings are caused by syncope due to congenital cardiac arrhythmias. If the victim is in the water at the time of syncope, the result can be drowning. Some congenital cardiac arrhythmias can be triggered by immersion. Victims of drowning with a personal history of syncope, seizures or previous unexplained drowning or with a family history of cardiac syncope, sudden death or unexplained drowning, should undergo genetic analysis. This can be done post-mortem. Identification of congenital predisposition to cardiac arrhythmias can benefit family members of drowning victims as well as survivors by allowing them to take appropriate precautions.

AVALANCHE RESCUE

INTRODUCTION

Overall, the majority of avalanche deaths are caused by asphyxia. A substantial number are also caused by trauma. The proportions vary with snow types and the activities of the victims. Many avalanche victims who asphyxiate also have major trauma. While many avalanche victims are hypothermic, it is the cause of death in only a small percentage.

In a classic avalanche burial study of 422 victims, there was an overall survival of 43%. The chance of survival was 92% if the victim was uncovered within 15 minutes after burial. However between 15-35 minutes after burial, survival dropped rapidly to only 30%. Between 30 and 90 minutes the slope of the survival curve became almost horizontal, but after 90 minutes it dropped again so that the survival rate was only 3% by 130 minutes. **[Figure 1]**

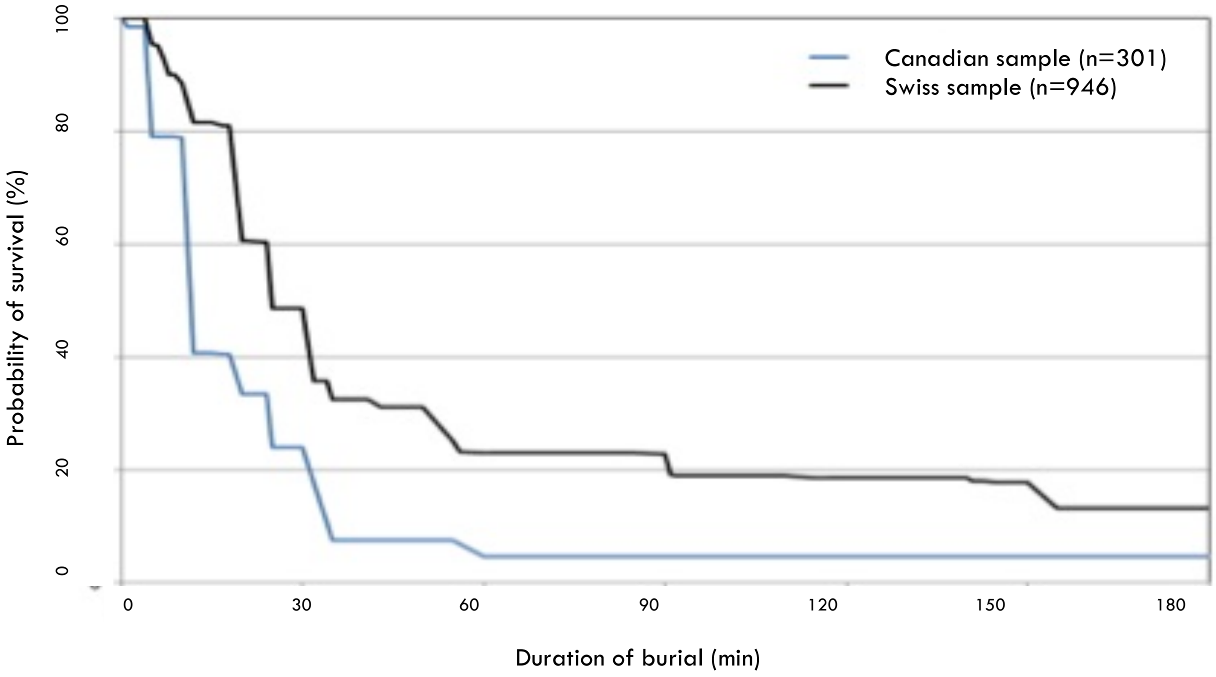
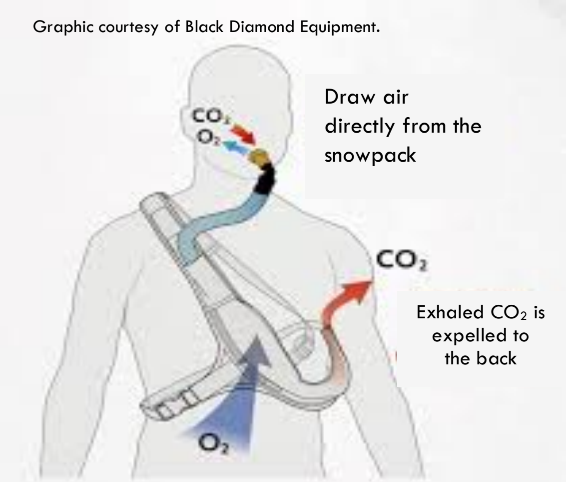


Figure 1 Comparison of survival curves in Canada (blue; *n*=301) and Switzerland (grey; *n*=946) from 1980 to 2005 from Brugger, et al; 2012, which is similar to the classic article, Falk, et. al; 1994.

Most of the deaths in the first 15 minutes were due to trauma or asphyxia. The rapid decline in survival over the next 20 minutes (15 to 35 minutes from the time of burial) reflected asphyxiation of victims with an obstructed airway. The horizontal slope of the survival curve between 35 and 90 minutes indicated the low risk of dying during this period for victims still alive, with an open airway, previously described as having an "air pocket". Insulation provided by the snow prevents rapid development of hypothermia. The increased decline in survival after 90 minutes reflected victims dying because of accumulation of carbon dioxide in the "air pocket."

In order to extricate a victim within the optimal 15-minute period after burial, the victim must be located and extricated by companions. It takes too much time to notify, mobilize and bring trained avalanche rescuers to the scene. Backcountry travelers should know the techniques of avalanche search and rescue, should carry shovels, collapsible probes, and avalanche transceivers and should know how to use them. They should also be taught the importance of an open airway and how to ensure that they will have an open airway if caught in an avalanche.

Graphic courtesy of Black Diamond Equipment.



An avalanche airbag is the best method of avoiding complete burial. The airbag may protrude above the snow even when the victim is completely buried. This aids in rapid location and rescue by companions. An avalanche breathing device, e.g. Avalung®, may prolong survival in a completely buried victim, but is not a substitute for an avalanche airbag. Since possession of information, skills and equipment may create a false sense of security, it is crucial to be able to recognize and avoid dangerous avalanche terrain and conditions.

AVALANCHE RESCUE - GENERAL POINTS

Prevention is the most effective measure to increase avalanche survival. People planning to travel in avalanche-prone areas should pick the safest possible route. If the danger is high, they should cancel the trip or turn around in order to avoid unacceptable hazard.

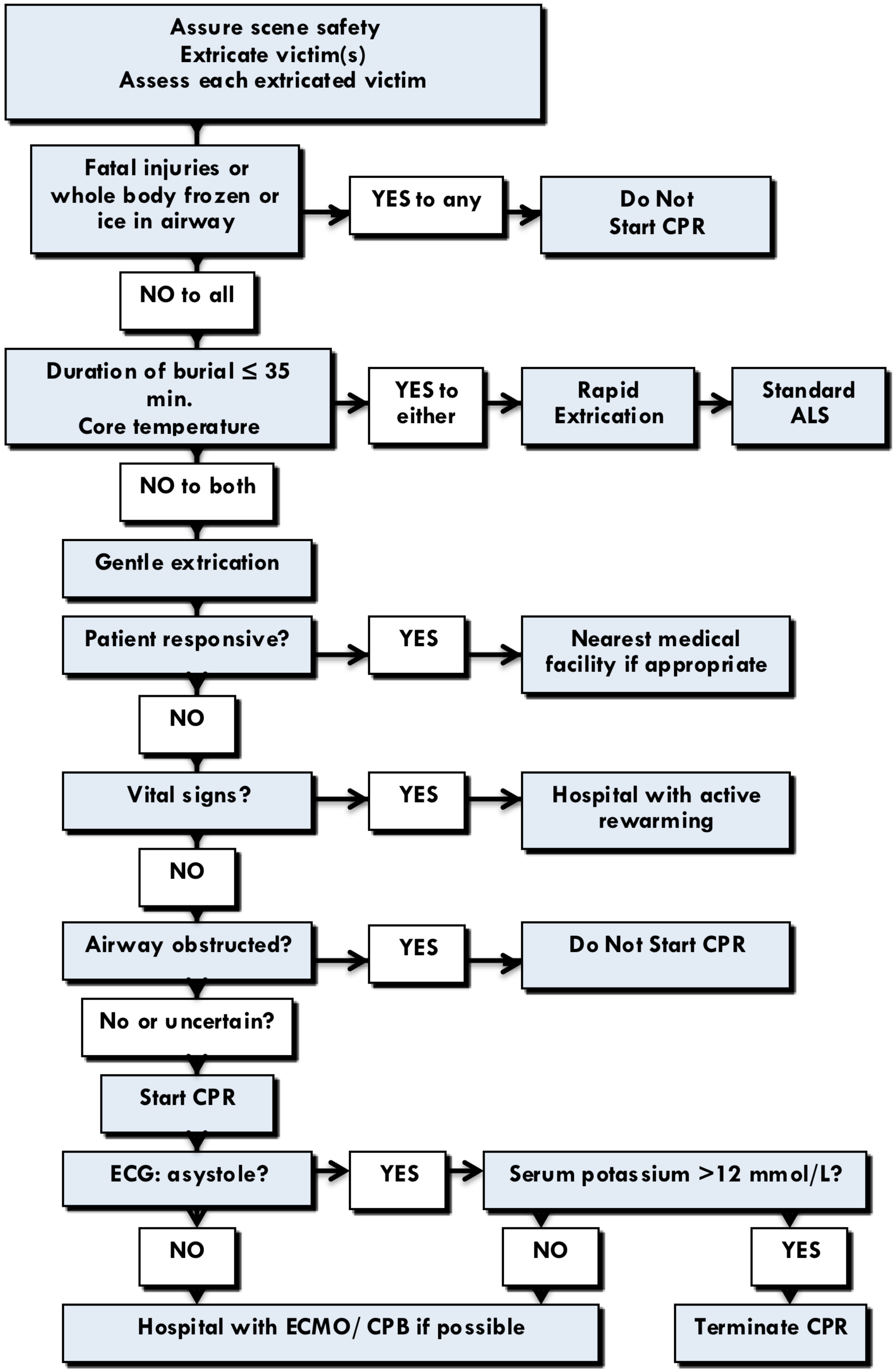
If someone is caught in an avalanche the best means of increasing survival is rescue by other members of the party. Every member of the party should have a shovel, a collapsible probe, and an avalanche beacon and should know how to use them. This requires training and regular practice.

An avalanche incident is a medical emergency. Because of the high survival in people extricated within 15 minutes and the rapid decline in survival over the next 20 minutes, the victim should be located and extricated by companions if possible. People on site should start a quick search for victims as soon as the area is safe. Search for 15 minutes before sending someone for help. If a radio or cell phone is readily available, the call for help can be made as soon as possible.

Transport medical personnel and search dogs with handlers to the scene as quickly as possible, especially if it has been less than 90 minutes from the time of the avalanche. However, scene safety is the first consideration. Just because one avalanche has come down does not mean the scene is safe. There may be a risk of subsequent avalanches from other starting zones.

An experienced avalanche safety person must secure the avalanche scene before other rescuers can begin on-site operations.

Alaska Avalanche Algorithm



THE FOLLOWING SECTION FOLLOWS ILCOR GUIDELINES.

When victims of avalanche burial are uncovered, it is important to determine whether the airway is obstructed with snow or ice or if the airway is open. Previously, the term "air pocket" was used to describe any air space between an avalanche victim's nose or mouth and the snow in which they were buried. It is more important to determine if the airway is open rather than looking for an air pocket during rescue. Victims with completely obstructed airways generally have a poor outcome.

Avalanche victims are not likely to survive when they are:

- Buried >35 minutes and in cardiac arrest with an obstructed airway on extrication;
- Buried and in cardiac arrest, found with an obstructed airway on extrication, and an initial core temperature ≤32°C (90°F);
- In cardiac arrest and have an initial serum potassium >12 mmol/L. Note: the 2010 American Heart Association guidelines use a cutoff of >8 mmol/L. Until further evidence is available, the Alaska Guidelines will use the more conservative cutoff.

Time of burial affects the victim's temperature:

- Victims buried <35 minutes are generally not hypothermic, so they should be extricated as rapidly as possible. If the person is in critical condition it is either because of acute asphyxia or trauma.
- Victims buried >35 minutes are likely to be hypothermic. They should be extricated as gently as possible.

Treatment of patients in asystole depends on estimated duration of burial, core temperature, and whether the airway is obstructed or clear.

- A patient who has been buried <35 minutes should be presumed not to be hypothermic. If the patient is pulseless it is due to asphyxia or trauma. CPR should be performed according to standard advanced life support protocols.
- A patient buried >35 minutes is presumed to be hypothermic. If the airway was obstructed and the patient is pulseless, CPR should not be performed. If the airway was clear or unknown (possibly clear), the decision to perform CPR is made in accordance with hypothermia guidelines. If core temperature can be measured and is ≥32°C (90°F), follow standard advanced life support protocols.
- If burial time is not known exactly and is thought to be about 35 minutes, assume that it is <35 minutes.

After a complete burial (head and trunk buried), a person should be transported to a hospital and admitted for observation.

- Hypothermia should be treated according to the Hypothermia Guidelines.
- Trauma should be treated according to State of Alaska Trauma Guidelines

Evaluation and treatment of avalanche victims

Basic Life Support

Burial time <35 minutes: If the patient has no signs of life and has no pulse, perform CPR. If an AED is available, use ILCOR guidelines for normothermic patients.

Burial time ≥35 minutes: If the patient has no signs of life, is not breathing and has no pulse (after checking for 1 minute):

- If the airway is obstructed, do NOT perform CPR.

- **If the airway is not obstructed or uncertain – treat the patient according to the Hypothermia guidelines with gentle handling. Perform CPR until a core temperature can be measured.**
- If an AED is available and shock is advised (VF or VT), make one defibrillation attempt. If successful, the patient should be transported immediately to the nearest medical facility. If unsuccessful, and the patient's core temperature is <30°C (86°F), CPR should be continued as feasible and the patient should be transported to the nearest medical facility without further attempts at defibrillation. If the temperature is ≥30°C (86°F), use ILCOR guidelines for normothermic patients.
- Assess carefully for associated injuries. Follow applicable trauma guidelines.

ADVANCED LIFE SUPPORT

Hypothermia, if present, should be treated according to the Hypothermia guidelines.

CLINIC/HOSPITAL – MANAGEMENT OF AVALANCHE VICTIMS

The evaluation of the avalanche victim should be directed towards treating specific injuries and conditions, including hypothermia, if present. Evaluation of hypothermia is generally the same as that indicated in the Clinic/Hospital Section of the Hypothermia Guidelines. Because avalanche burial is an asphyxial injury, like drowning, further treatment should follow the Clinic /Hospital Section of the Cold Water Drowning Guidelines.

FROSTBITE AND NONFREEZING COLD INJURIES

FROSTBITE

Frostbite is freezing of tissue. It may involve only superficial tissue or may extend to the bone. The onset and severity of frostbite is affected by air temperature, wind speed, duration of exposure, amount of exposed area, and predisposing conditions such as:

- Inadequate insulation from the cold or wind
- Immersion
- Altitude
- Impaired circulation from tight clothing or shoes
- Fatigue
- Injuries
- Circulatory disease
- Poor nutrition
- Dehydration
- Hypothermia
- Alcohol or drug use
- Use of tobacco products

Damage to the frostbitten tissue is caused by ice formation within the tissue and by resulting changes in electrolyte concentration within cells. Damage occurs during the freezing process and during reperfusion of frostbitten tissue.

Frostbite is frequently seen in Alaska. Superficial frostbite is often treated at home. Deep frostbite warrants transport to a medical facility for evaluation and treatment. It is seldom necessary for emergency medical personnel to perform in-field rewarming for deep frostbite. Frostbite may occur in conjunction with other injuries, (e.g. a motor vehicle crash patient who has been exposed to sub-zero temperatures while awaiting the arrival of rescue and medical personnel). Hypothermia and other life threatening conditions may be present in patients with frostbite. Life-threatening conditions, including hypothermia, must be evaluated and treated prior to treatment of frostbite.

When caring for a patient in extremely cold conditions, take care to prevent hypothermia. Protect tissue from becoming frostbitten and protect frostbitten tissue from further cold exposure. It may be difficult to assess the degree of frostbite in the field or even in a hospital setting.

- **Superficial frostbite** affects the dermis and shallow subcutaneous layers of the skin. It is characterized by white or gray colored patches. The affected skin feels firm, but not hard. The skin initially turns red and, once thawed, is not painful. No tissue loss will occur when superficial frostbite is treated with rapid rewarming.
- **Deep frostbite** affects the dermal and subdermal layers and may involve an entire digit or body part. The skin feels hard and cold and the affected tissue is white or gray. A pulse cannot be felt in deeply frostbitten tissue and skin will not rebound when pressed. Tissue loss will result, even with rapid rewarming.
- **Large blisters** on the frostbitten area indicate that frostbite has partially or totally thawed.
- Treatment of deep frostbite is usually best accomplished in a medical facility. Sometimes, however, it may be better to rewarm frostbitten areas in the field.
- **If transport time will be short (<2 hours)**, the risks posed by improper rewarming or refreezing outweigh the risks of delaying treatment for deep frostbite.
- **If transport time will be prolonged (>2 hours)**, frostbite will often thaw spontaneously. It is more important to treat or prevent hypothermia than to rewarm frostbite rapidly in warm water. This does not mean that a frostbitten extremity should be kept in the cold to prevent spontaneous rewarming. Anticipate that frostbitten areas will rewarm as a consequence of keeping the patient warm and protect these areas from refreezing at all costs.

Tissue that has been thawed and refrozen will be severely damaged and will likely be lost. Consequently, the decision to thaw the frostbitten tissue in the field commits the provider to a course of action that may involve pain control, maintaining warm water baths at a constant temperature, and protecting the tissue from further injury during rewarming and eventual transport. Victims should not walk on feet that have been rewarmed.

In most cases, the patient should be transported as promptly as circumstances allow. Rescue may be complicated by the patient being unable to walk or, in the case of frostbitten hands, to use ski poles, climbing gear or safety lines.

If frostbite is mild and is not complicated by other injuries, and there are resources available to care for the patient without transport, it may be appropriate not to transport the patient to a medical facility. This should only be done in consultation with a physician who is knowledgeable about the treatment of frostbite. The prehospital provider should carefully document any decision not to transport.

Do not:

- Rub the frozen part;
- Allow the patient to have alcohol or tobacco;
- Apply ice or snow;
- Attempt to thaw the frostbitten part in cold water;
- Attempt to thaw the frostbitten part with high temperatures such as those generated by stoves, fires, exhaust, etc.

Frostbitten tissue should be handled extremely gently before, during, and after rewarming.

When moving patients with frostbite by helicopter, care must be taken to protect the patient from additional exposure to cold due to the increased wind chill caused by rotor wash. Rotor wash can be eliminated if the helicopter shuts down while loading and unloading, but this is usually not practical in the field and is very time consuming. Package the patient carefully to avoid any additional loss of heat or skin exposure that can cause or worsen frostbite and hypothermia.

CARE DURING TRANSPORT (Ground or air ambulance)

- Anticipate, assess and treat the patient for hypothermia and other injuries, if present.
- Remove jewelry and clothing, if present, from affected areas.
- Assess frostbitten areas carefully since the loss of sensation may cause the patient to be unaware of soft tissue injuries.
- Obtain a complete set of vital signs, including the patient's temperature. Most patients with frostbite will be volume depleted. Administer IV or IO boluses of warm normal saline to replace volume.
- If there is frostbite distal to a fracture, attempt to align the limb unless there is resistance. Splint the fracture in a manner that does not compromise distal circulation. Continue to monitor circulation throughout transport.
- Determine whether rewarming frostbitten tissue can be accomplished in a medical facility. If it can, transport the patient while protecting the tissue from further injury.
- If the decision is made to rewarm frostbitten tissue in the field, prepare a warm water bath in a container large enough to accommodate the frostbitten tissue without touching the sides or bottom of the container.
- The temperature of the water bath should be 37-39°C (99–102°F). These temperatures are lower than those recommended in some earlier versions of this document. This decreases pain for the patient, without significantly slowing rewarming. A source of additional warm water must be available. Water should be maintained at approximately 37-39°C (99–102°F) gently circulated around the frostbitten tissue until the whole frostbitten part becomes flushed.
- Administer analgesics and anxiolytics as needed. Pain after rewarming usually indicates that tissue has been successfully rewarmed.
- After rewarming, let the frostbitten tissue dry in warm air. Do not towel dry.
- After thawing, tissue that was deeply frostbitten may develop blisters or appear cyanotic. Large blisters are usually filled with clear or cloudy fluid and may be tensely distended. These may be drained by sterile needle aspiration if necessary for dressing the wound or for transport. Small, hemorrhagic blisters should not be drained.

- Pad between affected digits and bandage affected tissue loosely with a soft, sterile dressing. Do not put pressure on the affected parts.
- Rewarmed extremities should be kept at a level above the heart, if possible.
- Protect the rewarmed area from refreezing and other trauma during transport. A frame around the frostbitten area can be constructed to prevent blankets from pressing directly on the injured area.
- A patient with frostbitten feet may walk prior to rewarming if necessary for rescue. Once frostbitten feet are rewarmed the patient probably will not be able to walk.
- Regional nerve blocks and adjunctive medications may be used, if appropriate. These topics are covered in the following section on hospital management of frostbite.

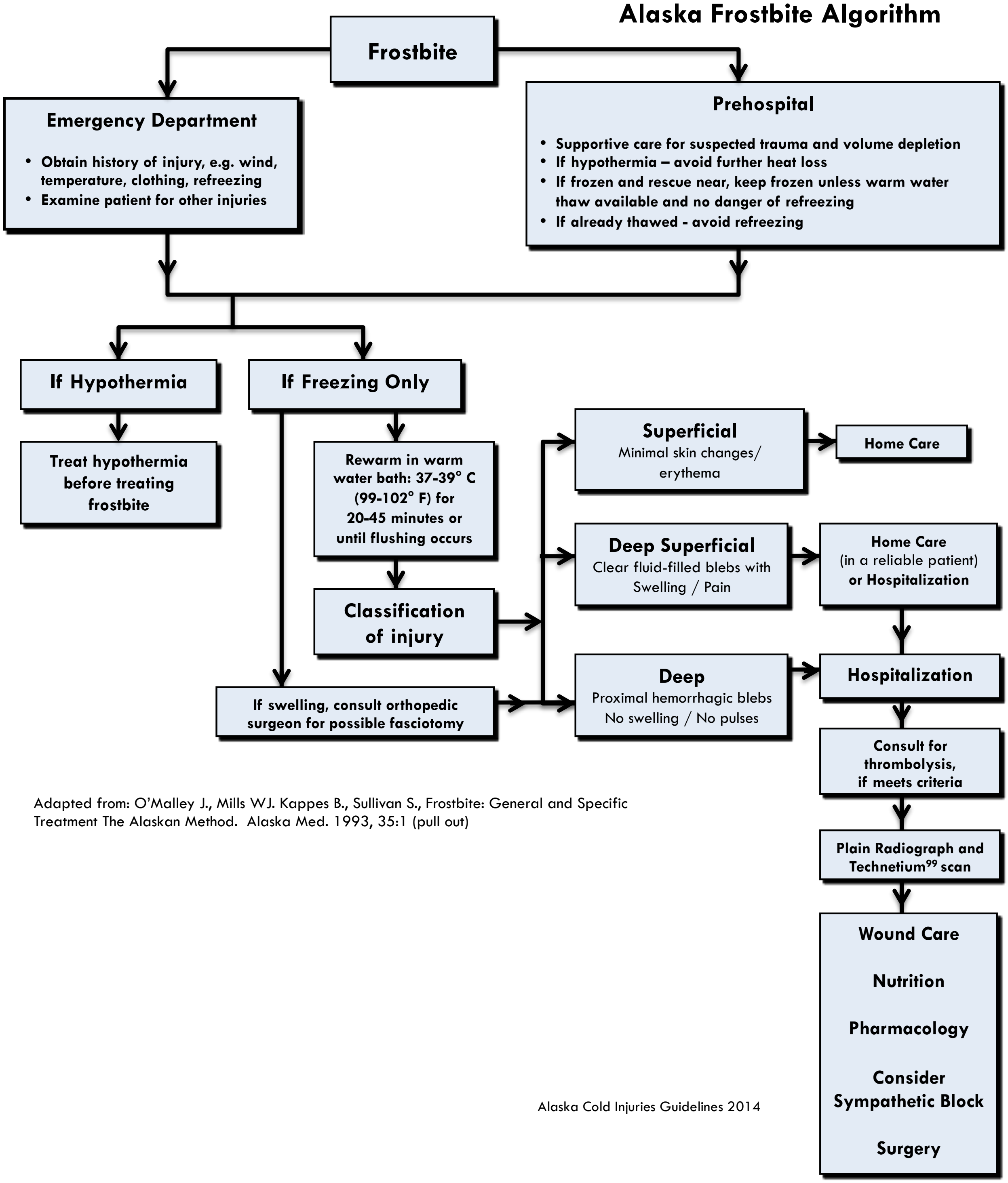
HOSPITAL

The following section covers general points and gives an overview of hospital treatment for frostbite. This section is not intended to give complete information. Medical care providers who are not experienced in the management of frostbite should consult a physician who regularly manages frostbite and should stabilize patients with deep frostbite before transfer to a facility experienced in the care of frostbite.

Many medications have been used as adjunctive treatments for frostbite. Hospitals should develop their own policies based on experience and available evidence. Medications that have been used in patients with frostbite include:

- Nonsteroidal anti-inflammatory drugs (NSAIDS). Aspirin has been widely used in the treatment of frostbite to block production of prostaglandins and thromboxanes that can cause tissue damage. Some research exists to support this practice. Some authors feel that ibuprofen has theoretical advantages compared to aspirin. There is no research data to support the use of ibuprofen rather than aspirin for frostbite.
- Regional nerve blocks, including epidural or spinal anesthesia as well as wrist and ankle blocks can be used in conjunction with rewarming to promote vasodilation (chemical sympathectomy) and for pain control. These interventions should be performed during or immediately after rewarming. In no case should they be initiated more than 24 hours after rewarming.
- Vasodilator/anti-inflammatory therapy. In a small study (Cauchy 2011), treatment with aspirin plus iloprost, a prostacyclin analog, was superior to aspirin plus iloprost and intravenous tPA. Some patients may still benefit from iloprost plus tPA. There are currently no centers in North America with published experience using prostacyclins. In future, this may become standard care for deep frostbite.
- Vasodilator therapy. Prostaglandin E1, nitroglycerin, pentoxyfilline, phenoxybenzamine, nifedipine, reserpine and buflomedil (not available in the USA) have all been investigated, but research to date has not shown any benefit for treatment of frostbite. The “Alaska Method” has traditionally used phenoxybezamine.
- Thrombolytic therapy (tPA). Limited data suggests that the use of IV or intra-arterial tPA in the first 24 hours may be beneficial in salvaging tissue at risk of necrosis. Thombolytic therapy with tPA given in conjunction with heparin is guided by angiography. Patients with severe frostbite who can be treated within 24 hours of thawing and who do not have any contraindications to the use of tPA should be considered for transfer to a center experienced in the use of thrombolytic therapy for frostbite.
- Low molecular weight dextran has been given in the past to decrease blood viscosity if the patient is not being considered for thrombolytic therapy. It is not currently available.

Alaska Frostbite Algorithm



Adapted from: O'Malley J., Mills WJ. Kappes B., Sullivan S., Frostbite: General and Specific Treatment The Alaskan Method. Alaska Med. 1993, 35:1 (pull out)

Alaska Cold Injuries Guidelines 2014

POST-THAWING WOUND CARE:

Tetanus immunization should be given according to standard guidelines

- If the injury is deep, use sterile sheets with cradles over the extremity to prevent additional trauma after thawing. Cotton pads between affected fingers/toes without excessive pressure on the digital vessels help prevent decreased circulation.
- Do not allow thawed tissue to be in a dependent position. Ideally thawed tissue should be at or above the level of the heart. Examine the blood flow into the extremity at consistent intervals.
- Large blisters that contain clear or cloudy fluid can be drained using needle aspiration, especially if tensely distended.
- Topical aloe vera may be used with dressing changes.
- Give whirlpool baths twice daily. The water temperature should be body temperature 98°F (37°C). Baths allow the part to be cleansed and remove superficial bacteria without surgical debridement. Surgical soaps (chlorhexidine or povidone-iodine) may be used in dilute solution.
- When an eschar (scab) forms (usually on day 10-14), split it manually to relieve stiffness. Patients should perform active range-of-motion exercises of all small joints.
- Delay debridement or amputations for at least 21 days unless absolutely necessary. There is less tissue retraction after this time. Premature amputation may cause the loss of up to 3-5 cm.
- Cover wounds as soon as possible with split thickness (mesh) skin grafts.
- Antibiotics are not necessary except for prophylaxis of grossly contaminated wounds or treatment of established infection.
- Hyperbaric oxygen has not been shown to be beneficial in the final outcome of frostbite, but may hasten wound healing.
- If a frostbitten extremity is swollen, the patient may develop a compartment syndrome. If compartment syndrome is suspected, emergent orthopedic consultation is mandatory. Increased compartment pressure mandates immediate performance of a fasciotomy to prevent disastrous loss of tissue.
- Nuclear medicine (Technetium^{99}) scanning can be useful to determine blood supply in order to guide treatment, including eventual amputation. Conventional angiography, computed tomographic angiography (CTA) and magnetic resonance angiography (MRA) are also useful, but have not been as well studied as nuclear medicine scanning.
- Smoking is not allowed during recovery as it causes vasoconstriction.
- Biofeedback may increase hand and foot circulation during long-term recovery.

If there are associated fractures and dislocations:

- Reduce dislocations immediately after thawing.
- Treat fractures conservatively until thawed and placed in splint. Reduction or open reduction can be done afterwards. These injuries tend to do poorly as the blood supply was restricted twice. Children's cartilage is more susceptible to cold injury than that of adults. This is especially true in the carpal and tarsal bones and is due to the epiphyseal growth plates being still open. Injury may occur in a child at any age at which the cartilage still persists. Orthopedic consultation is mandatory in children with frostbite that might affect a joint.
- Infected gangrenous areas require amputation. Modified guillotine amputations should be performed, even in the digits.

Nonfreezing cold injuries (NFCI)

Nonfreezing cold injuries (NFCI) include trench foot, immersion injury and pernio (chilblains). Trench foot and immersion injury are identical injuries that are caused by prolonged exposure to cold, wet conditions that do not cause freezing of tissue. Usually, the feet are affected, but hands are also susceptible to NFCI. Trench foot is caused by exposure to cold, wet conditions on land and immersion foot is caused by exposure to water, usually sea water. Mixed injury with frostbite and nonfreezing cold injury is possible. Pernio consists of localized nodular lesions caused by exposure to cold with less moisture than the amount necessary to cause trench foot or immersion injury.

Stages of trench foot or immersion injury

There are four stages of trench foot or immersion injury: During cold exposure, following cold exposure (pre-hyperemic), hyperemic and following hyperemia.

- In the first stage, during cold exposure, injured tissue will usually be completely without feeling. The extremities are initially bright red but later turn pale or white. There is no pain or swelling unless attempts are made to rewarm the affected part.
- The second stage (pre-hyperemic) begins immediately after removal from cold exposure and usually lasts a few hours, although occasionally it can persist for several days. The extremities turn a mottled pale blue, but pigmented skin can obscure the color change. The affected parts remain cold and numb. Swelling may take place.
- In the third stage (hyperemic) there is increased blood flow. This stage begins abruptly and lasts for days to months, but typically 6-10 weeks. The extremity becomes hot and red with full pulses and with very slow capillary refills. Pain begins at this stage that may be severe and difficult to treat. In severe injuries, blistering may occur. In rare cases damaged tissue may begin to turn black.
- The fourth stage (following hyperemia) lasts for weeks to months or sometimes years and may be permanent. Cold sensitivity is common, often with persistent pain. Gangrene may occur in severe cases, requiring amputation.

Initial treatment of nonfreezing cold injuries

Hypothermia and other life threatening conditions may be present in patients with NFCI. Life-threatening conditions, including hypothermia, must be evaluated and treated prior to treatment of NFCI.
There is no standard initial treatment regimen for trench foot and immersion injury. Injured parts should be elevated. Some authors recommend slow rewarming while others recommend keeping the affected parts cool and even exposing them to cool air from a fan. Mixed frostbite and NFCI injuries require rapid rewarming for the frostbite injury, if it has not already thawed.

Pernio or chilblains should be treated by drying and gentle massage. Active rewarming is contraindicated.

photo by carin marter

APPENDIX A

24/7 PHYSICIAN STAFFED EMERGENCY DEPARTMENTS IN ALASKA WITH CONTACT INFORMATION

SOUTHERN REGION

Alaska Native Medical Center, Anchorage	1.907.729.1729
Alaska Regional Hospital, Anchorage	1.907.264.1222
Central Peninsula General Hospital, Soldotna	1.907.714.4444
Cordova Community Medical Center, Cordova	1.907.424-8236
JBER Hospital, Anchorage	1.907.580.5555
Kanakanak Hospital, Dillingham	1.907.842.5201
Mat-Su Regional Medical Center, Palmer	1.907.861.6620
Providence Kodiak Island Medical Center, Kodiak	1.907.486.9578
Providence Hospital, Anchorage	1.907.261.3111
South Peninsula Hospital, Homer	1.907.235.0282
Valley Hospital, Palmer	1.907.861.2600

NORTHWEST ARCTIC REGION

Maniilaq Medical Center, Kotzebue	1.907.442.7202

SOUTHEAST REGION

Bartlett Regional Hospital, Juneau	1.907.796.8427
Peace Health Ketchikan Medical Center, Ketchikan	1.907.225.5171
SEARHC Mt. Edgecumbe Hospital	1.907.966.2411
Sitka Community Hospital, Sitka	1.907.747.1701
Wrangell Medical Center	1.907-874-7000
Petersburg Medical Center	1.907-772-4291

NORTON SOUND REGION

Norton Sound Regional Hospital, Nome	1.907.443.2303

INTERIOR REGION

Fairbanks Memorial Hospital, Fairbanks	1.907.458.5555
Bassett Army Hospital, Ft. Wainwright	1.907.361.5144

NORTH SLOPE REGION

Samuel Simmonds Memorial Hospital, Barrow	1.907.852.9229

YUKON-KUSKOKWIM DELTA REGION

Yukon-Kuskokwim Delta Region Hospital, Bethel	1.907.543.6395

APPENDIX B

PEDIATRIC INTENSIVE CARE UNITS IN ALASKA WITH CONTACT INFORMATION

PROVIDENCE ALASKA MEDICAL CENTER IN ANCHORAGE

Providence Alaska Medical Center
3200 Providence Drive
Anchorage AK 99508
907-312-3133
http://alaska.providence.org/locations/pamc/services/childrens/pediatrics/Pages/picu.aspx

ALASKA NATIVE MEDICAL CENTER IN ANCHORAGE

Alaska Native Medical Center
4315 Diplomacy Drive
Anchorage AK 99508
907-729-1050
http://anmc.org/services/pediatrics/

APPENDIX C:

AMAZING HYPOTHERMIA RESUSCITATIONS

Lowest recorded core temperature in accidental hypothermia with survival: 13.7°C (56.7°F)
The patient made an excellent neurologic recovery.[1]

Longest cardiac arrest in accidental hypothermia with survival: 8 hours 40 minutes
This case was also the longest CPR in accidental hypothermia treated with CPB (cardiopulmonary bypass), with survival: CPR for 4 hours 49 minutes Core temperature was 20.8°C (69.4°F) The patient made excellent neurologic recovery.[2]

Longest CPR in accidental hypothermia treated with ECMO (extracorporeal membrane oxygenation), with survival: CPR for 5 hours 7 minutes
CPR was given intermittently 1 minute on / 1 minute off for the first 25 minutes. Core temperature was 16.9°C (62.4°F). The patient made a good neurologic recovery.[3]

Longest CPR in accidental hypothermia treated without ECC (extracorporeal circulation – CPB or ECMO) with survival: 6 hours 30 minutes
Core temperature was 23.2°C. The patient was rewarmed with blankets, hot-water bottles, warm intravenous fluid and peritoneal lavage. The patient made a good neurologic recovery.[4]

Successful resuscitation from accidental hypothermia in spite of no CPR for 15 minutes after witnessed ventricular fibrillation
Core temperature was 21.7°C. Total duration of cardiac arrest was 150 minutes, with CPR for all but the first 15 minutes. The patient made an excellent neurologic recovery.[5]

Complete recovery from accidental hypothermia in an avalanche victim in spite of no CPR for 70 minutes after rescue in a patient with asystole
The patient was swept into a crevasse by an avalanche and was extricated after 5 hours. No resuscitation effort was made until the patient reached a nearby hospital 70 minutes after rescue. The core temperature was 19°C. CPR was started and the patient was flown to a referral hospital for rewarming with cardiopulmonary bypass. The patient recovered fully and resumed his prior occupation.[6]

Longest submersion time with complete neurologic recovery: 66 minutes in a 2.5 year-old child
Core temperature was 19°C (66°F).[7]

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APPENDIX E:

TEMPERATURE CONVERSIONS

Temperature Conversion
Celsius - Fahrenheit

44.0	111.2
43.0	109.4
42.0	107.6
41.0	105.8
40.0	104.0
39.0	102.2
38.0	100.4
37.0	**98.6**
36.0	**96.8**
35.0	95.0
34.0	93.2
33.0	91.4
32.0	89.6
31.0	87.8
30.0	86.0
29.0	84.2
28.0	82.4
27.0	80.6
26.0	78.8
25.0	77.0
24.0	75.2
23.0	73.4
22.0	71.6
21.0	69.8
20.0	68.0
19.0	66.2
18.0	64.4
17.0	62.6
16.0	60.8
15.0	59.0
14.0	57.2
13.0	55.4
12.0	53.6
11.0	51.8
10.0	50.0

(**Celsius** x 9/5) + 32° = ***Fahrenheit***

(**Fahrenheit** – 32°) x 5/9 = ***Celsius***

APPENDIX F:

REVISION HISTORY

1988 Revision: Participants in the 1988 Conference on Cold Injuries and Cold Water Near Drowning:
Frank Hollingshead, M.D., Moderator
Matt Anderson, EMS Training Coordinator
Peter Hackett, M.D.
John Hall, M.D., State EMS Medical, Director
Harvey Huyett, MICP
William Mills, M.D.

1996 Revision:
Special thanks to the following individuals for their substantive reviews:
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Sandy Call, EMT Instructor
Scott Call, MICP
Jerry Dzugan, AMSEA
Mike Motti, EMT Instructor, SEARHC
Leo Zeek, MICP, EMS Training Coordinator, IREMSC, Inc.
Michael Westley, M.D.
Casie Williams, R.N., M.Ed.
David Sonneborn, M.D.
Capt. Martin Nemiroff, M.D.

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Participants in the 2002 Southeast Regional EMS Council, Inc. Environmental Emergencies Conference
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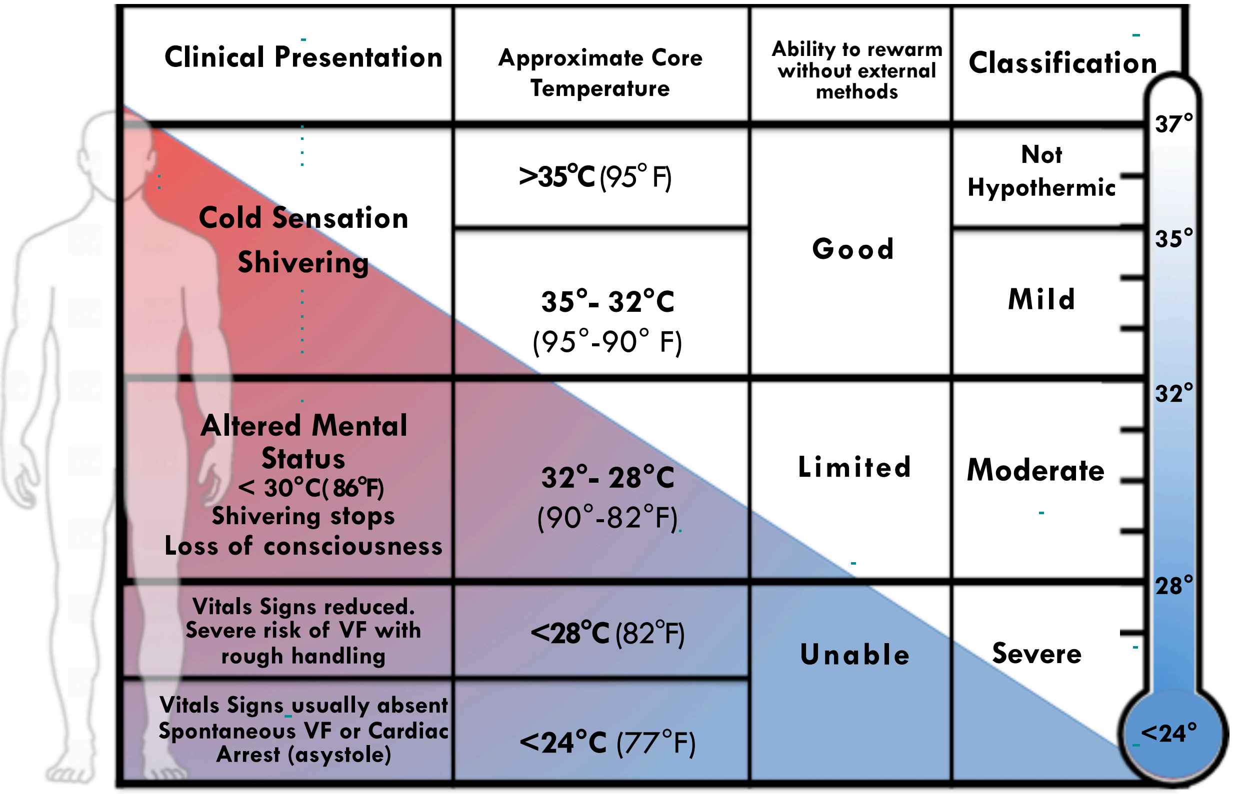
APPENDIX G: ALGORITHMS

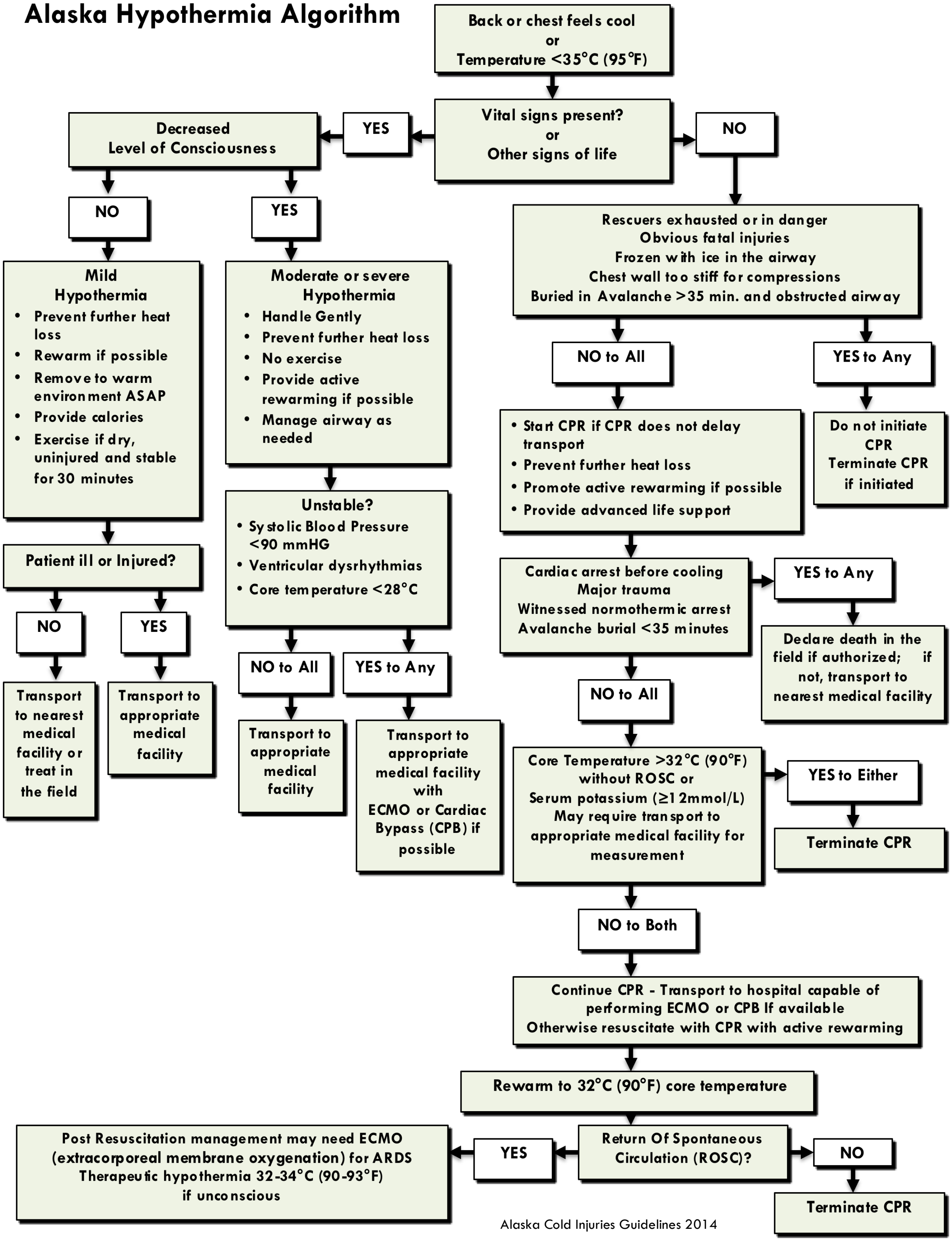
LEVELS OF HYPOTHERMIA



Clinical Presentation	Approximate Core Temperature	Ability to rewarm without external methods	Classification
Cold Sensation Shivering	>35°C (95° F)	Good	Not Hypothermic
	35°- 32°C (95°-90° F)		Mild
Altered Mental Status < 30°C(86°F) Shivering stops Loss of consciousness	32°- 28°C (90°-82°F)	Limited	Moderate
Vitals Signs reduced. Severe risk of VF with rough handling	<28°C (82°F)	Unable	Severe
Vitals Signs usually absent Spontaneous VF or Cardiac Arrest (asystole)	<24°C (77°F)		

Alaska Cold Injuries Guidelines 2014

Alaska Hypothermia Algorithm



Alaska Cold Injuries Guidelines 2014

Active External Rewarming Methods

Type of Patient	Method	Notes
All	Forced Air Warming	Preferred method
	Water filled (plumbed) blankets	Use only if forced air warming is not available
	Other external devices such as the *Norwegian Heatpac*	Primarily designed for prehospital use
	Warmed Blankets	Blankets from Warmer: Confirm temperature to avoid burns
Mild Hypothermia	Arterio-Venous Anastomoses (AVA)	The lower arms and hands (from just distal to the elbow) and the lower legs and feet (from just distal to the knees) are immersed in water between 42-45°C (107-112° F) This opens the arterio-venous anastomoses

Active Core Rewarming Methods

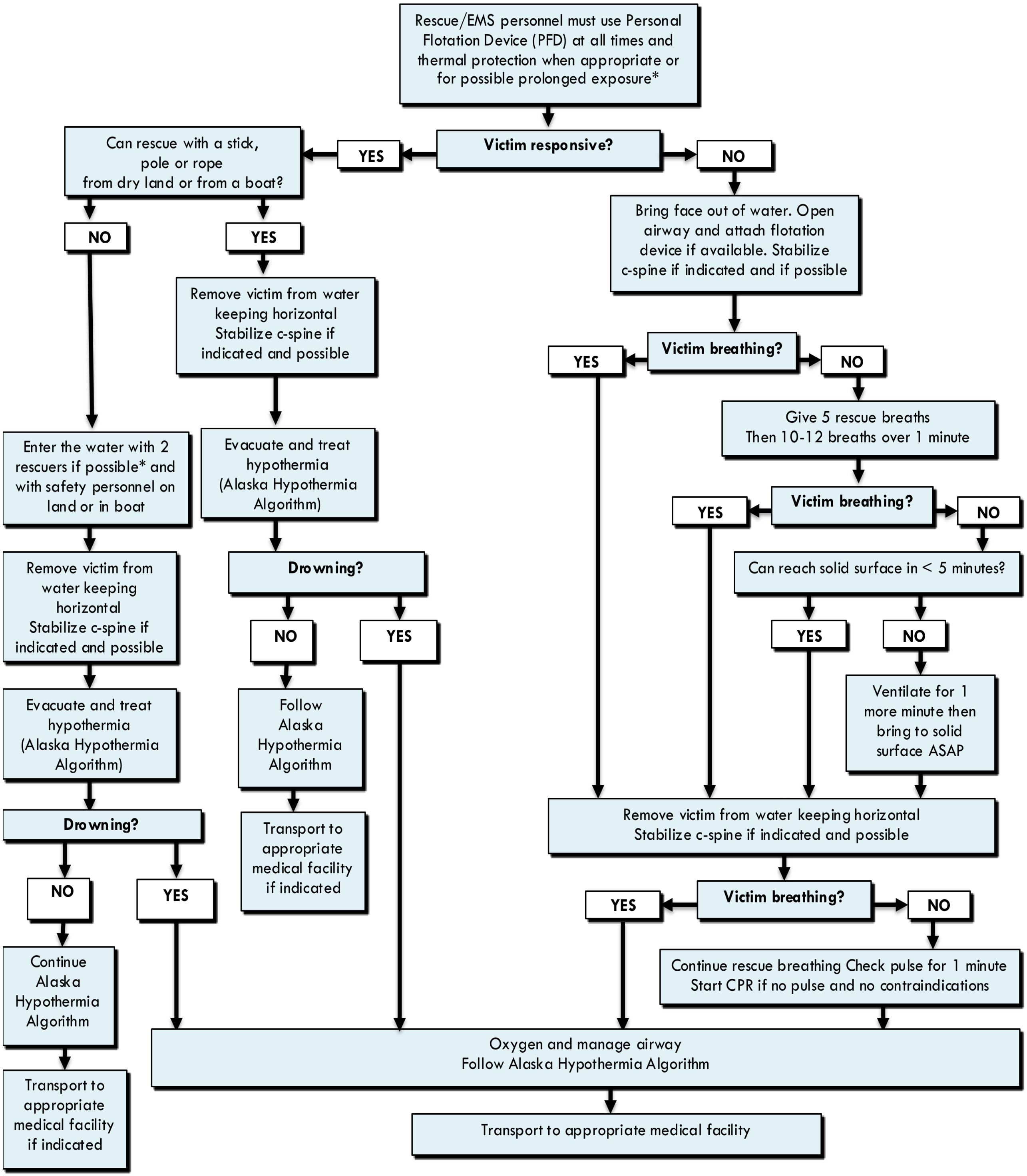
Type of Patient	Method	Notes
All	Warm IV/IO normal saline	40-42° C (104-108° F)
Moderate to severe hypothermia in a patient who is not rewarming with less invasive methods or who needs a chest tube.	Thoracic (pleural) lavage (via 2 chest tubes)	Preferred method 40-42°C (104-108°F) See: Danzl** for solution and rates
Moderate to severe hypothermia; may be less effective than chest lavage due to difficulty exchanging fluids. Two-catheter system recommended.	Peritoneal lavage	40-42°C (104-108°F) See: Danzl** for solution and rates
Severe Hypothermia with SBP ≥60 mm Hg*	Hemodialysis	Requires specialized equipment; widely available in referral hospitals.
Moderate – severe hypothermia without cardiocirculatory arrest	Heat exchange catheter (endovascular catheter)	Circulates warmed fluid contained within a catheter as heat exchanger. Requires specialized equipment
Severe hypothermia with SBP ≥60 mm Hg*	Continuous Arterio-Venous Rewarming (CAVR)	Requires specialized equipment with limited availability.
Severe hypothermia with SBP <60 mm Hg*	Extracorporeal Circulation (Cardiopulmonary Bypass or ECMO)	Requires specialized equipment generally available only in large referral hospitals.
Severe hypothermia with cardiac arrest in ED^	Thoracotomy with open cardiac massage and mediastinal irrigation	40-42°C (104-108°F)

* SBP can be maintained ≥60 mm Hg using mechanical chest compressions

^ Patients with out of hospital cardiac arrest may have a stiff heart; closed chest compressions may be effective, but open heart massage may be impossible.

**Danzl D. Accidental Hypothermia. In: Auerbach PS, ed. Wilderness Medicine, 6th edition. Philadelphia: Elsevier; 2012:116-142

Alaska Cold Water Drowning Algorithm



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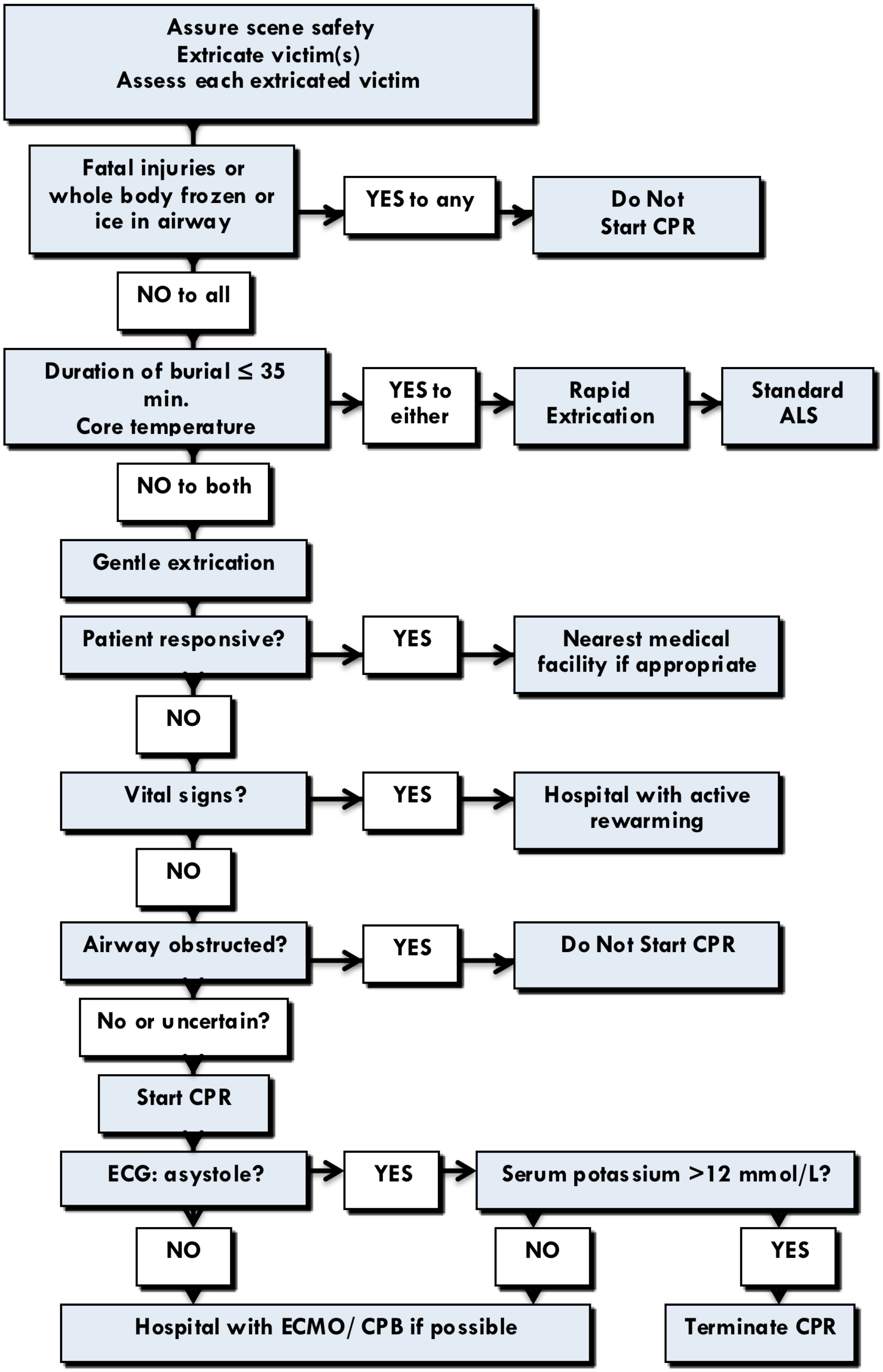
* **Rescuers must be trained in water rescue, follow all applicable safety standards and policies.**

Alaska Avalanche Algorithm



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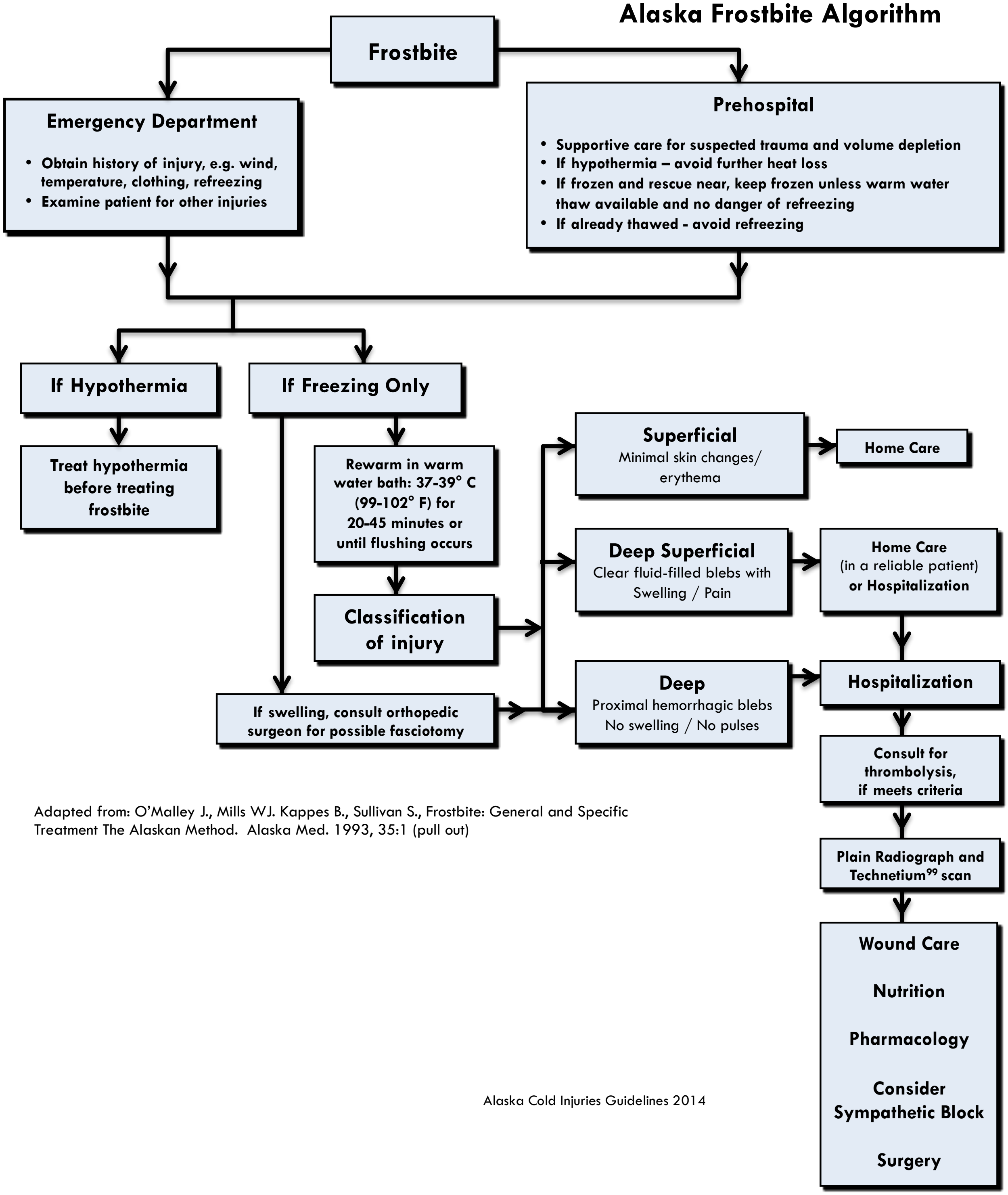
Alaska Frostbite Algorithm



Adapted from: O'Malley J., Mills WJ. Kappes B., Sullivan S., Frostbite: General and Specific Treatment The Alaskan Method. Alaska Med. 1993, 35:1 (pull out)

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http://dhss.alaska.gov/dph/Emergency/Pages/default.aspx