Accidental Hypothermia Clinical Practice Guideline for British Columbia

Accidental Hypothermia – Evaluation, Triage & Management

Version 1.03: December 9, 2016
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Scope

The objective of this guideline is to improve the efficiency and effectiveness of the management of accidental hypothermia in British Columbia. The use of simplified clinical staging, suggested treatment guidelines as well as triage and transportation algorithms has the potential to decrease morbidity and mortality of patients with accidental hypothermia in British Columbia.[1,2]

Target Population

Adults and children with a core temperature below 35°C presenting to emergency departments, physicians' offices, walk-in clinics, nursing stations and pre-hospital care providers.

Applicable Diagnositic Codes: ICD 10 T68

Evaluation and Diagnosis

Patients can be considered to have hypothermia if they have a history of cold exposure (primary hypothermia) or a disease that predisposes them to hypothermia (secondary hypothermia [see Appendix F]) **AND** if their trunk is cold to touch or they have a core temperature measurement of less than 35°C.[1,3,4] (see Appendix G for how to obtain an accurate core temperature)

Accidental hypothermia should be staged using clinical symptoms and core temperature (when available) as described in table 1.

Table 1: Staging and Treatment of Accidental Hypothermia[1,3,4,5,8,9]

Stage	Clinical Symptoms	Typical Core Temperature	Treatment
HT I (Mild)	Conscious, shivering	35 to 32 °C	Warm environment and clothing, warm sweet drinks, and active movement (if possible) HT I patients with significant trauma, co-morbidities or those suspected of secondary hypothermia should receive HT II treatment
HT II* (Moderate)	Impaired consciousness** (may or may not be shivering)	<32 to 28 °C	Active external and minimally invasive rewarming techniques (warm environment; chemical, electrical, or forced-air heating packs or blankets; warm parenteral fluids) Cardiac & core temperature monitoring Minimal and cautious movements to avoid arrhythmias Full-body insulation, horizontal position and immobilization
HT III (Severe)	Unconscious**, vital signs present	<28 °C	HT II management plus: Airway management as required Preference to treat in an ECMO/CPB center, if available, due to the high risk of cardiac arrest Consider ECMO/CPB in cases with cardiac instability that is refractory to medical management Consider ECMO/CPB for comorbid patients that are unlikely to tolerate the low cardiac output associated with HT III
HT IV	Vital signs absent	cardiac arrest is possible below 32°, the risk increases substantially below 28°C and continues to increase with ongoing cooling	CPR and up to three doses of epinephrine and defibrillation (further dosing guided by clinical response) Airway management Transport to ECMO/CPB*** Prevent further heat loss (insulation, warm environment, do not apply heat to head) Active external and minimally invasive rewarming (see HT II) during transport is recommended but controversial, do not apply heat to head ***Transfering a HT IV patient to an ECMO/CPB center may reduce mortality by 40-90% (NNT ~2), if ECMO/CPB is not available within six hours of transport,[1,2,7,10,11] consider onsite rewarming with hot packs or forced air blankets, warm IVF, +/- warm thoracic lavage, +/- warm bladder lavage +/- warm peritoneal lavage, do not apply heat to head

*If transport times are similar to an ECMO/CPB centre or an alternative centre, consider preferential transport to the ECMO/CPB centre for patients with a core temperature <32°C.

**Consider that consciousness may be impaired by comorbid illness (ie trauma, CNS pathology, toxic ingestion, etc.) independent of core temperature.

Triage

Isolated stage I & II hypothermia are rarely life threatening unless co-morbidities such as trauma are present and can usually be managed on site (HT I) or at the closest hospital (HT II) [see Appendix A]. Secondary hypothermia cases (those caused by medical illness) should be triaged to hospital.

Patients with stage III and IV hypothermia should ideally be managed in a hospital with extra-corporeal membrane oxygenation (ECMO) or cardiopulmonary bypass (CPB) [see Appendix A] unless co-morbid conditions (such as trauma) or prolonged transport time (>6hrs) mandate transport to a closer hospital (see Appendix B & C).[1] Historically BC Ambulance Service (BCAS) has always transported patients in cardiac arrest to the closest hospital. In the rare cases of cardiac arrest caused by isolated accidental hypothermia, it is recommended to consider transporting the patient directly to a hospital with ECMO or CPB capabilities. Note, it is somewhat rare for a patient to present with cardiac arrest caused by isolated hypothermia and it can often be difficult to be certain of the cause, therefore it is recommended to contact the Emergency Physician Online Support (EPOS) phone line for specialist assistance with all stage III and IV hypothermia patients (EPOS can be accessed by paramedics through BCAS dispatch and by physicians through the BC Patient Transfer Network [BCPTN], formerly BC Bedline) [see Appendicies B & C].

Transport & Management

A. HT I (conscious, shivering, core temperature >32ºC):

i. **Transport:** Transport to nearest hospital if injured, consider on-site or hospital treatment if uninjured. Patients with significant co-morbidities or suspected secondary hypothermia (caused by a medical condition) should be transported to hospital.

ii. **Management:** Provide warm environment and clothing, provide warm sweet drinks, encourage active movement. HT I patients with traumatic injuries, significant medical co-morbidities or in whom secondary hypothermia is suspected should be managed as per HT II.[1,3,4,6,8,9]

B. HT II (impaired consciousness, may or may not be shivering, core temperature ~32-28ºC) or HT I with trauma

Transport: Transport to nearest hospital. If transport times are similar to an ECMO/CPB centre or an alternative centre, consider preferential transport to the ECMO/CPB centre for patients with a core temperature <32ºC.

i. **Management:** [1,3,4,6,8,9]

- Active external and minimally invasive rewarming techniques: (see Appendix E)

- warm environment & insulation
- warming blanket placed under the patient
- hot packs, chemical, electrical, or forced-air heating blankets over the patient
- warm [38-42°C] IV fluids titrated to clinical volume status

- Cardiac & core temperature monitoring
- Minimal and cautious movements to avoid arrhythmias

C. HT III (unconscious, not shivering, vital signs present, core temperature usually <28°C)

i. **Transport:** Patients with significant trauma should be transferred to the nearest appropriate hospital. For all other cases, contact EPOS (access via BCAS dispatch [paramedics] or BCPTN [MDs & RNs]) to assist with making a transport decision. Ideally patients with HT III would be cared for in a centre with ECMO/CPB capability due to the significant risk of cardiac arrest (particularly if the patient has demonstrated any cardiac instability such as hypotension or ventricular arrhythmia). In cases with significant co-morbidities or when the transport time to an ECMO/CPB centre is greater than 6 hours, the EPOS physician may suggest transport to the nearest appropriate hospital (see Appendix C).

ii. **Management:**[1,3,4,8,9]

- HT II management plus: (see Appendix E)
  - airway management as required
  - warm (38-42°C) IV fluids titrated to clinical volume status (expect significant volume requirements during rewarming)
  - +/- warm (38-42°C) bladder lavage
- Bradycardia, mild hypotension plus or minus atrial fibrillation are common and usually resolve with rewarming.
- Vasopressors are usually not indicated during early resuscitation due to the profound vasoconstriction associated with hypothermia and the significant risk of cardiac arrhythmia. Relative hypotension may be physiologic depending on core temperature, consider expert consultation prior to starting vasopressors.
- Vasopressors may be indicated later during rewarming if rewarming induced vasodilation is contributing to significant hypotension.
- In patients with cardiac stability, invasive rewarming strategies (such as body cavity lavage, endovascular devices and extracorporeal heating systems) are not recommended due to the increased risk of complications such as hemorrage and thrombosis.
- If central venous access is required it is important to keep the tip of the catheter (and guide wire) far from the heart in order to minimise the risk of arrhythmia.
- ECMO or CPB should be considered for patients with cardiac instability who do not respond to medical management.

D. HT IV (vital signs absent, core temperature usually <28ºC) [cardiac arrest is possible below 32º and the risk increases substantially below 28ºC]

i. **Transport:**

- Patients with significant trauma should be transferred to the nearest appropriate trauma centre or managed as per existing traumatic arrest protocols.
- For patients with a core temperature >32ºC and asystole on ECG, hypothermia is not the cause of cardiac arrest.
- Serum potassium >10-12 mmol/L may be a marker of death before cooling and the patient is unlikely to benefit from prolonged resuscitation unless the history is compelling for cooling before cardiac arrest or extremely rapid cooling simultaneous with cardiac arrest.
- For all other cases, when the history suggests hypothermia prior to cardiac arrest, contact EPOS (access via BCAS dispatch [paramedics] or BCPTN [MDs & RNs]) to assist with making a transport decision. Ideally patients with HT IV would be cared for in a centre with ECMO/CPB capability. In cases with significant co-morbidities or when the transport time to an ECMO/CPB centre is greater than 6 hours, the EPOS physician may suggest transport to the nearest appropriate hospital (see Appendix B). Depending on availability and logistics, some ECMO providers may elect to dispatch a portable ECMO team in order to initiate ECMO on site prior to transport.

ii. **Management:** [1,3,4,8,9]

- CPR and up to three doses of epinephrine and defibrillation with further dosing guided by clinical response (after three defibrillation attempts have been unsucessful, do not pause CPR to analyze the rythmn until the core temperature has increased by at least 2-4ºC)
- Airway management
- Rewarming with **ECMO/ CPB** (if available)
- Prevent further heat loss during transport (insulation, warm environment)
- Active external and minimally invasive rewarming (see Appendix E) during tranport for the patient in cardiac arrest is recommended but controversial [unlikely to raise the core temperature but may help prevent a further drop in core temperature, do not apply heat to the head]
- If transport to ECMO/CPB is not available within 6 hours or not recommended, then **continue CPR** while rewarming with active external and alternative internal rewarming including as many of the following as possible:[1,2,10,11]
    - warm environment & insulation
    - warming blanket placed under the patient
    - hot packs, chemical, electrical, or forced-air hearing blankets over the patient (avoid applying heat to the head)
    - warm (38-42ºC) IV fluids titrated to clinical volume status (expect significant volume requirements during rewarming)
    - warm (38-42ºC) thoracic and/or peritoneal lavage
    - warm (38-42ºC) bladder lavage

Abbreviations

BC: British Columbia.

BCAS: British Columbia Ambulance Service.

BCPTN: British Columbia Patient Transfer Network (1-866-233-2337).

BCCH: British Columbia Children's Hospital.

CPB: Cardiopulmonary Bypass (extracorporeal provision of circulation, oxygenation and rewarming usually performed in the operating room for a short period of time [<~8 hours]).

CPR: Cardiopulmonary Resuscitation.

ECLS: Extracorporeal Life Support (inclusive term used to describe the use of CPB or ECMO for the mechanical provision of invasive cardiopulmonary resusciation).

ECMO: Extracorporeal Membrane Oxygenation (extracorporeal provision of circulation, oxygenation and rewarming commonly performed in the ICU or operating room that can be used for a prolongued period of time [days]).

EPOS: Emergency Physcian Online Support (provides services to BCPTN and BCAS).

ICU: Intensive Care Unit.

TSBC: Trauma Services of British Columbia.

VIHA: Vancouver Island Health Authority.

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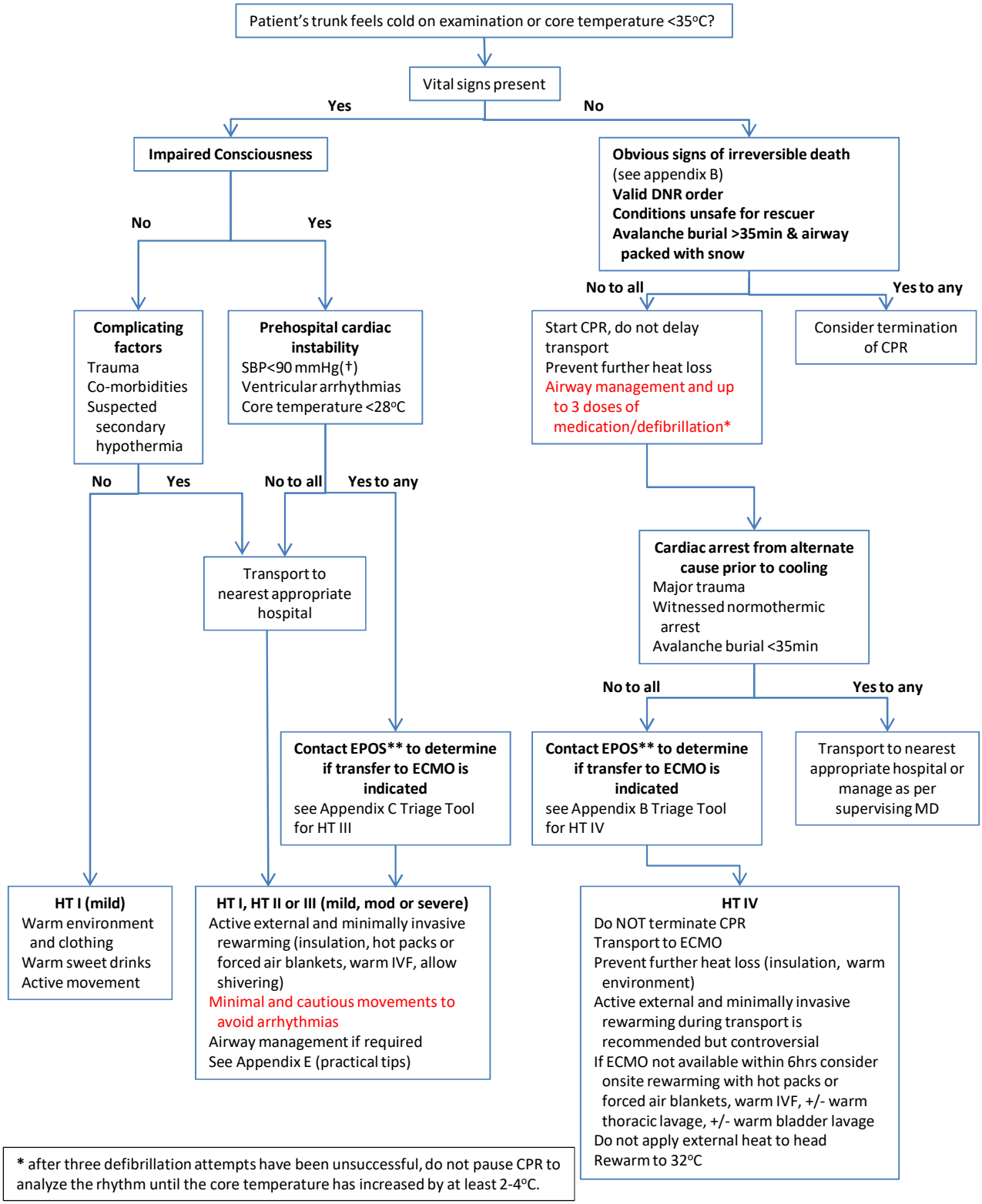
Appendix A: Management of Accidental Hypothermia

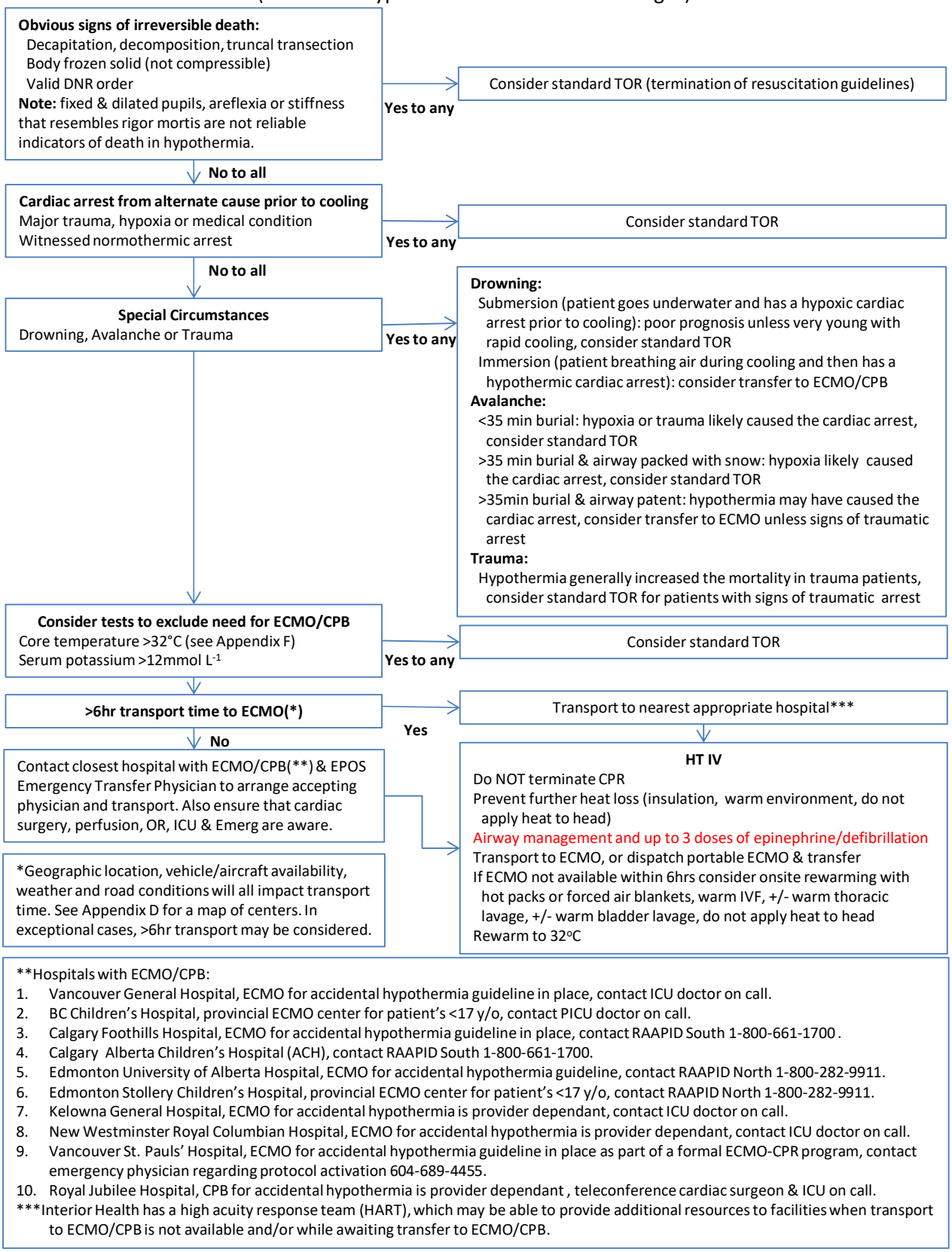


***** after three defibrillation attempts have been unsuccessful, do not pause CPR to analyze the rhythm until the core temperature has increased by at least 2-4°C.

****EPOS:** Emergency Physician Online Support: call BC Ambulance Dispatch or the BC Patient Transfer Network and ask to speak with the EPOS physician. These patients should initially be triaged as LLTO-Red.

Appendix B: EPOS Triage Tool for Stage IV Accidental Hypothermia

(Accidental Hypothermia with Absent Vital Signs)



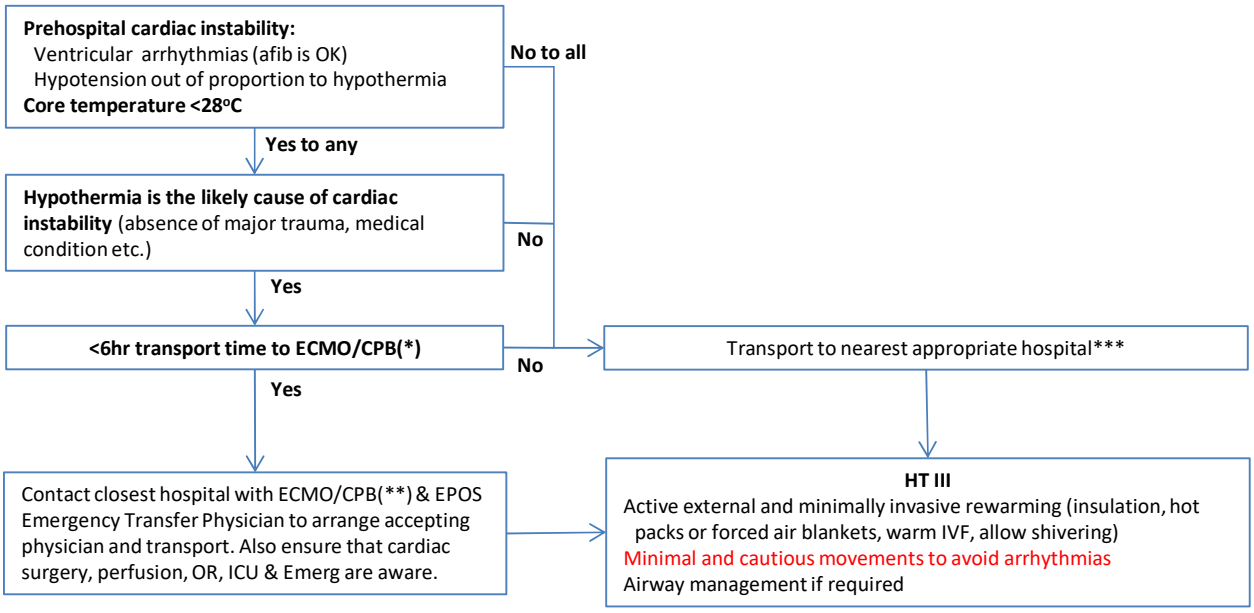
**Hospitals with ECMO/CPB:

1. Vancouver General Hospital, ECMO for accidental hypothermia guideline in place, contact ICU doctor on call.
2. BC Children's Hospital, provincial ECMO center for patient's <17 y/o, contact PICU doctor on call.
3. Calgary Foothills Hospital, ECMO for accidental hypothermia guideline in place, contact RAAPID South 1-800-661-1700 .
4. Calgary Alberta Children's Hospital (ACH), contact RAAPID South 1-800-661-1700.
5. Edmonton University of Alberta Hospital, ECMO for accidental hypothermia guideline, contact RAAPID North 1-800-282-9911.
6. Edmonton Stollery Children's Hospital, provincial ECMO center for patient's <17 y/o, contact RAAPID North 1-800-282-9911.
7. Kelowna General Hospital, ECMO for accidental hypothermia is provider dependant, contact ICU doctor on call.
8. New Westminster Royal Columbian Hospital, ECMO for accidental hypothermia is provider dependant, contact ICU doctor on call.
9. Vancouver St. Pauls' Hospital, ECMO for accidental hypothermia guideline in place as part of a formal ECMO-CPR program, contact emergency physician regarding protocol activation 604-689-4455.
10. Royal Jubilee Hospital, CPB for accidental hypothermia is provider dependant , teleconference cardiac surgeon & ICU on call.

***Interior Health has a high acuity response team (HART), which may be able to provide additional resources to facilities when transport to ECMO/CPB is not available and/or while awaiting transfer to ECMO/CPB.

Appendix C: EPOS Triage Tool for Stage III Accidental Hypothermia

(Unconscious Accidental Hypothermia with Vital Signs)



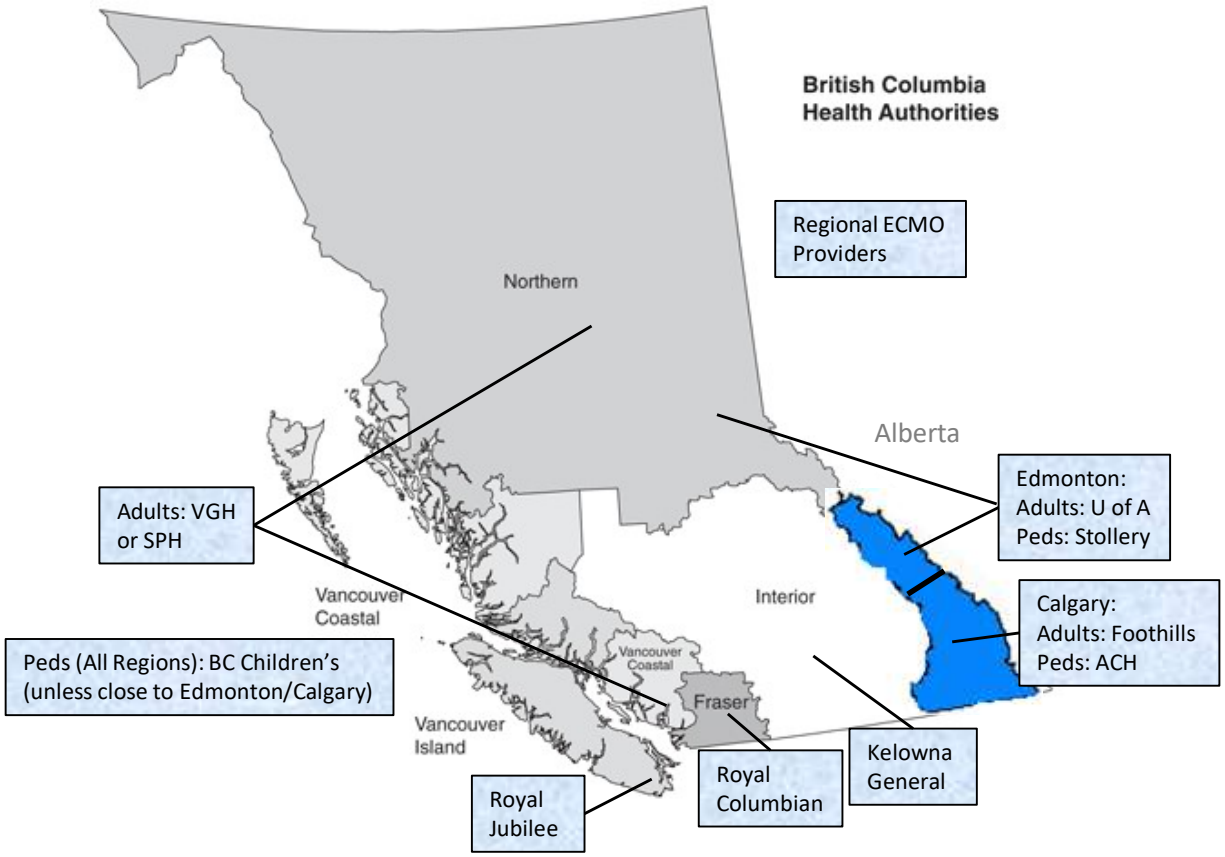
*Geographic location, vehicle/aircraft availability, weather and road conditions will all impact transport time. See Appendix D for a map of centers. In exceptional cases, >6hr transport may be considered.

**Hospitals with ECMO/CPB:

1. Vancouver General Hospital, ECMO for accidental hypothermia guideline in place, contact ICU doctor on call.
2. BC Children's Hospital, provincial ECMO center for patient's <17 y/o, contact PICU doctor on call.
3. Calgary Foothills Hospital, ECMO for accidental hypothermia guideline in place, contact RAAPID South 1-800-661-1700 .
4. Calgary Alberta Children's Hospital (ACH), contact RAAPID South 1-800-661-1700.
5. Edmonton University of Alberta Hospital, ECMO for accidental hypothermia guideline, contact RAAPID North 1-800-282-9911.
6. Edmonton Stollery Children's Hospital, provincial ECMO center for patient's <17 y/o, contact RAAPID North 1-800-282-9911.
7. Kelowna General Hospital, ECMO for accidental hypothermia is provider dependant, contact ICU doctor on call.
8. New Westminster Royal Columbian Hospital, ECMO for accidental hypothermia is provider dependant, contact ICU doctor on call.
9. Vancouver St. Pauls' Hospital, ECMO for accidental hypothermia guideline in place as part of a formal ECMO-CPR program, contact emergency physician regarding protocol activation 604-689-4455.
10. Royal Jubilee Hospital, CPB for accidental hypothermia is provider dependant , teleconference cardiac surgeon & ICU on call.

***Interior Health has a high acuity response team (HART), which may be able to provide additional resources to facilities when transport to ECMO/CPB is not available and/or while awaiting transfer to ECMO/CPB.

Appendix D: Provincial ECMO Provider Map



Regional ECMO/CPB Providers:

1. Pediatrics (All Regions):
    a) BC Children's Hospital, provincial ECMO center for patient's <17 y/o, contact ICU doctor on call (potential exists for BCCH ECMO team to travel, cannulate locally and transport on ECMO)
    b) If close to Edmonton or Calgary, may consider:
        - Stollery Children's Hospital (Edmonton), provincial ECMO center <17 y/o, contact RAAPID North 1-800-282-9911.
        - Alberta Children's Hospital (Calgary), contact RAAPID South 1-800-661-1700 .
2. Vancouver Coastal & Northern Health:
    a. Vancouver General Hospital, ECMO for accidental hypothermia guideline in place, contact ICU doctor on call.
    b. Vancouver St. Pauls' Hospital, ECMO for accidental hypothermia guideline in place as part of a formal ECMO-CPR program, contact emergency physician regarding protocol activation 604-689-4455.
3. Fraser Health Authority:
    a) New Westminster Royal Columbian Hospital, ECMO for accidental hypothermia is provider dependent, contact ICU doctor on call.
4. Interior Health Authority (except for the East Kootenays)
    a) Kelowna General Hospital, ECMO for accidental hypothermia is provider dependent, contact ICU doctor on call.
5. Interior Health Authority (East Kootenays: STARS Trauma Hotline 1-888-888-4567)
    a) Golden & Cranbrook -> Calgary:
        - Calgary Foothills Hospital, ECMO for accidental hypothermia guideline in place, contact RAAPID South 1-800-661-1700 .
    b) Fort St. John, Dawson Creek -> Edmonton:
        - University of Alberta Hospital (Edmonton), ECMO for accidental hypothermia guideline in place, contact RAAPID North 1-800-282-9911.
6. Island Health Authority:
    a) Royal Jubilee Hospital, ECMO for accidental hypothermia is provider dependent, teleconference cardiac surgeon & ICU on call.

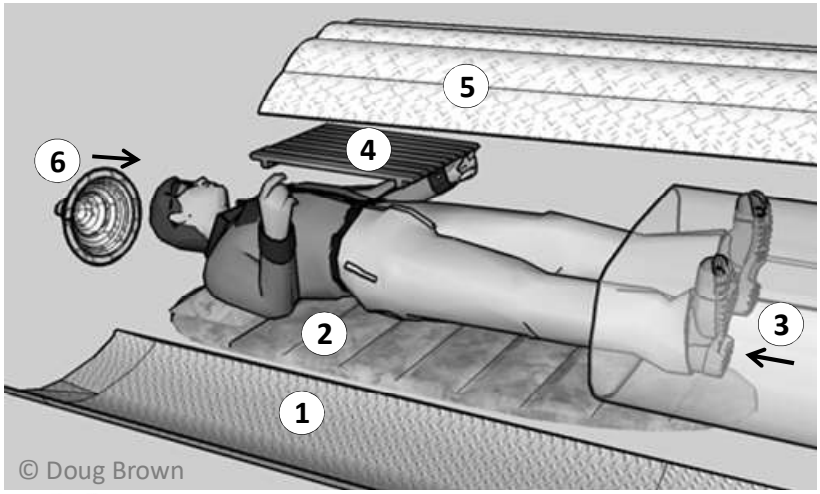
Appendix E: Practical Tips for Rewarming HT II & III (moderate & severe)

(from Tintinalli's Emergency Medicine 8th Ed.[3] with permission)

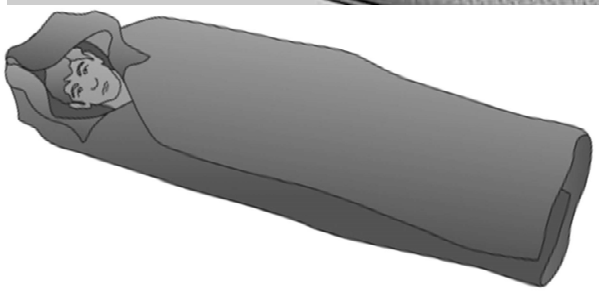
Hospital Resuscitation Checklist:

- ❑ Cardiac monitor & careful handling
- ❑ Core temperature monitoring (esophageal, rectal or bladder)
- ❑ If cardiac arrest, ventricular dysrhythmia, core temp <28°C or unstable:
  - do not stop resuscitation, seek expert consultation (see Apendix B & C)
  - potential for good outcome despite prolonged resuscitation, ideally transfer to ECMO center if indicated
- ❑ Minimally invasive rewarming:
  - ❑ Hypothermia burrito (see below, preference for forced air warming blankets)
  - ❑ +/- Bladder lavage
    (3-way Foley, 40°C saline, 2-4 L/hr by gravity)
    [confirm volume in = volume out, will invalidate bladder and rectal temperature measurements]
- ❑ IV Fluid Resuscitation: (crystaloid, 38-42°C)
  - ❑ Titrate fluids to clinical volume status (avoid over-resuscitation)
  - ❑ 10-20 mL/kg (~1L) to start (may be reasonable)
  - ❑ Additional 10-20 mL/kg per ~3°C core temp increase (may be required)
- ❑ Hypothermia is NOT a contraindication to airway management
- ❑ Avoid hyperoxia (titrate FiO_2 to 92-98%)
- ❑ If central venous access is required, keep the tip of the catheter (and guidewire) far from the heart (femoral, shallow internal jugular or shallow subclavian)
- ❑ Avoid vasopressors during early resuscitation (relative hypotension may be physiologic depending on core temperature, consider expert consultation)

Minimally Invasive Rewarming: (hypothermia burrito)



1. Outer wind & waterproof +/- reflective tarp (prehospital only)
2. Insulation or heating pad*
3. Replace wet clothes if practical, otherwise wrap patient in plastic
4. Forced air, chemical or electrical heating device(s)*
5. Insulating blanket
6. Insulate the head**



* To avoid burns, keep heating device temperatures <~40°C.

**If in cardiac arrest, do not apply heat to the head (allow warm oxygenated blood to rewarm the brain centrally).

Appendix F: Causes of Secondary Hypothermia

(from Tintinalli's Emergency Medicine 8th Ed.[3] with permission)

Predominantly Increased Heat Loss
Burns
Iatrogenic (i.e. blood transfusions and other cold infusions, cooling blankets, inadequate insulation)
Recent birth
Predominantly Impaired Thermogenesis
Impaired shivering (i.e. advanced or very young age, malnutrition, physical exhaustion, neuromuscular disease)
Multifactorial
Medications & Toxins (i.e. alcohol, anesthetic agents, narcotics, sedatives, vasodilators)
Metabolic & Endocrine disorders (i.e. alcoholic or diabetic ketoacidosis, hypoadrenalism, hypoglycemia, hypopituitarism, hypothyroid, lactic acidosis, Wernicke's encephalopathy)
Neurological (i.e. space occupying lesion, stroke, spinal cord injury)
Sepsis (small subset of sepsis cases, more common in the elderly or cachectic patient)
Shock
Trauma

Appendix G: Core Temperature Measurement

(from Tintinalli's Emergency Medicine 8th Ed. [3] with permission)

Make sure that the device being used to measure core temperature is capable of extreme measurements, and is properly calibrated (thermistor devices are usually preferred). Temperature measurement at different body sites will yield different readings depending on local perfusion and environmental conditions. In the intubated patient, the lower third of the esophagus (~24cm below the larynx in an adult), is the preferred site for core temperature measurement, since it closely mirrors the cardiac temperature.[4] In the absence of an esophageal probe, a rectal probe inserted to a depth of 15cm or a bladder probe is adequate but realize that these temperatures often lag behind true core temperature during rewarming and that bladder or peritoneal lavage may falsely elevate the reading. Oral and infrared tympanic temperature measurements do not correlate well with core temperature and should not be used. When an accurate core temperature measurement is not available, management decisions should be made based on clinical staging (see Table 1 & Appendix A). Ongoing core temperature monitoring should be implemented as soon as possible for all HT II, III & IV patients.