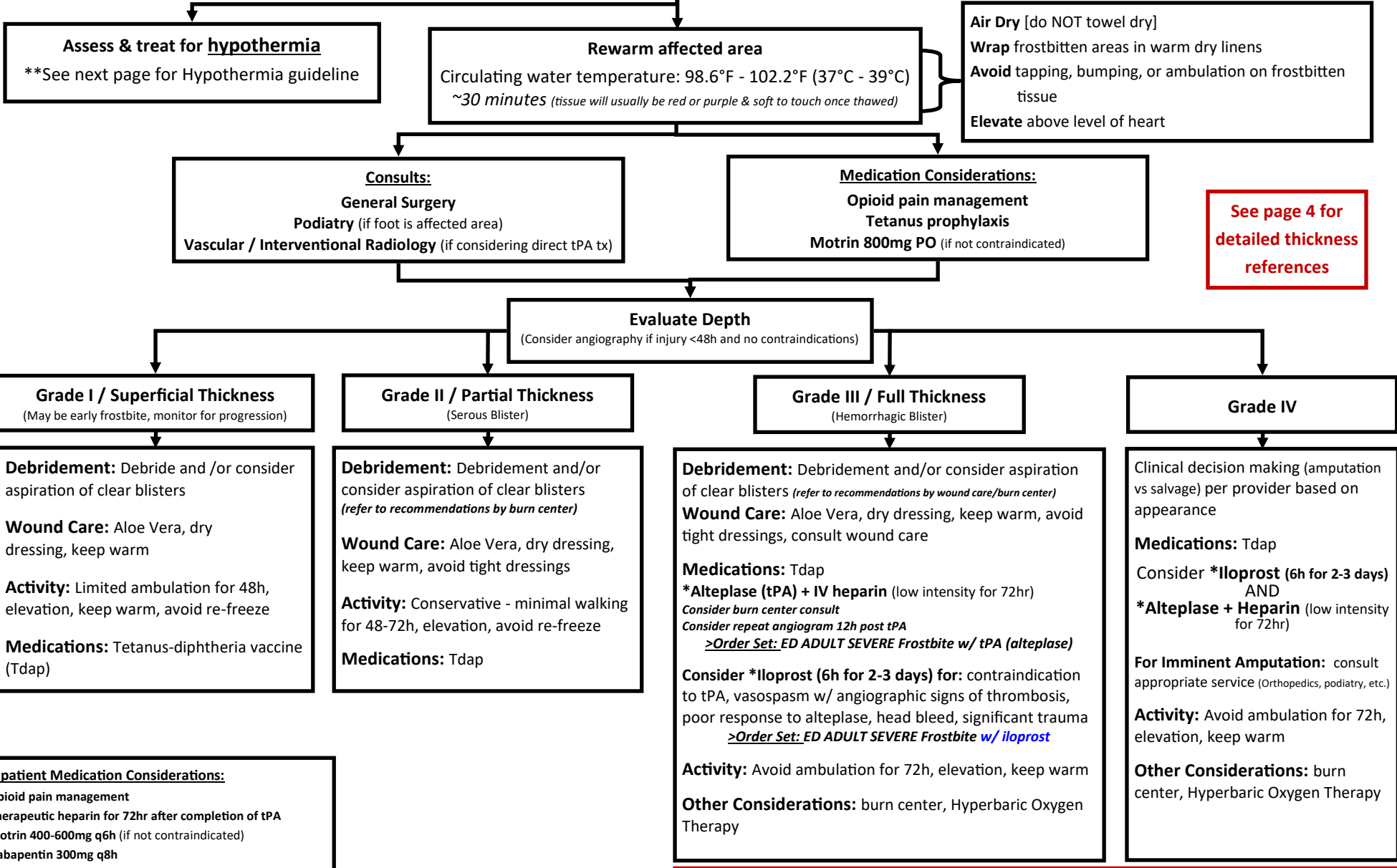


Clinical Practice Guideline (CPG) Hypothermia & Frostbite

Physician clinical judgement supersedes this guideline

See last page for references

Cold Injury Soft Tissue Injury Management



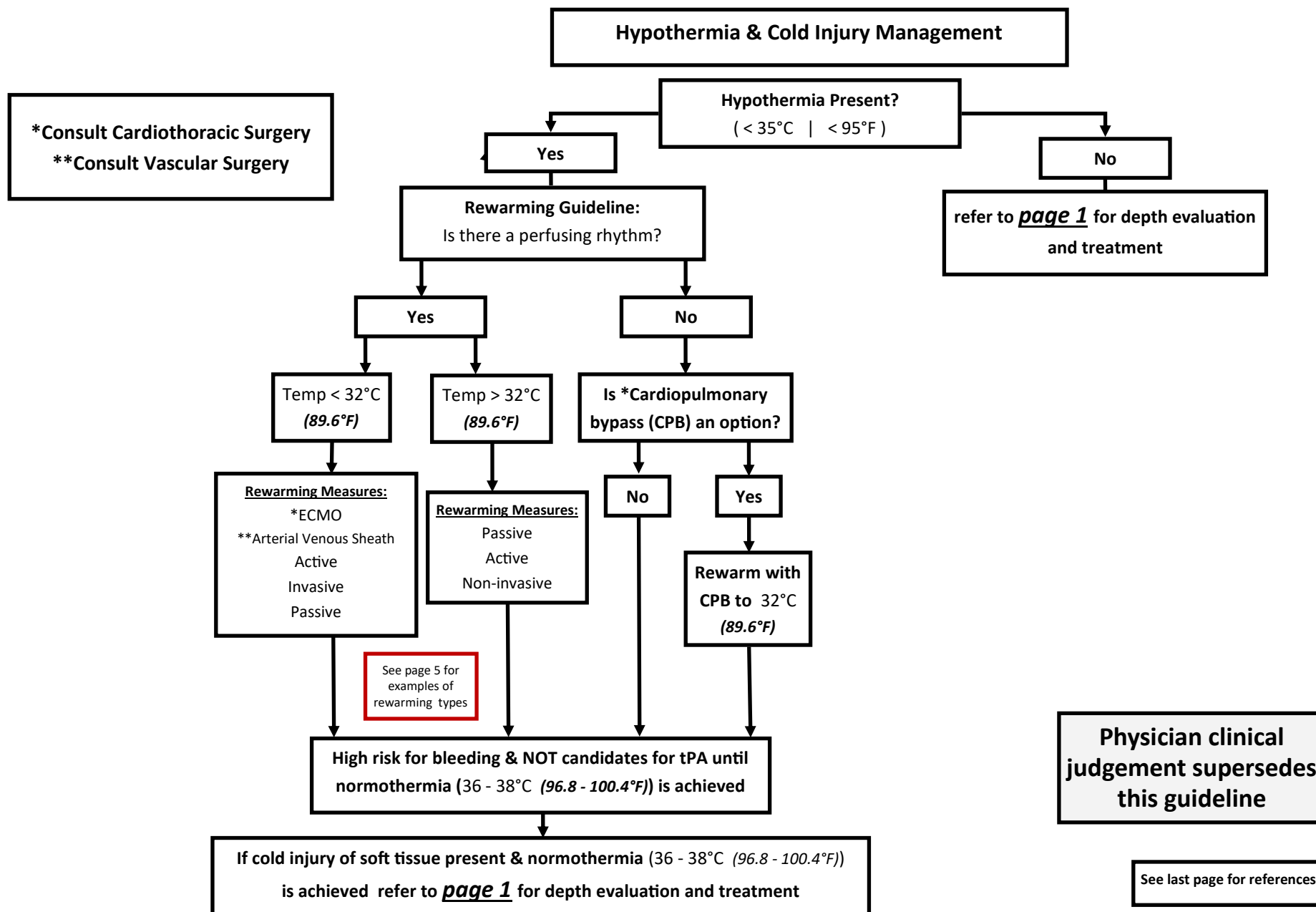
See page 4 for detailed thickness references

Inpatient Medication Considerations:
Opioid pain management
Therapeutic heparin for 72hr after completion of tPA
Motrin 400-600mg q6h (if not contraindicated)
Gabapentin 300mg q8h

*See page 3 for Iloprost & tPA considerations & page 5 for Iloprost & tPA dosing

Clinical Practice Guideline (CPG)

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Alteplase (tPA) Management for Severe Frostbite

Contraindications & Considerations

- ***ABSOLUTE Contraindications**
(if YES to any - do NOT give Alteplase (tPA))
- Repeated freeze-thaw cycles
 - Platelets <50
 - >24h warm ischemia time (can be passive or active rewarming)
 - Concurrent or recent (within 1mo) intracranial hemorrhage, subarachnoid hemorrhage, or trauma with active bleeding
 - Inability to follow a neurologic exam (altered mentation, intubated & sedated, etc.)
- Severe uncontrolled hypertension (SBP > 180mmHg and/or DBP > 105mmHg)
***Hydralazine and/or labetalol may be used to lower BP to acceptable limits w/ burn center consult suggestion*
- Do NOT begin tPA until blood pressure within acceptable limits**

****RELATIVE Contraindications**

- (if YES to any - discuss w/ patient & burn center specialist)*
- Recent intracranial or intraspinal surgery, serious head trauma (w/in 3 mo)
 - History of an active gastrointestinal bleed
 - Pregnancy
 - >48h from injury

***Use with caution**

- (if YES to and - use w/ caution & discuss w/ burn center specialist)*
- Age > 75
 - Platelets <100
 - Prior ICH (>1mth), known structural intracranial process, intracranial neoplasm
 - Current or recent use of anticoagulants
 - Non-compressible vascular punctures
 - Traumatic or prolonged CPR (>10min)
 - Recent internal bleeding (within 2-4 weeks)
 - Dementia
 - Remote history of ischemic stroke (<3 mo)
 - Recent major surgery (within 3 weeks)

Administration restricted to Critical Care Units

Iloprost Management for Severe Frostbite

Contraindications & Considerations

*****Contraindications**

- Pregnancy, lactation
- Severe coronary heart disease or unstable angina
- Myocardial infarction within the last 6 months
- Severe arrhythmias

****Special Precautions**

- Caution in acute or chronic congestive heart failure (NYHA II-IV)
- Surgery should not be delayed in patients requiring urgent amputation (e.g. in infected gangrene)
- Iloprost elimination is reduced in patients with hepatic dysfunction and in patients with renal failure requiring dialysis
- Patients with low blood pressure care should be taken to avoid further hypotension and patients with significant heart disease should be closely monitored
- Monitor for possible orthostatic hypotension in patients getting up from the lying to an upright position after the end of administration
- Patients with a cerebrovascular event (e.g. transient ischemic attack, stroke) within the last 3 months a careful benefit-risk evaluation should be undertaken
- Currently only sporadic reports of use in children and adolescents are available
- The paravascular infusion of undiluted iloprost can lead to local changes at the injection site
- Oral ingestion and contact with mucous membranes must be avoided. On contact with the skin, iloprost may provoke long-lasting erythema

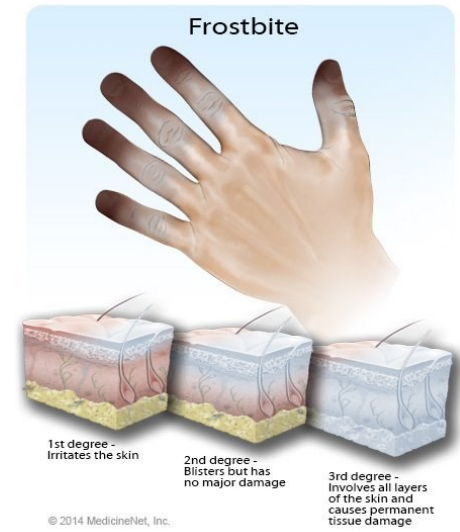
Administration restricted to Critical Care Units

Grading severity of frostbite after rewarming			
Absence of cyanosis	Cyanosis on distal phalanx	Cyanosis up to MP joint	Cyanosis proximal to MP joint
Grade 1 No amputation of bone	Grade 2 Moderate risk of amputation	Grade 3 High risk of amputation	Grade 4 Risk of amputation 100%

Clinical Practice Guideline (CPG) Hypothermia & Frostbite

Staging

**Consider skin color, skin temperature, sensation, & pulse*



Grade I / Superficial Thickness
(May be early frostbite, monitor for progression)

- **Edema & redness without tissue necrosis.**
- **No blisters**
- **No cyanosis**
- **Partial skin freezing**

Grade II / Partial Thickness
(Serous Blister)

- **Serous blister formation**
- **Erythema w/ substantial edema**
- **Distal cyanosis**
- **Full-thickness skin freezing**

Grade III / Full Thickness
(Hemorrhagic Blister)

- **Hemorrhagic blister**
- **Full-thickness subcutaneous freezing**
- **Skin necrosis**
- **Blue-grey discoloration**

Grade IV / Non-viable

- **Development of gangrene**
- **Requires Amputation**
- **Initially mottled deep red**
- **Eventually dry, black, & mummified**
- **Full thickness subcutaneous, tissue, muscle, tendon & bone freezing**





Clinical Practice Guideline (CPG)

Hypothermia & Frostbite

Dosing Guidelines

ILOPROST DOSING

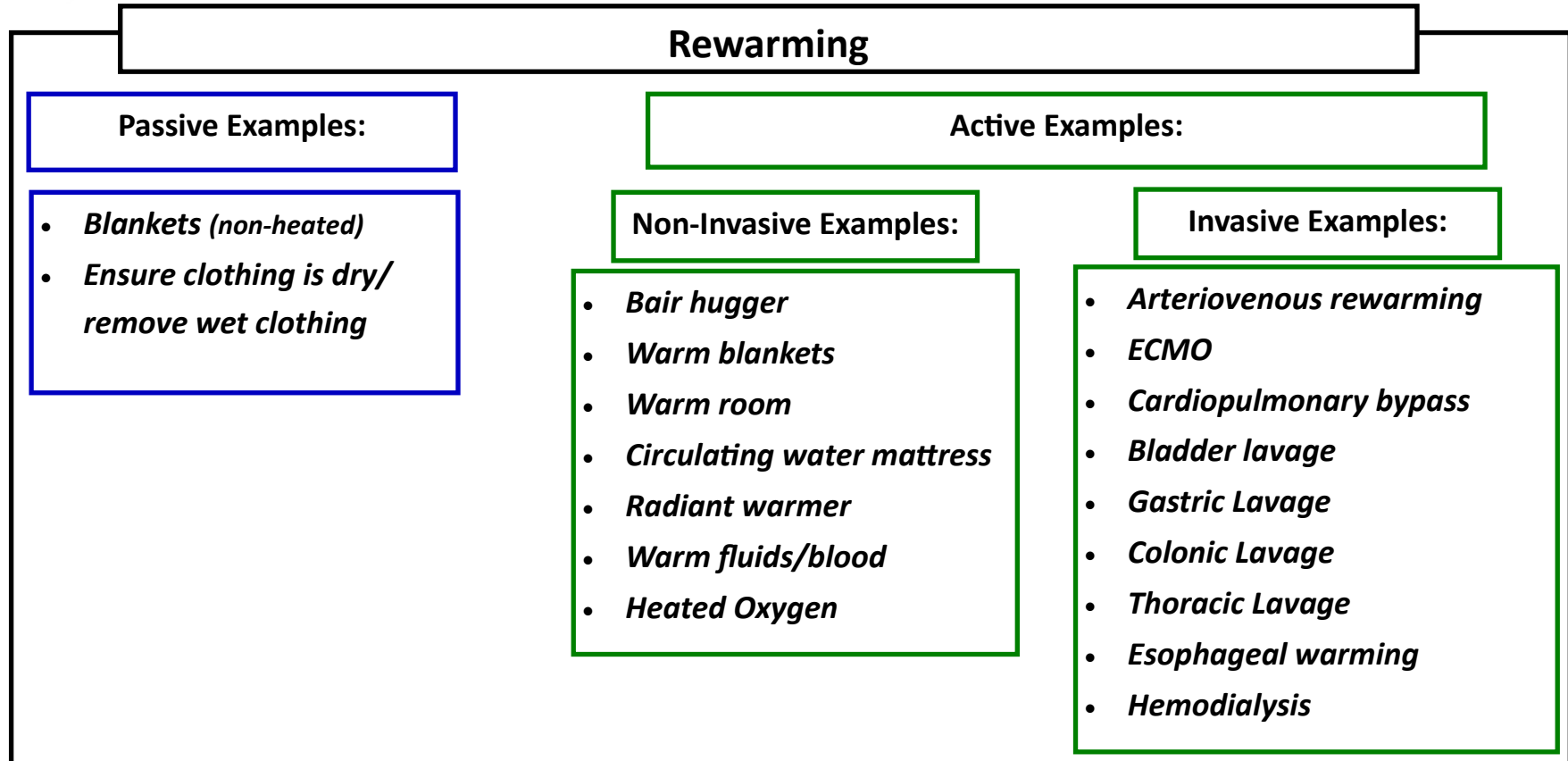
- Dose range: 0.5 to 2 nanogram/kg/min
 - Lower starting rate of 0.25ng/kg/min in patients with severe hepatic or renal dysfunction but can titrate to same max/goal dose of 2ng/kg/min
- Rate is adjusted to individual tolerability. If headaches, hypotension, tachycardia, palpitations, nausea, vomiting or facial flushing, **decrease the infusion rate by 0.5ng/kg/min and re-assess 30 minutes later** (these are dose-related side effects; usually quickly disappear with dose reduction)
- Continue infusion for a total of 6 hours. Mix an additional bag as needed.
- Repeat infusion daily for a total of 2-3 days. Consult pharmacist for administration times
- If patient tolerates infusion well on Day 1 and 2, may initiate infusion at maximum infusion rate on Day 3

Physician clinical judgement supersedes this guideline

Quick Reference for approximate expected dose based on weight—refer to provider order for actual dosing

Administration of Activase (Alteplase) when thrombolytic therapy (t-PA) is INITIATED at Billings Clinic					
Weight (kg)	TOTAL Dose (mg)	Discard quantity (mL)*	Bolus dose (mg) (over 2 min)	Infusion Dose (mg) (over 6 hours)	Rate (mL/hr)
40	42	58	6	36	6
42	44.1	55.9	6.3	37.8	6.3
44	46.2	53.8	6.6	39.6	6.6
46	48.3	51.7	6.9	41.4	6.9
48	50.4	49.6	7.2	43.2	7.2
50	52.5	47.5	7.5	45	7.5
52	54.6	45.4	7.8	46.8	7.8
54	56.7	43.3	8.1	48.6	8.1
56	58.8	41.2	8.4	50.4	8.4
58	60.9	39.1	8.7	52.2	8.7
60	63	37	9	54	9
62	65.1	34.9	9.3	55.8	9.3
64	67.2	32.8	9.6	57.6	9.6
66	69.3	30.7	9.9	59.4	9.9
68	71.4	28.6	10.2	61.2	10.2
70	73.5	26.5	10.5	63	10.5
72	75.6	24.4	10.8	64.8	10.8
74	77.7	22.3	11.1	66.6	11.1
76	79.8	20.2	11.4	68.4	11.4
78	81.9	18.1	11.7	70.2	11.7
80	84	16	12	72	12
82	86.1	13.9	12.3	73.8	12.3
84	88.2	11.8	12.6	75.6	12.6
86	90.3	9.7	12.9	77.4	12.9
88	92.4	7.6	13.2	79.2	13.2
90	94.5	5.5	13.5	81	13.5
92	96.6	3.4	13.8	82.8	13.8
94	98.7	1.3	14.1	84.6	14.1
95	99.75	0.25	14.25	85.5	14.25

See last page for references



References: (ALL)

Emmanuel Cauchy, Christopher B. Davis, Mathieu Pasquier, Eric F. Meyer, Peter H. Hackett, A New Proposal for Management of Severe Frostbite in the Austere Environment, Wilderness & Environmental Medicine, Volume 27, Issue 1, 2016, Pages 92-99, ISSN 1080-6032, <https://doi.org/10.1016/j.wem.2015.11.014>.

Gauthier J, Morris-Janzen D, Poole A. Iloprost for the treatment of frostbite: a scoping review. Int J Circumpolar Health. 2023 Dec;82(1):2189552. doi: 10.1080/22423982.2023.2189552. PMID: 36966492; PMCID: PMC10044161.

Lindford A, Valtonen J, Hult M, Kavola H, Lappalainen K, et. Al., The Evolution of the Helsinki Frostbite Management Protocol, Science Direct Burns, 2017-11-01, Volume 43, Issue 7, Pages 1455-1463, DOI:10.1016/j.burns.2017.04.016

Poole A, Gauthier J, MacLennan M. Management of severe frostbite with iloprost, alteplase and heparin: a Yukon case series. CMAJ Open. 2021 May 21;9(2):E585-E591. doi: 10.9778/cmajo.20200214. PMID: 34021017; PMCID: PMC8177911.

Zafren, K., & Mechem, C. C. (2021, February 1). <https://www.uptodate.com/contents/frostbite-emergency-care-and-prevention#H11>. UpToDate. Retrieved December 6, 2021, from <https://www.uptodate.com/contents/frostbite-emergency-care-and-prevention#H11>.