Wilderness Wounds

GEOFF CLOVER, MD

Topics

Definition of wilderness

Wound types

Wilderness wound assessment & management

Wound Kit

Antibiotic use

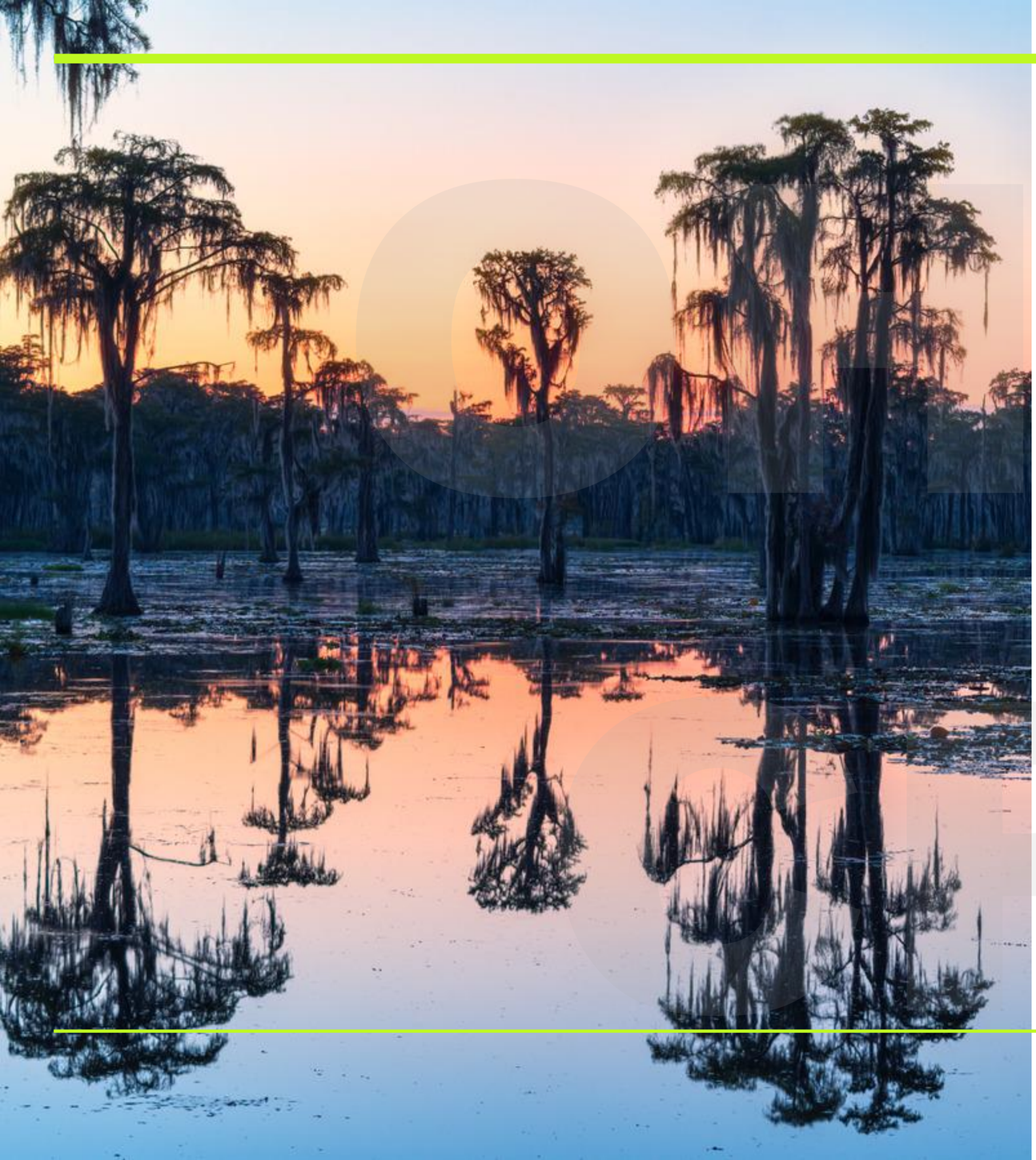
Evacuation

The Wilderness is 30 minutes from definitive care.

Wilderness wounds are contaminated.

Wounds are a common form of wilderness injury.

A simple wound kit can make a big difference.



Wound Types Classification

- Clean
  - a simple wound (eg, blade)
  - low bacterial load
  - treated quickly
- Dirty
  - high bacterial load (eg, axilla, groin)
  - not treated quickly (> 6hr open)
- Contaminated
  - organic soil (swamps, jungle)
  - claylike soil
  - fecal material
  - overt infection

Wound types
Animal Bites

- Usually on an extremity
- Contaminated
- Puncture wounds
- Crush injury
- Toxins
- Microbial agents

AWLS.org

Wound types
Animal Bites

- Puncture wounds are uniquely difficult
- Deep and narrow
- May leave foreign bodies
- High infection risk
- Unusual pathogens
- May co-exist with crush injuries

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Wound types
Bites - Toxins

- Spiders - all have poison
- Scorpion - most cause pain only
  - US: Bark Scorpion
- Snakes (US)
  - Elapids
  - Crotalids
- Hymenoptera
  - Allergy is the main threat

Wound Types
Snakebite - US

- You don’t have Anti-Toxin
- Carry Epinephrine, Antihistamines, Inhaler (B-agonist)
- Take picture of snake if possible
- Sudden decompensation may indicate IV envenomation or allergy
- Evacuate
- Move carefully to reduce toxin spread. Compression for certain bites outside the US. Nothing else.

Wound Types
Lacerations

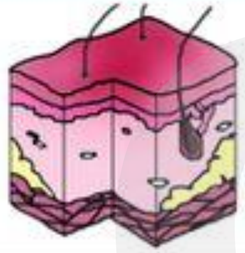
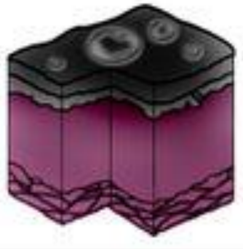
- Generally cleaner
  - Knives, other sharps objects
  - Simpler wounds
  - Bleeding
  - Underlying structures
    - Nerves, Vital organs
  - May be more appropriate for early closure

Wound Types
Crush

- Significant kinetic force
- Assess for fracture, C Spine, head trauma
- Hematoma formation
- Compartment syndrome
  - Distal Extremities
- Evacuate

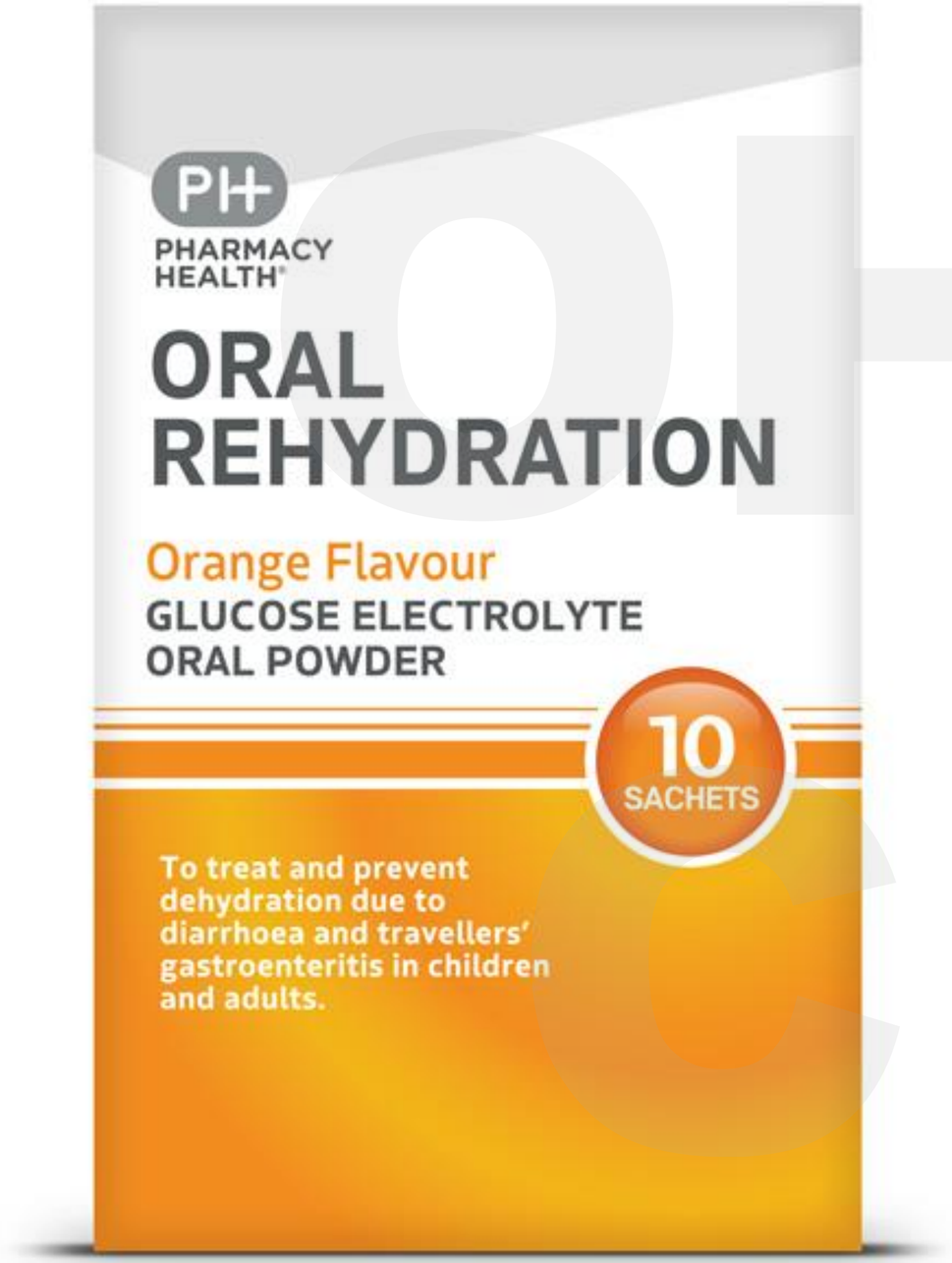
Burns

- 2-8% Wilderness injuries
- Scalds, hot objects, Geysers, campfires
- Majority are small, rarely over 40% TBSA
- Mortality increases quickly with increased TBSA and inhalation
- Generally sterile for 24-48 hrs
- After 48 hours - skin flora
- Gram negatives by 7 days (Pseudomonas)

Clinical appearance		Thickness	Degree	Depth	Characteristics
		Superficial	First	Epidermis	Pain, redness, mild swelling
		Superficial Partial	Second	Dermis: papillary region	Pain, blisters, splotchy skin, severe swelling
		Deep partial		Dermis: reticular region	White, leathery, relatively painless
		Full	Third	Hypodermis (subcutaneous tissue)	Charred, insensate, eschar formation

Burn Management

- Cover burn with dry sterile dressing
- Cold water (Not ice) may reduce pain
- > 20% TBSA - attention to hydration
- %TBSA x 10ml/hr in adults (>40 kg) + 100ml/hr per 10 kg over 80 kg (TCCC)
- Oral preferred, may be given rectally (ORS)
- Hypothermia Risk - consider wrap/barrier heat loss prevention
- Facial burns may have inhalation injury



ORS - simple

- 6 tsp sugar
- 1/2 tsp salt
- 1L clean water

Topical Burn Agents

- Silver sulfadiazine is commonly used
- Petroleum gauze
- Hydrocolloids
- Honey (antipseudomonal properties)
- Banana leaf dressing, boiled potato peel dressings have been used for decades. They must be close to sterile before use - usually boiling in RLS

Bitter, C et al. Management of Burn Injuries in the Wilderness: Lessons from Low-Resource Settings WILDERNESS & ENVIRONMENTAL MEDICINE, 27, 519–525 (2016)

Burns - Evacuation

- Inhalational injury
- Burns to the thorax that impair ventilation
- Circumferential burns to extremities
- Significant burns to the hands, feet, face or mucous membranes
- Full thickness burns greater than 5% TBSA
- Partial thickness burns greater than 10% TBSA
- Burns that become secondarily infected

Bitter CC et al. Wilderness Medical Society Clinical Practice Guideline on Care of Burns in the Wilderness. Wilderness Environ Med. 2025 Jun 19.

Wilderness Wound Management

First, Stop the Bleeding

- **MARCH: Bleeding is the Highest Priority**
- Direct pressure only (not pressure points)
- Clotting/Hemostatic agents
- Tourniquets
  - Apply until bleeding stops
  - Practice

Tourniquet

- C-A-T, SOF-TT, EMT
- Recommended by TCCC, widely used by the Military, EMS, Police
- 85% reduction in preventable combat deaths after military implementation in 2005
- Wider/Double Tourniquets are better - lower tissue pressure and better bleed control.
- Safe time < 2hours
- > 6 hours associated with significant nerve and tissue damage, hyperkalemia, acidosis, and need for fasciotomy

Brendon Drew, et al. Application of Current Hemorrhage Control Techniques for Backcountry Care: Part One, Tourniquets and Hemorrhage Control Adjuncts WILDERN

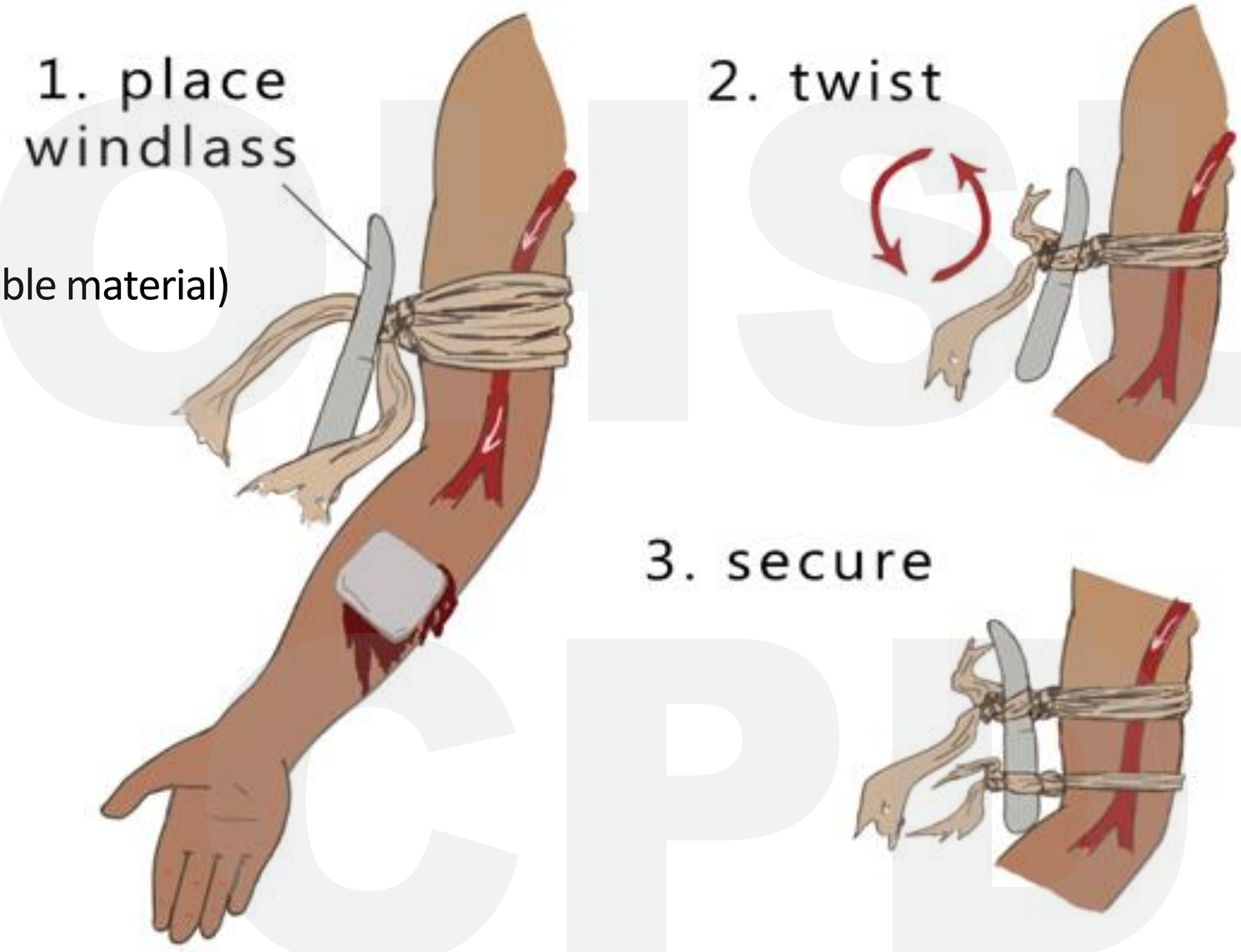
Tourniquet

- 2-3 inches proximal to wound
- Tighten as much as possible before cranking the windlass
- Note time on TQ or patient
- Training is a key indicator of success

CAT

SOF-TT

(Non-stretchable material)



Secured with second wrap

Tourniquet Conversion

- Consider when there is prolonged transport time
- Ongoing re-evaluation of TQ
- Apply second TQ proximal to the first
- Clear wound to enable visualization
- Ideally before 2 hours, not recommended after 6 hours (outside an ICU)
- May be able to convert to dressing

Tourniquet mistakes

- Not applying a Tourniquet
- Removing Tourniquet in unstable patient
- Periodic loosening for limb perfusion
- Not using second tourniquet - large limbs particularly
- Venous tourniquets (compartment syndrome, arterial bleeding)
- Removing Tourniquet if transport time is short (< 2 hours)

Hemostatic Agents

- Kaolin - Clay based - acting on Factor 12 (TCCC preferred agent)
- Chitosan - Shellfish derived Mucoadhesive (not reliant on clotting cascade)
- Patches can be applied with manual pressure
- Can be packed into deeper wounds
- Long shelf life
- Room temperature storage

Hemostatic Agents

- Most agents are in gauze/membrane sheets. Preferred over powder or granule preparations.
- Highly effective for hemorrhage control (around 90%)
- Kaolin-impregnated (Combat Gauze, QuikClot) - requires intact clotting mechanisms
- Chitosan-based (Celox, ChitoGauze) - antibacterial activity


QuikClot
COMBAT GAUZE
Vacuum Packed and Z-Folded
For Temporary External Use
To Control Traumatic Bleeding
ONE (1) 3 IN X
(7.5 CM X 3.7 M) HEMOSTATIC DRESSING
510-01-562-3325


For Emergency Temporary External Use Only
TEAR
TEAR
TEAR
TEAR
CELOX™ RAPID
Hemostatic Z-Fold Gauze
Chito-R™ Technology, Stops Bleeding Fast*
To Control Moderate-To-Severe Bleeding
Works in Hypothermic Conditions*
One Gauze Strip 3in x 5ft (7.6cm x 1.5m)
Do not re-use
Do not resterilize
STERILE R
Sterilized using irradiation
Caution
Do not use if package is damaged
Rx Only
Instructions for Use on Back
*Proven in laboratory trials to stop major arterial bleeding by coagulating the blood within 60 seconds, reducing blood loss. Granules shown to be effective in blood temperatures down to 56°F (hypothermic). Data on file at Medtrade Products Ltd.

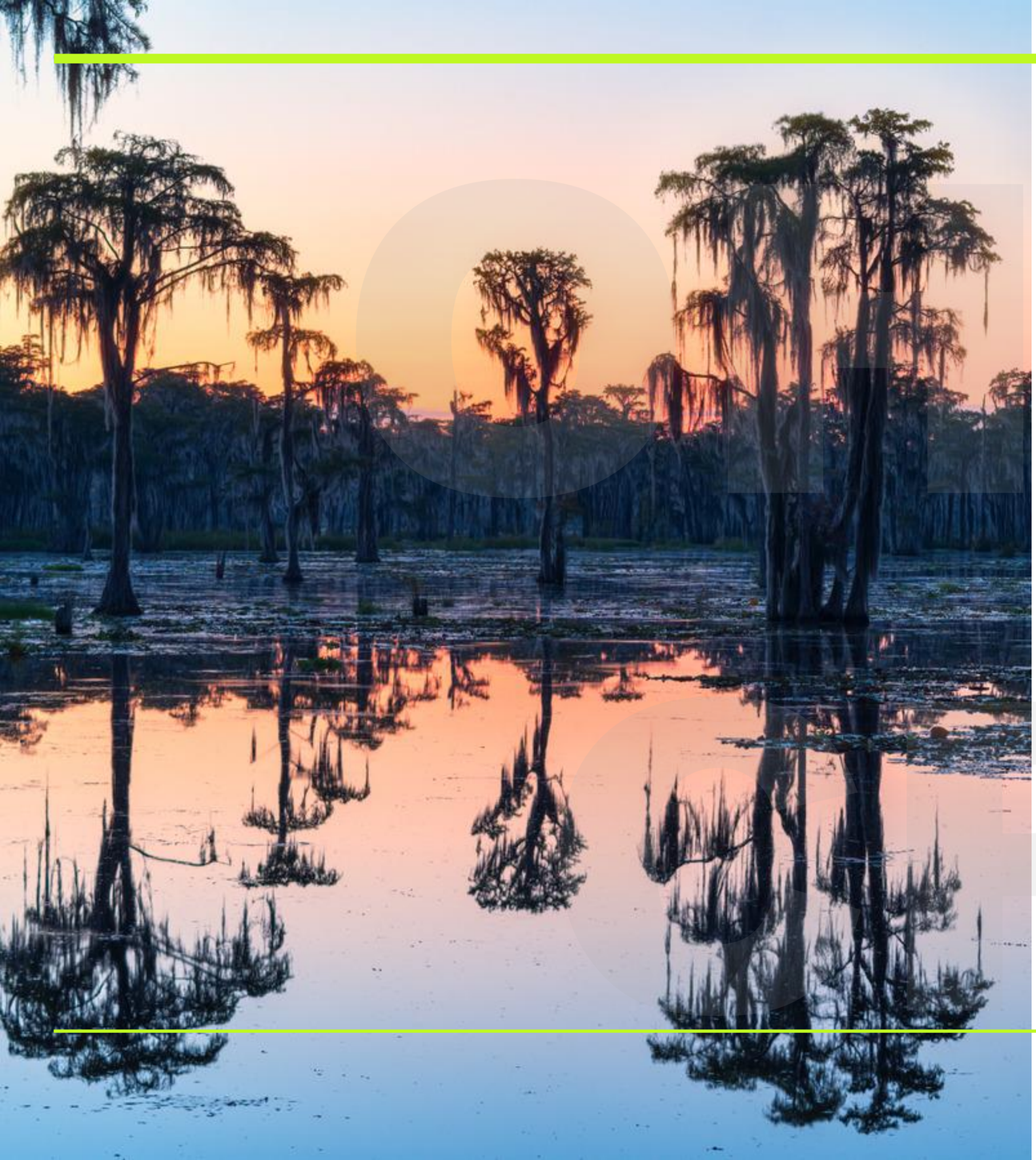
Wilderness wound assessment

Then, get the story

- Patient history
  - Cause of injury and related environment
    - Animal and human bites
      - Rabies PEP is very effective
      - Very few are immunized (PREP)
    - Sea water
    - Soil (Tetanus)
  - Immunocompromise (medical condition or medication)
    - Diabetes, Steroids, cancer therapies
  - Clotting disorders (medications - Aspirin, DOACs)
  - Immunization status (tetanus and rabies)

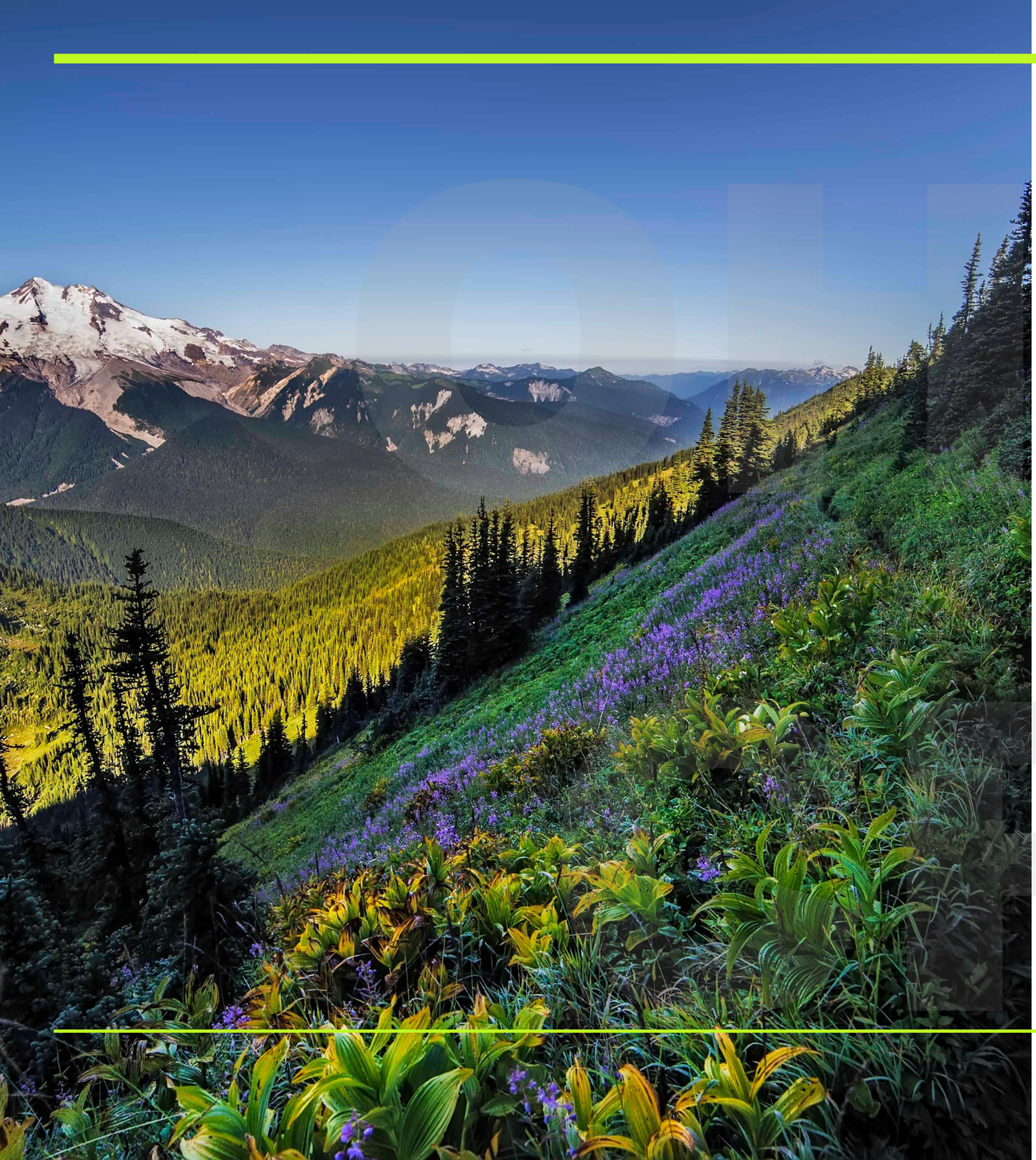
Wilderness wound assessment

- Good visualization
  - Headlamp
  - Anesthesia
  - Consider mechanism, foreign bodies, underlying structure
  - Cath/Syringe for cleaning
- Clotting agents
- Some clean dressing supplies
- Tape (Micropore, Athletic tape, Duct tape with holes)



Wound anesthesia

- Usually via injection
  - Lidocaine, Bupivicaine vials
  - Small needles
  - Epinephrine prolongs action and reduces bleeding
  - LET (Lidocaine, Epi, Tetracaine)
    - Topical anesthesia



Foreign bodies

- Remove:
  - Reactive materials (wood, vegetative material)
  - Contaminated clothing
  - Anything in the foot
  - Anything impinging neuro-vascular structures
- Don’t remove:
  - Large foreign bodies penetrating
    - Vital structures
    - Cavities
    - The eye

Wound Management

- Direct mechanical cleaning as tolerated
- DPC is preferred due to Low risk of infection
- Attention to cosmetic effect
- Avoid closure unless necessary for function
  - Stitches (interrupted)
  - Staples
  - Tape/Steri strips with gaps
  - Clean dressing
- Re-evaluate frequently for bleeding and infection

Wilderness wound management

- Wilderness wounds are generally contaminated
- Pressure cleaning
  - Direct pressure with the cleanest water you have
    - Virucidal agents (Povidine, Iodine) can be considered if there is rabies risk
      - Tissue toxicity

Improvised Wound irrigation

- Syringe/Angiocath (16-49 psi)
- 50 ml syringe (7-11 psi)
- 14 ga punctured bottle (7-25 psi)
- Sports bottle (3-7 psi)
- Bladder hydration (1-2 psi)
- Plastic bag 14 ga puncture (2-3 psi)
- Commercial bottle with splashguard (4-5 psi)

Wound Irrigation

- Aim to remove bacteria, debris, dead tissue and dirt
- Any irrigation provides some benefit
- Optimal method is not defined
- WMS guidelines recommend 6-15 psi
- High pressure (35+ psi ACS, 15+ psi WMS)
- Surgical irrigators > 20 psi
- 3-10L (pressure dependent)
- Additives do not help and may harm

Antibiotics

- Antibiotic use is more liberal in the Wilderness
- Bites (animal) - mainly mammalian bites to Hands, Human bites, Open fractures
- Agents:
  - Augmentin (animal bites to Hand, Human bites)
  - Cephalexin (Also C2, C3)
  - Moxifloxacin (SSTI, Marine, **Eye puncture,** PCN allergic)
  - Doxycycline
  - Bactrim
- Topical antibiotics

Wound Kit

- **Exercise:**
  - Write 10 items for your wound kit
    - Aim for dual use items
    - Include wound assessment, cleaning, closure, and antibiotics
    - Aim for a size and weight that will actually get carried

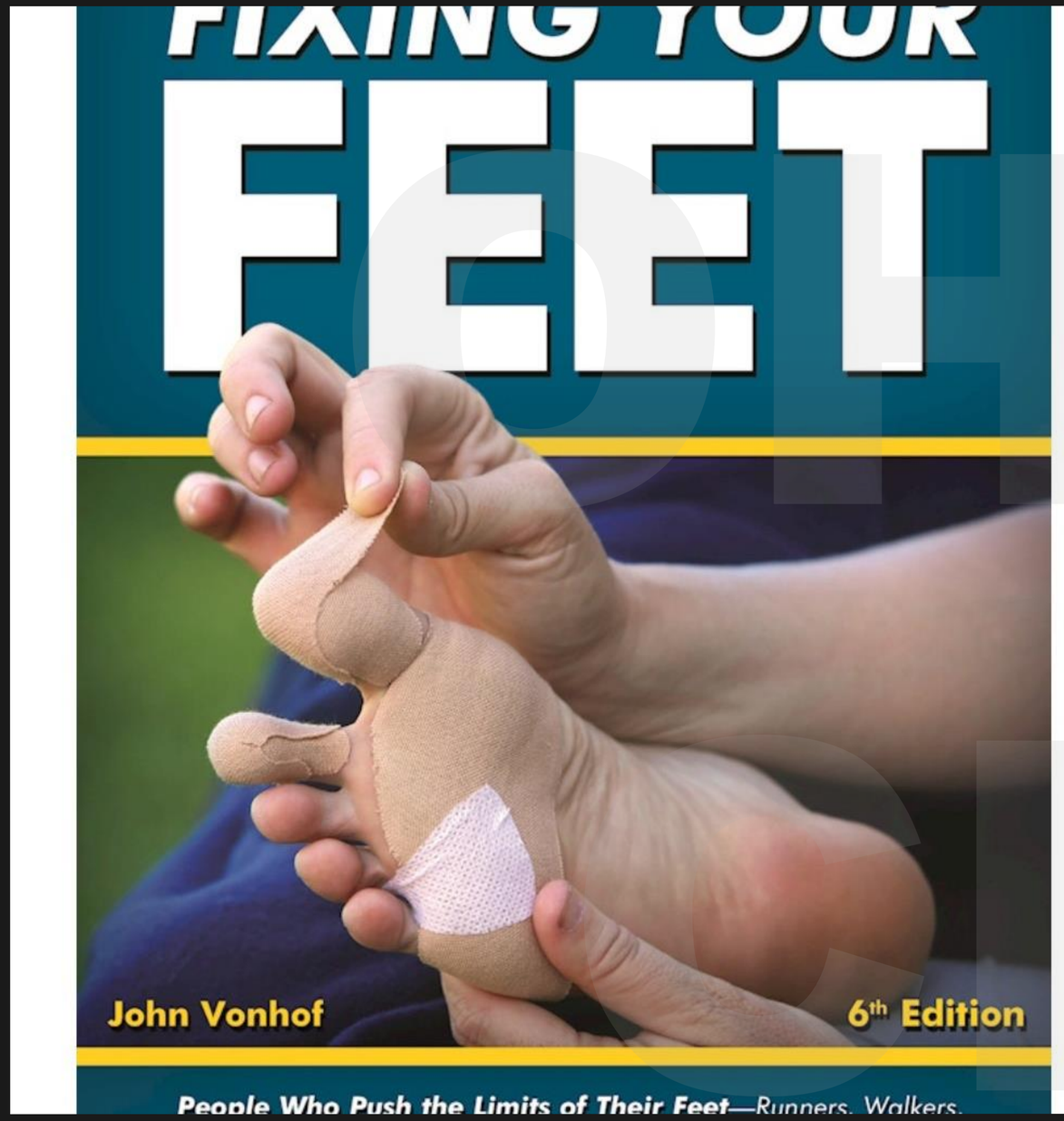
Wound Kit

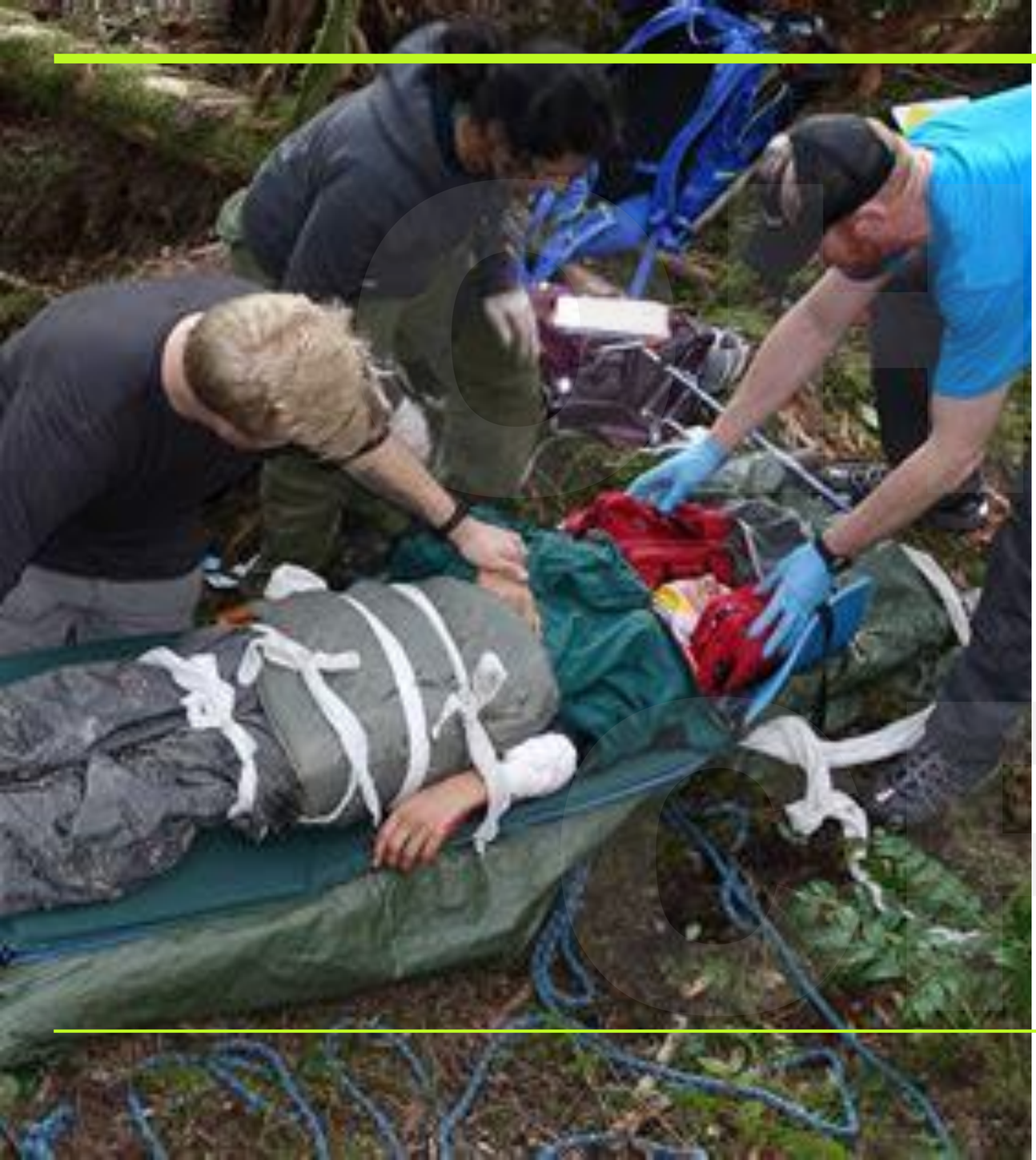
Light, small, and in your bag

- Syringe/pressure cleaning system
- Clean gauze for cleaning
- Tape (Micropore, Athletic are ideal)
  - Suture/Staples
- Tweezers, knife, scalpel
- Headlamp
- (Tourniquet)
- Antibiotics (topical and systemic)
- Skin glue
- Anesthesia (Injected, Topical)

POCUS in austere environments

- Described in space, altitude, resource limited settings, natural disasters, EMS
- HAPE
- Ocular US (HACE)
- Foreign bodies
- Abscess
- Fractures
- FAST
- Pneumothorax, Tamponade
- OB/GYN


FIXING YOUR
FEET
John Vonhof
6th Edition
People Who Push the Limits of Their Feet—Runners, Walkers,



Evacuation

- Complex wounds not closed primarily
- Open fractures
- Tendon, joint, nerve, or vessel damage
- Mammalian bites
- Infection, not treated with available agents
- Large foreign body
- Systemic toxicity
- Hypothermia
- Devitalized tissue
- Tetanus or Rabies-prone

Evacuation Burns

- Airway inhalation injury
- Hands, feet, genitals, mucous membranes, or face
- Circumferential burns
- Full-thickness burns >5% TBSA
- Partial-thickness burns 10% to 20% TBSA
- Uncontrolled pain
- Lightning injuries
- Electrical burns
- Chemical burns

Wilderness Wounds Summary

- Most commonly skin/soft tissue
- **Stop bleeding first**
- Antibiotic use is more liberal
- Anesthesia helps assessment
- Consider evacuation early
- Consider temperature
- Toxins/Poisons