FO-09 Wilderness, expedition, polar and ship medicine: the modern literature of improvised care

HEALING after the FALL, research library, FO-09

Researched 10 October 2026 by Claude Opus agent for THRIVING after the FALL, Book Four. Library document, unverified.

How to read this report

Four specialties practise medicine far from hospitals and have written down what works. Wilderness medicine has the Wilderness Medical Society (WMS) guidelines. Tactical Combat Casualty Care (TCCC) has been US military doctrine since 1996. Expedition and polar medicine covers Antarctic stations and Himalayan clinics. Ship medicine has the WHO International Medical Guide for Ships. All four answer the first hours, then hand the patient to a helicopter, ship or surgeon. This report asks what is left when that never comes.

WMS grades (1A strong and high quality, down to 2C weak and low quality) are quoted as the guidelines give them (Quinn 2014, Dow 2019). The book's own A to X grades are in section 2. The reference list says where only an abstract or summary was read.

1. Findings by section

1.1 The evacuation assumption

Wilderness and tactical medicine are built around a clock. Lerner and Moscati traced the "golden hour" in 2001 and found no evidence for it. It began as an opinion attributed to R Adams Cowley of Baltimore in the 1970s (Lerner 2001).

The military later made the golden hour real by policy. After the 2009 order that casualties in Afghanistan reach care within 60 minutes, median transport time fell from 90 to 43 minutes. Among 21,089 casualties the case-fatality rate fell from 13.7% to 7.6%, an estimated 359 lives saved (Kotwal 2016). Commentators noted that this was achieved in an unusually well-resourced theatre [VERIFY].

Speed to surgery saves lives when surgery exists. Every protocol tuned to a one-hour evacuation is tuned to a world the village will not have.

The nearest modern literature to the village is the Joint Trauma System's Prolonged Casualty Care guideline (Remley, Loos and Riesberg, 21 December 2021, CPG ID 91). Even it is a bridge, not a destination. A 2024 CoTCCC position statement put the goal as getting out of prolonged care (secondary summaries only, the file returned "not found" on 10 October 2026 [VERIFY]). Only the polar stations plan honestly for months without rescue (section 1.13).

1.2 Massive bleeding from a limb

The record. Bleeding from a limb is the preventable death of war.

- **Vietnam.** Maughon's 1970 review found that 193 of 2,600 American soldiers killed in action (7.9%) died of isolated limb haemorrhage (cited in Butler 2012).
- **Early Iraq and Afghanistan.** 15 to 28% of deaths were judged potentially preventable (Butler 2012).
- **2001 to 2011.** Of 4,596 US battlefield deaths, 24.3% were potentially survivable. 90.9% of those were from haemorrhage: 67.3% truncal, 19.2% junctional (neck, armpit, groin) and 13.5% limb. About nine in ten died before reaching any medical facility (Eastridge 2012, abstract).

Kragh's Baghdad series. This is the best clinical series, from a combat support hospital in Baghdad over seven months of 2006.

- **Who and how many.** 232 casualties had 428 tourniquets on 309 limbs. 31 died (13%).
- **Before or after shock.** Survival was 90% when the tourniquet went on before shock, against 10% after ($P<0.001$).
- **Prehospital or hospital.** Mortality was 11% with prehospital application against 24% in the emergency department ($P=0.05$).
- **Tourniquet indicated but not used.** None of the five survived.
- **Harm.** Nerve palsy occurred in 1.7%. No amputation was caused by the tourniquet alone (Kragh 2009, abstract).
- **Time.** The companion paper found no link between tourniquet time and complications. Fasciotomy was done in 28% of limbs at 2 hours or less (75 of 272) and 36% over 2 hours (9 of 25, $p=0.4$), a group too small to reassure (Kragh 2008, abstract).

Replication.

- **The 75th Ranger Regiment** trained every soldier in TCCC. Among 419 casualties, 10.7% were killed in action against 16.4% for the wider Department of Defense. None of its 32 deaths was judged preventable before hospital (Kotwal 2011, abstract).
- **US civilians.** At 11 American trauma centres (2011 to 2016), 17.6% of 1,026 patients with limb vascular injury had a prehospital tourniquet, on for a mean 77.3 minutes. The adjusted odds ratio for survival was 5.86 (95% CI 1.41 to 24.47) (Teixeira 2018, secondary summaries).

No randomised trial exists, but consistency earns a high observational grade.

The WMS rules (Quinn 2014, full text read).

- **Pressure first.** Direct pressure is the method of choice (1B). Firm manual pressure averages about 180 mmHg, a pressure dressing about 90 mmHg.
- **What not to bother with.** Elevation is weak (2C). Pressure points have no role (1C).
- **When to use a tourniquet.** It is the primary treatment for life-threatening limb arterial bleeding (1A), and for bleeding other methods fail to control (1B).
- **How to apply it.**
  - It must be at least 4 cm (1.5 in) wide with a windlass. A belt will not do.
  - A tourniquet that only stops venous return increases bleeding. Tighten it until distal pulses vanish.
  - A second tourniquet goes immediately above the first.
- **How long.** Up to 2 hours carries minimal risk, and most limbs tolerate up to 6 hours. Never release it periodically (1B).
- **Haemostatic dressings** (1B). Pack them in and press for at least 5 minutes. Gauze is preferred to powder.

Where two sources on time differ.

- **Iraq.** Kragh and the WMS put the safe band at about 2 hours, with 6 hours as the outer limit. These figures come from wars with helicopter evacuation within the hour.
- **Ukraine.** Evacuation often takes more than 6 hours (Stevens 2024).

  - A forward surgical team screened 1,945 casualties and studied 90 (4.6%) whose tourniquets had been on for at least 4 hours. Short-term dialysis was needed.
  - One summary reported compartment syndrome in all 74 analysed limbs, delayed amputation in 27 (36.3%) and 5 deaths (6.7%) [VERIFY, full text not read] (Lukiianchuk 2025, abstract).
- **Appropriateness.** Stevens and colleagues cite a 2022 Ukrainian study in which only 24.6% of tourniquets were appropriate (Stevens 2024, abstract).
- **The CoTCCC response.** It now requires reassessment within 2 hours, with conversion after 2 hours reserved for medical personnel (CoTCCC 2025, abstract and trade summary).

Both agree on 2 hours. Between 2 and 6 hours, Iraq saw little harm and Ukraine much, though blast wounds confound the comparison.

Improvised tourniquets. The evidence is almost all from manikins.

- **The windlass decides.** T-shirt tourniquets without a windlass failed in 79 of 80 manikin trials (99%), and with one in 32% (Altamirano 2015, abstract).
- **Bandage and bandana.** Against a commercial CAT that worked every time, an improvised bandage worked 40% and a bandana 10% (Lyles 2015, abstract).
- **Space blanket.** A space-blanket design occluded flow in roughly half of applications (Outdoor Medicine summary 2023 [VERIFY]).
- **Boston, 15 April 2013.** All but one of the tourniquets applied to 27 bleeding victims were improvised. Gerald King concluded they were mostly venous, not arterial. The counts differ between summaries [VERIFY] (King 2015, secondary summary).

Only a wide, windlassed, locked improvisation has evidence. A belt, cord or knotted bandana is folklore.

Haemostatic dressings.

- **The evidence.** A 2018 systematic review found 17 human studies with 809 patients. Bleeding control ranged from 67 to 100% (median 90.5%), with evidence of very low to moderate quality (EMJ 2018 review, abstract). ILCOR rates the certainty very low (ILCOR).
- **The vendor.** QuikClot's maker answered critics with a count of over 3.5 million units shipped without adverse report, a company claim rather than an outcome study (secondary summary).

What carries forward when stocks end is the technique: pack the cavity tightly with clean cloth and press hard for at least 5 minutes (Quinn 2014).

Tranexamic acid (TXA). CRASH-2 randomised 20,211 bleeding trauma patients in 40 countries. Death fell from 16.0% to 14.5% (RR 0.91, 95% CI 0.85 to 0.97). Bleeding deaths fell further when TXA was given within 3 hours (RR 0.72) but rose when it was given later (CRASH-2 2010, abstract). The trial dose was 1 g over 10 minutes then 1 g over 8 hours [VERIFY, not in the abstract I read]. This is grade A medicine no village can make.

1.3 Fluids and shock

Bickell 1994. In Houston, patients with penetrating torso wounds and systolic pressure of 90 mmHg or less were allocated by alternate day to immediate or delayed fluids. Survival was 70% delayed against 62% immediate (p=0.04, 598 analysed), with about 386 mL against 2,611 mL given. Allocation by day is not true randomisation (Bickell 1994, secondary summary).

TCCC doctrine. TCCC followed Bickell from its founding paper (Butler, Hagmann and Butler 1996).

- **2003.** Fluid was given only for shock, judged by confusion or a weak radial pulse. The dose was 500 mL Hextend, repeated once after 30 minutes, to a 1,000 mL maximum.
- **2014.** Whole blood moved to the top.

- **2021 (Change 21-01).** Cold-stored low-titre O whole blood was made preferred, crystalloid and Hextend were dropped, and calcium was added (Butler 2012 and secondary summaries).

For the village. The transferable principle needs no kit. Do not pour fluid into a bleeding patient before the bleeding stops. Aim for a palpable radial pulse and a patient who can answer. Fresh whole blood from typed donors belongs to WO-13.

1.4 Wounds

The WMS wound guideline (Quinn 2014, full text read) is the most useful document here for a village.

Irrigation.

- Use high pressure, 6 to 12 psi (1A). A 35 mL syringe through a 19-gauge needle gives about 8 psi.
- Irrigate as early as practical (1B), with at least 1 litre (1C). Up to 10 litres adds nothing.
- Drinking-quality water equals sterile saline (1A, backed by a Cochrane review of 11 trials).
- Add nothing to the water except povidone-iodine for possible rabies (1A).

Cleaning.

- Clean technique suffices (1A).
- Clip hair, do not shave (1C).
- Remove or leave open dead tissue (1C).
- Organic or clay soil lowers the bacterial dose needed for infection about a thousandfold.

Closure.

- Close most clean wounds, ideally within 6 hours, or 10 hours on face and scalp (1C). Bacteria pass 10^5 per gram by about 5 hours.
- Pack grossly contaminated wounds open (1B). Vietnam punji-stake wounds closed late had about 2% infection.
- For possible rabies, delay closure 4 days (1C).

Burns.

- Silver sulfadiazine slows healing (1A).
- Circumferential full-thickness burns need escharotomy (1A).
- No prophylactic antibiotics are needed (1C).

Antibiotics.

- Give systemic antibiotics for open fractures (1A) and for human and hand bites (1B).
- Infection still follows 1 to 12% of well-treated wounds.
- First choice is amoxicillin-clavulanate. Moxifloxacin is for marine wounds or penicillin allergy.

Tetanus and blisters. Give tetanus toxoid where indicated (1C). Drain blisters over 5 mm without removing the roof (1C).

The evacuation list. Here the guideline assumes rescue (1C). It lists:

- complex wounds not closed primarily
- open fractures
- tendon, joint, nerve or vessel damage
- mammalian bites
- infection without antibiotics or progressing on them
- large organic foreign bodies
- systemic toxicity

- gas in tissue
- tetanus- and rabies-prone wounds

For a village this list is the dispensary's agenda (WO-01, WO-05).

1.5 Fractures, spine, splints and litters

Spine. The WMS spinal guideline (Hawkins 2019, updated 2024) abandons routine rigid collars and backboards.

- It favours restricting movement where possible.
- It clears alert, sober patients without distracting injury by the NEXUS or Canadian C-spine rules.
- It omits spinal precautions for isolated penetrating wounds (WMS 2024 spinal summary). TCCC reached the same conclusion for penetrating wounds (Butler 2012).

Clinical clearance spares most patients the sores and aspiration of immobilisation.

Traction splints. A 2012 pilot by Weichenthal and colleagues compared an improvised traction splint with commercial devices in 10 healthy volunteers. Its results could not be confirmed from summaries [VERIFY]. A 2023 review found no clear advantage of traction over simple splinting (LITFL 2023 summary). A padded rigid splint spanning the joints above and below is defensible.

Litters and carries. I found no outcome study of improvised litters, only teaching material (NOLS 2008). A 2024 US Army test of two-person litter carries gives the only measured numbers (USAARL 2024):

- unassisted teams carried about 159 m in 2.4 minutes before resting
- shoulder harnesses gave about 1,071 m in 15.8 minutes
- wrist hooks gave about 304 m

Straps that put the load on the shoulders multiply distance per carry about sevenfold. Four to six rotating bearers is a practical minimum for any carry over a kilometre [VERIFY, my inference].

1.6 Hypothermia

The WMS hypothermia guideline (Dow 2019, full text read) is rich in field detail.

Staging.

- Hypothermia is a core temperature of 35 °C or below. Mild is 35 to 32 °C, moderate 32 to 28 °C, severe below 28 °C.
- The Swiss staging works without a thermometer. HT I is conscious and shivering, HT II drowsy, HT III unconscious and HT IV without vital signs.
- Shivering may persist to about 30 °C.

Handling.

- Keep the patient horizontal (1B) and handle gently, without moving the limbs (1B).
- Cut wet clothes off only in shelter (1B).
- Insulate from the ground, add a vapour barrier and cover the head (1C).

Rewarming.

- **Shivering.** It produces five to six times resting heat and can raise core temperature 3 to 4 °C per hour in an insulated, fed patient (1A). A safe rewarming rate is 1 to 2 °C per hour.
- **Food and rest.** Give high-carbohydrate food and drink (1C). Rest insulated about 30 minutes before walking.
- **Added heat.** Apply heat to armpits, chest and back (1B), never the limbs (1B), checking the skin every 20 to 30 minutes for burns (1C).

- **What does not work.** Small chemical heat packs cannot rewarm the core (1B). Body-to-body warming is no faster than shivering and serves comfort (1B). No warm shower or bath (1C).
- **Limb immersion.** In mild cases, distal limb immersion at 42 to 45 °C is an option (1C).

Arrest.

- **Whether to start.** Fixed pupils and stiffness do not rule out CPR (1A). Obvious lethal injury or a chest too frozen to compress do (1A).
- **Pulse check.** Feel for a carotid pulse for up to 1 minute (1C).
- **No temperature cut-off** (2C). The lowest recorded survival is 13.7 °C. Oxygen use falls about 6% per degree, to half at 28 °C, which is why patients have survived 6 hours 30 minutes of CPR.
- **Interrupted CPR.** If CPR must be interrupted, alternate at least 5 minutes of compressions with pauses of no more than 5 minutes (1C).

Disposition.

- An alert, shivering, uninjured patient can be treated in the field without hospital (1B). This is the key line for the village.
- Reduce fractures and dislocations (1C).
- In trauma, a core temperature below 35 °C raises mortality, so warm actively (1B).

Survival of HT III and HT IV depends on heart-lung bypass, so in a village it will mostly fail.

1.7 Frostbite

The 2024 WMS update (summarised in Omidi 2025) and the 2019 guideline (summarised in Armstrong 2020a) agree on the core.

Thawing.

- Thaw in water at 37 to 39 °C for about 30 minutes until the tissue is soft (strong, moderate evidence). Rapid rewarming is advised if care is over 2 hours away.
- Test the water with an uninjured hand for 30 seconds.
- Never refreeze. Do not rub. Spontaneous thaw is acceptable if water cannot be heated (1C).
- Whether to walk out on frozen feet is left to judgement.

Ibuprofen. The two sources give the same daily ceiling on different schedules. Omidi gives 12 mg/kg per day in two doses, maximum 2,400 mg (weak). Armstrong gives up to 600 mg four times a day.

Aloe and hospital drugs. Aloe vera gel at dressing changes is weakly recommended. Iloprost within 72 hours and tPA within 24 hours belong to a hospital, and tPA salvage falls about 28% per hour of delay (Armstrong 2020a).

Afterwards.

- Give daily hydrotherapy.
- Do not walk on a thawed foot.
- Do not amputate early except for sepsis, because demarcation may take 3 months.

Risk. Risk begins below 0 °C and rises below minus 15 °C (Omidi 2025).

For the village. Thaw, wait and hydrotherapy transfer completely. Only the clot drugs, and some digits with them, are lost.

1.8 Heat illness

The WMS heat guideline (Lipman 2019, full text read) was updated in 2024 (Nelson 2025).

What heat stroke is. Exertional heat stroke is a core temperature above 40 °C with brain dysfunction. Treat on suspicion if there is no thermometer.

Cooling.

- **Cold-water immersion** is optimal (1A). Ice water cools at about 0.2 °C per minute against 0.1 °C for soaked towels, and military immersion series report close to zero deaths.
- **Without a tub.** A tarpaulin filled with water, the "tarp taco", or a stream with the airway protected, will do.
- **Evaporation** is an adjunct (1C), with mean cooling times of 40 to 68 minutes. Ice packs should cover the whole body (1C).
- **When to stop.** Stop at about 39 °C (1B). Avoid antipyretics (2B).

Outcomes. Field-cooled patients who recover fully can be observed without hospital. Mortality is about 5%, rising to about 33% with low blood pressure (Nelson 2025).

Over-drinking. Exercise-associated hyponatraemia is treated with up to three 100 mL boluses of 3% saline 10 minutes apart (Lipman 2019). It is prevented by drinking to thirst.

Immersion is grade A medicine with no kit, and should be the first treatment for every collapsed, confused worker at harvest.

1.9 Altitude illness

Two summaries were read (Omidi 2025 for the 2024 Luks update, Armstrong 2020b for 2019).

Prevention.

- Above 3,000 m, sleep no more than 500 m higher each night, with a rest day every 1,000 m.
- Acetazolamide 125 mg every 12 hours prevents illness (strong, high quality). The child dose is 2.5 mg/kg (Armstrong 2020b).

Treatment.

- **Descent** is definitive: 300 to 1,000 m for acute mountain sickness and cerebral oedema (HACE), at least 1,000 m for pulmonary oedema (HAPE).
- **Drugs.** Acetazolamide 250 mg every 12 hours. Dexamethasone 8 mg then 4 mg every 6 hours for HACE.
- **Nifedipine for HAPE.** The sources differ on dosing. Omidi gives 30 mg extended-release every 12 hours, and my notes of the 2020 summary record a different schedule [VERIFY].
- **Oxygen** to keep saturation above 90%.
- **Portable hyperbaric bag.** It buys time but has never been trialled against descent. A small CPAP comparison is registered (NCT04710953).

Untreated HAPE mortality is quoted at up to 50% [VERIFY].

Descent and staged ascent need no kit, while the drugs will run out.

1.10 Snakebite

I found no current WMS snakebite guideline.

The evidence.

- **Systematic review.** A 2016 review found 14 studies, all of low or very low quality. Pressure immobilisation is the only technique with support, lay rescuers rarely apply it correctly, and tourniquets should be avoided (Avau 2016).

- **Origin.** The method rests on Sutherland's 1979 monkey work. Target pressures are about 40 to 70 mmHg on an arm and 55 to 70 mmHg on a leg (Avau 2016).
- **Can people do it?** In a test of 96 people, mostly health professionals, crepe bandages lost pressure within 30 minutes of transport. Elastic bandages held it, and training helped (Canale 2009, abstract).

WHO and harm.

- The WHO guideline confines pressure immobilisation to neurotoxic elapids, not vipers. It rejects tight tourniquets and incisions (WHO SEARO 2016, secondary summary).
- Bandages left 7.5 to 9.5 hours have caused rhabdomyolysis (Queensland Health 2023).

For the village. Keep the patient still and immobilise the limb. Never cut, suck, burn or tie. Once antivenom is gone, snakebite becomes nursing and breathing support (WO-15).

1.11 Drowning and lightning

Drowning. The 2024 WMS guideline rules out compressions in the water and allows rescue breaths in water only for trained rescuers. Submersion beyond 30 minutes in water warmer than 6 °C, or 90 minutes colder, leaves minimal chance of survival (Davis 2024). Ventilation matters most, because the cause is lack of oxygen.

Lightning. The WMS lightning guideline teaches "reverse triage". Treat the apparently dead first, since many are in respiratory arrest with hearts that restart if ventilated (WMS lightning guideline 2014). It costs nothing.

1.12 Water treatment

Improvised methods are summarised here, and HY-11 covers the rest.

Boiling.

- A rolling boil inactivates pathogens even at altitude, though bacterial spores survive (WHO 2015).
- CDC advice adds 1 minute of boiling, or 3 minutes above 6,562 feet (about 2,000 m) (CDC). A full minute satisfies both.

Household bleach. At 5 to 6% strength, the dose is 8 drops per gallon, or 16 if cloudy, then a 30-minute wait. Bleach is weak against Cryptosporidium (CDC). By my arithmetic that is about 2 drops per litre [VERIFY].

Solar disinfection (SODIS).

- In 206 Maasai children, it cut diarrhoea, with an odds ratio of 0.66 (95% CI 0.50 to 0.87) (Conroy 1996, abstract).
- In a 1998 outbreak, cholera struck 3 of 155 children using it against 20 of 144 not using it (Conroy 2001, secondary summary [VERIFY]).
- The method is clear PET bottles in full sun for 6 hours, or two days if cloudy, with turbidity under 30 NTU (SODIS method summaries).

Sari cloth. In 65 villages of Matlab, Bangladesh (about 133,000 people), old sari cloth folded to eight layers cut cholera by 48%, and nylon mesh by about 41%. The cloth removes the plankton to which the vibrio clings. Allocation was not individually randomised (Colwell 2003, full text).

1.13 Expedition and polar medicine

Mostly minor. NOLS recorded 1.18 injuries and 1.08 illnesses per 1,000 programme-days in 2002 to 2005, with no deaths. Fractures, teeth and tick fever drove evacuations (McIntosh 2007).

Nepal.

- **1984 to 1987.** Between 1 January 1984 and 30 June 1987, 148,000 trekking permits produced 23 deaths and 111 helicopter rescues. That is 15 deaths and 75 rescues per 100,000. Trauma caused 11 deaths, illness 8 and altitude sickness 3 (Shlim 1989, abstract).
- **1987 to 1991.** There were 40 deaths among 275,950 trekkers (Shlim and Gallie 1992, secondary summary).
- **Everest Base Camp.** The clinic recorded 85.3% medical presentations from 2003 to 2012 (Némethy 2015, secondary summary [VERIFY]).

Australia's Antarctic stations.

- Desmond Lugg ran Australian Antarctic medicine from 1968 to 2001 (Australian Antarctic Division 2001). His JAMA review "Antarctic medicine" exists, but I could not read it (Lugg 2000), so the brief's [VERIFY] stands for its content.
- Winter populations of 15 to 35 people are isolated up to nine months with one doctor.
- Wintering doctors must have their appendix removed beforehand, a rule dating from a 1950s appendicitis case on Heard Island (Australian Antarctic Division health page).
- In March 2015 the Aurora Australis turned back to collect a sick expeditioner from Davis station (Australian Antarctic Division 2015).

Japan's Syowa station gives the best numbers (Ikeda 2019).

- From 1956 to 2016, 1,734 wintering members produced 6,837 cases, about four each. 45.3% were surgical or orthopaedic.
- There were no winter evacuations.
- Two appendectomies were done under spinal anaesthesia.
- A pelvic fracture with urethral injury was held three months until the ship came.
- One member died in a blizzard.

Across 18 stations of 13 nations, one survey counted 21 summer evacuations and only 2 in winter (Hasegawa 2007, abstract).

Famous exceptions.

- **Leonid Rogozov.** At Novolazarevskaya, on about 30 April 1961, he removed his own appendix under local anaesthetic, with two assistants holding mirror and retractors (Rogozov 2009, secondary only).
- **Jerri Nielsen.** At the South Pole in 1999 she biopsied her own breast cancer and gave herself airdropped chemotherapy until evacuation on 16 October 1999 (Wikipedia, Jerri Nielsen, secondary only).

The routine record is sprains, fractures, teeth and skin managed for months by one generalist with a planned kit, which is the village's situation.

1.14 Ship medicine

The WHO guide. The WHO International Medical Guide for Ships, 3rd edition 2007, follows editions of 1967 and 1988. I could not read the guide itself.

The chest.

- Its medicines come from the WHO Essential Medicines List and its equipment from the Inter-agency Emergency Health Kit.
- The quantities are in a 2011 Quantification Addendum covering 55 medicines for ship categories A, B and C, sized for a month (WHO Quantification Addendum, catalogue description).
- Interim owner guidance lists amoxicillin-clavulanate, ceftriaxone, doxycycline, morphine and oxygen (Schlaich 2009, full text read).

Who gives the care. The model is lay. A non-medical officer acts on training, a written guide and radio advice (Schlaich 2009). The Maritime Labour Convention 2006 requires the chest.

The record. The Italian radio medical service CIRM advised on 21,869 seafarers from 1984 to 2006, of whom 339 (1.55%) died, mostly of circulatory disease and then accidents (CIRM 1984 to 2006 study, abstract). A review of 29,146 files from 1986 to 2010 found 383 deaths (1.31%) (CIRM 1986 to 2010 study, abstract).

For the village. This is the closest institutional template for a dispensary: lay officer, written guide, quantified chest, a voice to consult. After the Fall that voice may be the district healer.

1.15 Summary table: does it assume evacuation?

Guideline element	Guideline grade	Assumes evacuation?	Transfers to a village with none?
Direct pressure, wound packing	1B	No	Yes, fully
Limb tourniquet	1A	Yes, within about 2 hours	Yes, but plan conversion and limb loss
Haemostatic gauze	1B	Yes	Until stock runs out, then plain packing
TXA within 3 hours	RCT	Yes	No once stock is gone
Permissive low fluids	Quasi-RCT	Yes, to surgery	Principle yes, blood products no
Irrigation with drinkable water	1A	No	Yes, fully
Primary or delayed closure	1B to 1C	Partly	Yes
Evacuate open fractures, bites	1C	Yes, entirely	No, must be done locally
Mild hypothermia care	1A to 1B	No	Yes, fully
Hypothermic arrest	1A to 2C	Yes, to bypass	Rarely survivable
Frostbite thaw	Strong	Partly	Yes, minus drugs
Heat stroke immersion	1A	No	Yes, fully
Altitude descent	Strong	No	Yes
Altitude drugs	Strong	No	Until stock runs out
Snakebite immobilisation	Low quality	Yes, to antivenom	Partly
Spinal clearance rules	Moderate	No	Yes, fully
Lightning reverse triage	Consensus	No	Yes

2. Evidence grades

The book's own grades are A (trials or systematic reviews), B (consistent clinical series), C (convergent tradition with plausible pharmacology), D (single tradition or anecdote) and X (ineffective or harmful).

Practice	Grade	Tradition says	Record shows	Science infers
Direct pressure on bleeding	B	Press on a wound	Effective in most bleeding (Quinn 2014)	Mechanical haemostasis, about 180 mmHg

Practice	Grade	Tradition says	Record shows	Science infers
Commercial limb tourniquet	B	Feared as a limb-killer [VERIFY]	90% survival if applied before shock (Kragh 2009), replicated in civilians (Teixeira 2018)	Saves lives, costs limbs beyond about 2 hours
Improvised tourniquet with windlass	B (manikin)	None	Fails about 32% (Altamirano 2015)	Works if wide, windlassed, locked
Tourniquet without windlass, belt, cord	X	Any band will do	99% manikin failure (Altamirano 2015)	Venous only, increases bleeding
Releasing a tourniquet periodically	X	Old first aid	Not supported (Quinn 2014)	Repeated blood loss and reperfusion
Pressure points	X	Taught for decades	No role (Quinn 2014)	Ineffective
Haemostatic gauze	B (low certainty)	Vendor claims	67 to 100% control, low quality (EMJ 2018 review)	Packing explains much of it
Tranexamic acid within 3 hours	A	None	CRASH-2	Antifibrinolytic, harmful after 3 hours
Low-volume fluids in torso bleeding	A minus	“Fill the tank”	Bickell 1994, quasi-random	Avoids diluting clot
High-pressure irrigation, drinking water	A	Wash wounds	Cochrane, WMS 1A	Dilution and removal of bacteria
Delayed closure of dirty wounds	B	Military surgery	2% infection in punji wounds (Quinn 2014)	Contamination declares itself
Silver sulfadiazine on burns	X	Standard for decades	Slower healing (Quinn 2014)	Topical toxicity
Rigid collar and board for all	X	Universal immobilisation	Harms outweigh benefit (Hawkins 2019)	Sores, airway risk
Clinical spinal clearance	B	None	NEXUS, Canadian rule	Valid in alert sober patients
Improvised traction splint	D	Wilderness courses	10-volunteer pilot only	Unproven over simple splint
Shoulder-harness litter carry	B (lab)	Bearers’ slings	About seven times farther per carry (USAARL 2024)	Load transfer
Shivering plus insulation for mild hypothermia	A	Wrap and feed	WMS 1A	Endogenous heat

Practice	Grade	Tradition says	Record shows	Science infers
Body-to-body rewarming	X for speed	Shared sleeping bag	No faster than shivering (Dow 2019)	Comfort only
Warm bath for hypothermia	X	Folk practice	Afterdrop and collapse risk (Dow 2019, 1C)	Vasodilation
Frostbite thaw at 37 to 39 °C	B	None	Strong, moderate evidence (Omidi 2025)	Limits ice damage
Rubbing frostbite with snow	X	Northern folk practice	Advised against (Armstrong 2020a)	Mechanical and further cold injury
Aloe vera on thawed frostbite	C	Wide traditional burn use	Weak WMS recommendation	Anti-thromboxane effect proposed [VERIFY]
Cold-water immersion, heat stroke	A	Dousing	Near-zero deaths (Lipman 2019)	Fastest cooling
Descent for altitude illness	A	Mountain peoples descend	Universal	Removes hypoxia
Pressure immobilisation, elapid bites	B minus	Australian first aid since 1979	Low quality, poorly applied (Avau 2016)	Slows lymphatic spread
Cutting and sucking snakebite	X	Global folk practice	Advised against (WHO SEARO 2016)	Tissue damage, infection
Boiling water	A	Universal	WHO 2015	Heat kills pathogens
SODIS	A minus	None	Conroy 1996 trial	UV and heat
Sari-cloth filter	B	Bengali practice	48% less cholera (Colwell 2003)	Removes plankton-borne vibrio
Lightning reverse triage	B	None	Consensus from case series	Respiratory arrest outlasts cardiac arrest

3. Means ledger

Rungs run from hands to the pre-Fall hospital. The last column says what each rung changes.

3.1 Life-threatening limb bleeding

Rung	What can be done	What it changes
Hands	Pressure with fist or knee, packing with fingers	Controls most bleeding
Hearth	Cloth band at least 4 cm, stick windlass, locking tie, clean packing, time on skin	Improvised tourniquet that works about two times in three

Rung	What can be done	What it changes
Garden and still	Boiled dried packing rolls, alcohol, forged windlass rod and buckle	More reliable tourniquets, clean packing in reserve
Village dispensary	Salvaged commercial tourniquets and gauze, reassessment at 2 hours, records	Fewer needless limb losses
District infirmary	Vessel ligation, clean amputation, fresh whole blood [VERIFY feasibility]	Some junctional and truncal bleeding survived
Hospital	Vascular repair, blood bank, TXA	Limb salvage, torso bleeding survivable

3.2 Contaminated wound

Rung	What can be done	What it changes
Hands	Stop bleeding, remove gross dirt, cover	Some infection prevented
Hearth	1 litre or more of boiled water under pressure, soap, clean cloth	The single most effective step
Garden and still	Honey dressings (WO-01), boiled needle and thread, alcohol	Primary and delayed closure
Village dispensary	Syringes for 8 psi, sutures, salvaged antibiotics and toxoid, microscope	Open fractures and bites treated
District infirmary	Debridement under anaesthesia, drainage, amputation	Spreading infection rescued
Hospital	Culture-guided antibiotics, plastic surgery	Function preserved

3.3 Fractures and suspected spinal injury

Rung	What can be done	What it changes
Hands	Spinal clearance, gentle realignment, holding still	Most spared needless immobilisation
Hearth	Padded board splints, rolled blankets, slings	Less pain, bleeding and nerve damage
Garden and still	Stiffened-bandage casts [VERIFY], harnessed litters, willow-bark analgesia (NU-05)	Long carries possible
Village dispensary	Malleable splints, opioids while they last, reduction of dislocations	Earlier reduction, better pain control
District infirmary	Bed traction for femur, open-fracture debridement	More open fractures survived
Hospital	X-ray, internal fixation	Union and function

3.4 Hypothermia

Rung	What can be done	What it changes
Hands	Horizontal, gentle handling, out of wind, 1-minute pulse check, CPR	Prevents rescue collapse
Hearth	Ground insulation, vapour barrier, sweet drinks, heat to trunk	Mild cases recover fully
Garden and still	Hot-water bottles, tub for limb immersion at 42 to 45 °C	Faster rewarming of mild cases
Village dispensary	Low-reading thermometer, warm room	Staging by number
District infirmary	Warmed IV fluids [VERIFY], monitoring	Some moderate cases
Hospital	Extracorporeal rewarming	Arrest survivable

3.5 Heat stroke

Rung	What can be done	What it changes
Hands	Recognise confusion, shade, strip, pour water	Cooling begins
Hearth	Tarpaulin taco, trough, pond	Grade A cooling, about 0.2 °C per minute
Garden and still	Shaded rest and water at the fields	Prevention
Village dispensary	Thermometer, salt and sugar drinks	Stop at 39 °C, manage over-drinking
District infirmary	IV fluids, seizure control	Severe cases
Hospital	Intensive care	Organ failure survived

3.6 Drinking water

Rung	What can be done	What it changes
Hands	Cleanest source, settling	Fewer pathogens
Hearth	Rolling boil, 8-layer sari cloth, SODIS bottles	Large falls in diarrhoea and cholera
Garden and still	Sand filters, covered storage, salvaged bleach	Household scale
Village dispensary	Turbidity checks, dosing records	Quality control
District infirmary	Outbreak tracing with microscope	Source found
Hospital	Municipal chlorination	Near elimination

4. Harm test

Tourniquets.

- **How they harm.**
  - A venous-only tourniquet increases bleeding.
  - Hours of tourniquet time kill the limb, and release floods the body with potassium and muscle breakdown (Lukiianchuk 2025).

  - A tourniquet on a wound that did not need one costs a limb for nothing. Only 24.6% were appropriate in one Ukrainian series (Stevens 2024).
  - Nerve palsy followed in 1.7% (Kragh 2009).
- **Never for.** Bleeding that pressure and packing can hold.
- **Warning signs.** Bleeding below the band, a swelling dusky limb, a returning distal pulse.
- **What to do.**
  - Tighten the tourniquet or add a second above it.
  - Reassess at 2 hours.
  - After many hours, do not release suddenly without a plan. Amputation above the band may be the only survivable choice (WO-13 [VERIFY]).
- **Historical harm.** "Last resort" doctrine produced the Vietnam limb-haemorrhage deaths (Butler 2012). Over-correction now shows in Ukraine.

Packing. Powders can embolise, so gauze is preferred (Quinn 2014). Count packing in and out.

Fluids. Large volumes before bleeding is controlled worsen survival (Bickell 1994). Oral fluid in a drowsy or vomiting patient risks inhalation.

Wound closure.

- **The harm.** Closing a dirty, late or bitten wound traps infection.
- **Signs.** Spreading redness, pus, red streaks, fever, crackling gas.
- **What to do.** Reopen, irrigate and leave open.
- **Tetanus.** Tetanus-prone wounds without toxoid remain a lethal risk (WO-05).

Splints and immobilisation. A tight splint on a swelling limb causes compartment syndrome. Check the digits hourly for the first day [VERIFY interval]. Backboards and rigid collars cause pressure sores within hours, inhaled vomit and restricted breathing (Hawkins 2019).

Rewarming.

- Heat on the limbs can trigger collapse, and rough handling of a severely cold patient can trigger ventricular fibrillation (Dow 2019).
- Hot stones and bottles burn numb skin.
- The Heat Pac device produces carbon monoxide (Dow 2019).
- Never put a severely hypothermic patient in a hot bath.

Frostbite. Refreezing after a thaw is the worst outcome. Water above 39 °C burns. Early amputation removes tissue that might have lived (Armstrong 2020a).

Aloe.

- **Part used.** Aloe vera (L.) Burm.f. clear inner leaf gel. The yellow latex beneath the skin is a strong laxative and irritant and should be rinsed off [VERIFY].
- **Lookalike.** Agave americana L., whose sap causes dermatitis [VERIFY].

Cooling. Overcooling below about 39 °C risks hypothermia. An immersed patient can drown unless one person holds the head. Antipyretics do not help (Lipman 2019).

Altitude drugs. Dexamethasone masks symptoms and does not treat HAPE. Nifedipine can drop blood pressure.

Snakebite.

- Arterial tourniquets risk gangrene beyond about 40 minutes (WHO SEARO 2016).

- Pressure bandages left 7.5 to 9.5 hours caused rhabdomyolysis (Queensland Health 2023). On viper bites they may worsen local damage (WHO SEARO 2016).
- Incision, suction, electric shock and ice all harm.

Water. Boiling does not remove chemicals. SODIS fails in cloudy water or coloured bottles (SODIS method summaries).

5. Red flags

These signs mean death or disability without what the village cannot give.

Bleeding.

- **Signs.** Trunk, neck, armpit or groin bleeding that packing cannot hold. Confusion and a fading radial pulse despite tourniquets.
- **Do anyway.** Pack and press with knee and fist in relays. Keep the patient warm and flat. Give sips only if fully awake.
- **Honest comfort.** Stay and hold a hand. Most such deaths come within the first hour (Eastridge 2012).

Wounds.

- **Signs.** Crackling gas, grey watery foul discharge, rapidly spreading redness, fever with a fast pulse.
- **Do anyway.** Reopen and irrigate every closed wound. Cut away dead tissue. Give any remaining antibiotics. At the district, consider amputation above the margin.

Open fracture or crush.

- **Signs.** Bone through skin, a cold pulseless foot below a break, a limb trapped for hours.
- **Do anyway.**
  - Irrigate, realign and splint.
  - Give antibiotics if any remain (1A for open fractures).
  - Leave the wound open.
  - Push oral fluids after a crush release [VERIFY, WO-13].

Head and spine.

- **Signs.** Falling consciousness, unequal pupils, loss of feeling or movement below a level.
- **Do anyway.** Lay the patient on the side with the head supported. Turn every 2 hours [VERIFY]. Manage bladder and bowel. Tell the family plainly.

Hypothermia.

- **Signs.** Unconscious, not shivering, weak irregular pulse or none.
- **Do anyway.** Handle gently, insulate, and start CPR after a 1-minute pulse check. Recovery from arrest without bypass is rare. Stop when the chest cannot be compressed or rescuers are endangered.

Heat. Seizure, coma, bleeding gums or dark urine. Cool to 39 °C, protect the airway, give fluids once awake.

Altitude. Breathless at rest, wet cough, confusion or staggering. Descend that night, carried if necessary.

Snakebite.

- **Signs.** Drooping eyelids, double vision, trouble swallowing or breathing after an elapid bite. Bleeding gums or spreading swelling after a viper bite.
- **Do anyway.** Relay ventilation by mouth or bag has kept paralysed patients alive [VERIFY, WO-15].

6. The case against

This literature assumes rescue.

- The WMS wound guideline ends with an evacuation list (Quinn 2014).
- Hypothermia survival stories end on bypass (Dow 2019).
- Prolonged casualty care is defined as a bridge (CoTCCC 2024, secondary).
- The founding "golden hour" was an opinion (Lerner 2001).

Their authority does not extend to a world they never studied.

Young, fit men. Kragh's and the Rangers' casualties were overwhelmingly young men (Kragh 2009, Kotwal 2011). A village casualty may be 70 with fragile vessels, or a child too small for an adult tourniquet. Tourniquet tolerance in the old is untested here [VERIFY].

Speed made the military data. Kotwal credits evacuation time with much of the fall in deaths (Kotwal 2016). The tourniquet saved the life, the helicopter saved the limb.

The Ukraine critique. Stevens and colleagues argue that "tourniquet first" teaching causes avoidable amputations when evacuation takes hours (Stevens 2024). Patterson and colleagues, in "Life Over Limb: Why Not Both?", note that tourniquet guidance rests on evacuation under an hour (Patterson 2024, abstract). An estimate of 75,000 Ukrainian amputations comes from a press interview, not a study (Telegraph report via Yahoo 2025 [VERIFY]). The tourniquet must be taught with its exit plan.

Improvised tourniquets. Gerald King argues they are mostly venous and should not be relied on (King 2015). Defenders reply that "improvised" is poorly defined and the Iraq improvised data were tiny. Both sides agree a windlass is essential (Altamirano 2015).

Vendor-driven products. Haemostatic gauze entered guidelines on animal studies and low-quality series (EMJ 2018 review, ILCOR), defended by a count of units shipped. Much tourniquet and splint testing is funded by, or benchmarked against, the products themselves [VERIFY]. Take the technique, not the brand.

Small improvisation studies. Ten volunteers, a manikin, a collar study without X-rays, and no litter outcome data.

Weak foundations elsewhere. Bickell allocated by day, so bias is possible (Bickell 1994). Pressure immobilisation rests on a 1979 animal study, is done badly by professionals and has caused harm (Avau 2016, Canale 2009, Queensland Health 2023).

The romance of the hospital. Syowa managed 6,837 cases over 60 years without a winter evacuation (Ikeda 2019). Serious NOLS events were rare (McIntosh 2007). Seafarers mostly survive on lay care and radio advice (CIRM studies). What a hospital uniquely gives is narrow: surgery, blood, imaging, antibiotics, antivenom, intensive care.

The romance of the herbal. Aloe is the only plant this literature endorses, and only weakly. No herbal haemostatic or antivenom appears in any guideline reviewed.

Today against after the Fall. Today every guideline here is deliverable by a trained first-aider with a kit and a phone.

- **Fully feasible after the Fall.** Pressure, packing, windlass tourniquets, irrigation, delayed closure, spinal clearance, splints, litters, shivering-based rewarming, frostbite thaw, immersion cooling, descent, reverse triage, boiling, SODIS and sari filtering.
- **Feasible until stocks end.** Commercial tourniquets, haemostatic gauze, TXA, antibiotics, toxoid, altitude drugs, antivenom.
- **Never feasible without a surgeon or hospital.** Bypass rewarming, stored blood products, vascular repair, fracture fixation.

7. 10-line summary

1. Direct pressure and wound packing control most bleeding and need no kit (Quinn 2014).
2. A wide limb tourniquet applied before shock is the best-documented life-saver in this literature (Kragh 2009, Teixeira 2018).
3. Improvised tourniquets work only with a windlass and still fail about a third of the time (Altamirano 2015).
4. Tourniquet safety data come from evacuation within about 2 hours. Hours more cost limbs (Lukiianchuk 2025, Stevens 2024).
5. Do not flood a bleeding patient with fluid before the bleeding is stopped (Bickell 1994).
6. Irrigate wounds with at least 1 litre of drinkable water under pressure. Close clean wounds early and pack dirty ones open (Quinn 2014).
7. Mild hypothermia is cured by insulation, sugar and the patient's own shivering. Severe hypothermia mostly needs a hospital (Dow 2019).
8. Heat stroke is cured by cold-water immersion within minutes, a grade A treatment with no kit (Lipman 2019).
9. Boiling, solar disinfection and sari-cloth filtering each have trial or field evidence (WHO 2015, Conroy 1996, Colwell 2003).
10. Isolated communities with one generalist and a planned kit have managed thousands of cases for months without evacuation (Ikeda 2019).

8. Open questions

- What is a safe tourniquet time when evacuation never comes, and who converts it? Change 25-2 reserves conversion for medics the village lacks.
- Should a limb ischaemic for over 6 hours be released, amputated or left? The Lukiianchuk full text should be read.
- Do improvised tourniquets do better on real limbs than manikins, and how do they work on children and the old?
- Do improvised traction splints add anything to simple splints?
- Do harnessed litters change outcomes on long carries?
- Without antivenom, does pressure immobilisation save lives or only delay death?
- How should closure and antibiotics adapt for wounds first seen after 24 hours?
- What did Lugg's JAMA 2000 review recommend for Antarctic kits and training? Not read.
- Is the 2011 ships' Quantification Addendum a good template for a village chest? Not read.
- What does Auerbach's Wilderness Medicine (7th edition 2017) say on long-duration care? Not read.

9. Sources to read in full

1. Quinn and colleagues 2014, the WMS wound management guideline. It is the village's surgical primer.
2. Dow and colleagues 2019, the WMS hypothermia guideline.
3. Lipman and colleagues 2019, the WMS heat illness guideline, and its 2024 update.
4. Kragh and colleagues 2008 and 2009, the tourniquet series.
5. Butler and Blackbourne 2012, "Battlefield trauma care then and now", the history of TCCC.
6. Lukiianchuk and colleagues 2025, and Stevens and colleagues 2024, on long tourniquet times in Ukraine.
7. Joint Trauma System, Prolonged Casualty Care guideline, 2021.
8. Ikeda and colleagues 2019, on six decades of medical care at Syowa station.
9. WHO International Medical Guide for Ships, 3rd edition 2007, with the 2011 Quantification Addendum.
10. Colwell and colleagues 2003, the sari-filtration trial.

10. At the bedside after the Fall

Household

- **Minimum viable version.** Every adult can press and pack a wound, apply a windlass tourniquet and write the time, put a confused hot worker in cold water, and insulate and feed a cold person.
- **Needs to start.**
  - Three cloth bands at least 4 cm wide and a metre long, each with a hardwood stick, kept in one place.
  - Clean dry packing cloth, a boiling pot and two clear PET bottles.
  - A blanket, a waterproof sheet and a card of the protocols below.
- **First failure to expect.** A tourniquet too narrow or loose, which worsens bleeding. Then a cold patient put in a hot bath.

Village of 300

- **Minimum viable version.** A trained lay healer who irrigates, debrides, closes or packs wounds, splints fractures, clears spines clinically and stages hypothermia by signs. Water safety in every household.
- **Needs to start.**
  - Syringes or squeeze bottles, and boilable needles and thread.
  - Salvaged tourniquets and gauze, kept for arterial bleeding.
  - Antibiotics kept for open fractures and bites.
  - Splints and a harnessed litter.
  - A low-reading thermometer [VERIFY availability].
  - A log of every injury, treatment and outcome. The ship's chest and the Antarctic kit are the template.
- **First failure to expect.** A dirty wound closed and infected. Then a tourniquet left on for hours because no one owns the reassessment.

District of 3,000

- **Minimum viable version.** A nurse or doctor who debrides, amputates, drains abscesses and reduces fractures under some anaesthesia. The district holds the last TXA, antibiotics and antivenom, keeps the records, trains the villages and is their voice to consult, as CIRM is for ships.
- **Needs to start.**
  - A sterile room, boiled or pressure-cooked instruments and ten beds.
  - Blood typing and willing donors [VERIFY, WO-13].
  - A microscope.
  - Litter teams.
- **First failure to expect.** Antibiotics spent on minor wounds before the first open fracture arrives.

11. Protocols

These checklists distil the guidelines above and do not replace training. My own inferences are marked.

Protocol 1: Severe limb bleeding, first hour

1. Make yourself safe. Cover your hand with a glove or clean cloth if you can.
2. Press hard on the wound with the heel of your hand or your knee. Do not lift to look.
3. If the wound is deep, pack it full with clean cloth and press for at least 5 minutes (Quinn 2014).
4. Apply a tourniquet if blood spurts or pools fast, pressure fails, or you must move on to others.
5. To improvise one:
   - Use a cloth band at least 4 cm wide, 5 to 8 cm above the wound and not over a joint [VERIFY distance].

   - Tie a stick into the knot and twist until bleeding stops and the pulse below is gone.
   - Lock the stick with a second tie.
6. If bleeding continues, add a second tourniquet directly above.
7. Write the time on the forehead or the band. Never loosen it to "let blood in".
8. Keep the patient warm and lying down.

Protocol 2: The week after a tourniquet, with no surgeon

1. **At or before 2 hours** (CoTCCC 2025, Quinn 2014), decide whether packing and a pressure bandage can hold the wound.
2. **If yes.** Pack, bandage firmly, loosen the tourniquet slowly and leave it loose in place. Watch 30 minutes [VERIFY] and retighten if bleeding returns.
3. **If no, or after more than 6 hours.** Leave it on and carry the patient to the district for amputation above the band. Sudden release of a long-dead limb can kill (Lukiianchuk 2025, my inference [VERIFY]).
4. **Days 1 to 7.**
   - Irrigate the wound daily with 1 litre of boiled cooled water.
   - Watch for redness, smell and fever.
   - Give 2 to 3 litres of fluid a day by mouth if the patient can drink [VERIFY].
   - Record urine amount and colour.

Protocol 3: Cleaning and closing a wound

1. Stop the bleeding.
2. Irrigate with at least 1 litre of drinkable water in a firm stream, from a syringe with needle or catheter, or a squeeze bottle.
3. Remove dirt and clearly dead tissue. Clip, do not shave, hair.
4. **Close now** if the wound is clean, under 6 hours old (10 hours on face and scalp), and not a bite or crush.
5. **Pack open with moist clean cloth** if the wound is dirty, a bite, a puncture or late. For possible rabies, wash with povidone-iodine and wait 4 days.
6. Re-examine packed wounds daily. Close when clean, usually after several days [VERIFY].
7. Give antibiotics, if any remain, for open fractures, human bites, hand bites and spreading infection.

Protocol 4: Broken limb

1. Check the pulse, colour and feeling below the break.
2. If the limb is badly bent and the foot or hand is cold, pull gently along its line to straighten it.
3. Splint the joints above and below with padded boards or rolled blankets.
4. If bone is through the skin, irrigate, cover with moist clean cloth, give antibiotics if any, and do not close.
5. Check the digits hourly for 24 hours [VERIFY]. Loosen the splint if they go numb, cold or dark.
6. For long carries, use a litter with shoulder harnesses and four to six rotating bearers [VERIFY].

Protocol 5: Possible neck or back injury

1. If the patient is alert, sober and without another painful injury:
   - Press along the spine for tenderness.
   - Test movement and feeling in all four limbs.
2. If there is no tenderness and no deficit, the spine is clinically clear (Hawkins 2019).
3. Otherwise, keep the patient lying, support the head with rolled clothing, and move them as a unit.
4. Never leave anyone strapped to a hard board longer than the move takes.

Protocol 6: Cold patient

1. Keep the patient horizontal and handle gently. No walking.
2. Shelter from wind. Insulate from the ground, add a waterproof layer and blankets, and cover the head.
3. Cut away wet clothes once sheltered.
4. **If shivering and alert.** Give sweet warm drinks and food, let them shiver inside the wrapping, and rest 30 minutes before walking.
5. **If drowsy or not shivering.** Put cloth-wrapped warm bottles at the armpits, chest and back, never the limbs. Check the skin every 20 to 30 minutes.
6. **If unresponsive.** Feel the neck pulse for a full minute. If there is none and the chest gives, start CPR.
7. Never a hot bath.

Protocol 7: Frostbite

1. Do not thaw if refreezing is possible. Do not rub.
2. Heat water to 37 to 39 °C, warm but not hot to your own hand for 30 seconds.
3. Immerse the part about 30 minutes until soft, keeping the temperature up.
4. Ibuprofen: no more than 2,400 mg a day for an adult, as 600 mg four times daily or 12 mg/kg/day in two doses (Armstrong 2020a, Omidi 2025).
5. Dress loosely with dry cloth between digits, and apply aloe gel if available.
6. No walking on thawed feet.
7. Let dead parts separate, which can take 3 months. Cut only if infection spreads.

Protocol 8: Collapsed hot worker

1. A confused, collapsed or fitting worker in heat has heat stroke until proved otherwise.
2. Strip them and put them up to the neck in the coldest water available, with one person holding the head. A tarpaulin held by four people works.
3. Stir the water. Cool until alert, or 39 °C on a thermometer.
4. Without immersion, soak and fan hard and cover the whole body in cold cloths.
5. No fever medicines. Drinks only when fully awake.

Protocol 9: Snakebite

1. Move away from the snake. Keep the patient still and calm. Remove rings.
2. Splint the limb.
3. Where neurotoxic snakes (cobras, kraits, mambas) are the danger, wrap a broad elastic bandage firmly over the bite and up the limb, as for a sprained ankle [VERIFY].
4. Do not cut, suck, burn, ice or tie a tight band.
5. Carry the patient. If breathing fails, ventilate in relays (WO-15).

Protocol 10: Drinking water

1. Settle cloudy water or pour it through cotton cloth folded to 8 layers (Colwell 2003).
2. Boil at a rolling boil for 1 minute, or 3 minutes above about 2,000 m (WHO 2015, CDC).
3. Or add 5 to 6% bleach, about 2 drops per litre, or 4 if cloudy [VERIFY]. Wait 30 minutes (CDC).
4. Or set clear PET bottles of 2 litres or less in full sun for 6 hours, or 2 days if overcast (SODIS method summaries).
5. Store covered and pour out. Never dip into it.

12. Numbers to carry

1. **Tourniquet.**
   - At least 4 cm wide, with a windlass.
   - Note the time.
   - Under 2 hours is low risk.
   - Over 6 hours, expect to lose the limb.
2. **Pressure.** Press and pack for at least 5 minutes before you look.
3. **Wound water.** At least 1 litre of drinkable water under pressure.
4. **Wound clock.** Close within 6 hours, or 10 hours on the face. Otherwise pack open.
5. **Body temperature.**
   - 35 °C is the hypothermia line.
   - 32 °C is where shivering fails.
   - 40 °C with confusion is heat stroke.
   - Stop cooling at 39 °C.
6. **Hypothermia.** Feel for a pulse for 1 minute. Never put a cold patient in a hot bath.
7. **Frostbite.** Thaw in water at 37 to 39 °C for about 30 minutes. Never refreeze.
8. **Altitude.** Above 3,000 m, climb no more than 500 m of sleeping height per night. For HAPE, descend at least 1,000 m.
9. **Water.**
   - A rolling boil for 1 minute.
   - 2 drops of 5% bleach per litre, then wait 30 minutes.
   - 6 hours of sun for SODIS.
10. **Tranexamic acid.** It helps only within 3 hours of injury.

References

1. Altamirano MP, Kragh JF Jr, Aden JK, Dubick MA. 2015. Role of the windlass in improvised tourniquet use on a manikin hemorrhage model. Journal of Special Operations Medicine 15(2):42-46 [VERIFY pages]. https://pubmed.ncbi.nlm.nih.gov/26125163/ (abstract and secondary summary only).
2. Armstrong C [VERIFY author]. 2020. Frostbite: recommendations for prevention and treatment from the Wilderness Medical Society. American Family Physician 101(7):440-441. https://www.aafp.org/pubs/afp/issues/2020/0401/p440.html (summary of the 2019 guideline, read). Cited as Armstrong 2020a.
3. Armstrong C [VERIFY author]. 2020. Acute altitude illness: updated prevention and treatment guidelines from the Wilderness Medical Society. American Family Physician 101(8):505-507. https://www.aafp.org/pubs/afp/issues/2020/0415/p505.html (summary of the 2019 guideline, read). Cited as Armstrong 2020b.
4. Australian Antarctic Division. 2001. Australian polar medicine veteran takes NASA post (on Dr Desmond Lugg). https://www.antarctica.gov.au/news/2001/australian-polar-medicine-veteran-takes-nasa-post/ (read).
5. Australian Antarctic Division. Health in Antarctica (undated web page). https://www.antarctica.gov.au/about-antarctica/people-in-antarctica/health/ (read). Cited as Australian Antarctic Division health page.
6. Australian Antarctic Division. 2015. Medical evacuation at Australian Antarctic station. https://www.antarctica.gov.au/news/2015/medical-evacuation-at-australian-antarctic-station/ (read via search summary).
7. Avau B, Borra V, Vandekerckhove P, De Buck E. 2016. The treatment of snake bites in a first aid setting: a systematic review. PLoS Neglected Tropical Diseases 10(10):e0005079. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5066967/ (read via summary of full text).

8. Bickell WH, Wall MJ Jr, Pepe PE, et al. 1994. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. New England Journal of Medicine 331:1105-1109. https://www.thebottomline.org.uk/summaries/em/bickell/ (secondary summary only).
9. Butler FK, Blackbourne LH. 2012. Battlefield trauma care then and now: a decade of Tactical Combat Casualty Care. Journal of Trauma and Acute Care Surgery 73(6 Suppl 5):S395-S402. https://www.east.org/content/documents/MilitaryResources/b/TCCC%20Butler%20A%20Decade%20of%20TCCC%20J% (full text read). Secondary source for Maughon 1970, Holcomb, Kelly, the USAISR tourniquet tests and Butler, Hagmann and Butler 1996. Cited as Butler 2012.
10. Canale E, Isbister GK, Currie BJ. 2009. Investigating pressure bandaging for snakebite in a simulated setting: bandage type, training and the effect of transport. Emergency Medicine Australasia 21(3):184-190. https://researchnow.flinders.edu.au/en/publications/investigating-pressure-bandaging-for-snakebite-in-a-simulated-set/ (abstract only).
11. Centers for Disease Control and Prevention. Use of household bleach for emergency disinfection of drinking water (archived page). https://cybercemetery.unt.edu/oilspill/20130216154842mp_/http://emergency.cdc.gov/disasters/bleach.asp (read via search summary). Cited as CDC.
12. CIRM 1984 to 2006 study. Deaths on board ships assisted by the Centro Internazionale Radio Medico (CIRM). University of Camerino repository record. https://pubblicazioni.unicam.it/handle/11581/108558 (abstract via search summary only).
13. CIRM 1986 to 2010 study. Mortality on board ships assisted by CIRM. University of Camerino repository record. https://pubblicazioni.unicam.it/handle/11581/250526 (abstract via search summary only).
14. Colwell RR, Huq A, Islam MS, et al. 2003. Reduction of cholera in Bangladeshi villages by simple filtration. Proceedings of the National Academy of Sciences 100(3):1051-1055. https://pmc.ncbi.nlm.nih.gov/articles/PMC298724 (full text read).
15. Committee on Tactical Combat Casualty Care. 2025. Standardizing tourniquet reassessment and conversion across TCCC tiers: TCCC Guidelines proposed change 25-2. Journal of Special Operations Medicine. https://jsomonline.org/product/standardizing-tourniquet-reassessment-and-conversion-across-tccc-tiers-tccc-guidelines-proposed-change-25-2/ (abstract and trade summary at https://www.oneshear.com/blogs/education/tccc-2026-updates-what-you-need-to-know only). Cited as CoTCCC 2025. The 2024 CoTCCC position statement on prolonged casualty care (cited as CoTCCC 2024) was known only from these secondary summaries.
16. Conroy RM, Elmore-Meegan M, Joyce T, McGuigan KG, Barnes J. 1996. Solar disinfection of drinking water and diarrhoea in Maasai children: a controlled field trial. Lancet 348:1695-1697. https://acnpsearch.twebdev.unibo.it/singlejournalindex/1913935 (bibliographic record and secondary summary only). The 2001 cholera follow-up (cited as Conroy 2001) was known from secondary summary only.
17. CRASH-2 trial collaborators. 2010. Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial. Lancet 376:23-32. https://www.themednet.org/publications/effects-of-tranexamic-acid-on-death-vascular-occlusive-events-and-blood-transfusion-in-trauma-patients-with-significant-haemorrhage-crash-2-a-randomised-placebo-controlled-trial (abstract and summaries only). Cited as CRASH-2 2010.
18. Davis CA, et al. 2024. Wilderness Medical Society clinical practice guidelines for the treatment and prevention of drowning: 2024 update. Wilderness and Environmental Medicine 35(1 Suppl):94S-111S. https://wms.imiscloud.com/magazine/1503/2024-Drowning-Summary/default.aspx (WMS summary only).
19. Dow J, Giesbrecht GG, Danzl DF, et al. 2019. Wilderness Medical Society clinical practice guidelines for the out-of-hospital evaluation and treatment of accidental hypothermia: 2019 update. Wilderness and Environmental Medicine 30(4S):S47-S69. https://www.femecv.com/sites/default/files/WMS%20hipotermia_2019.pdf (full text read).
20. Eastridge BJ, Mabry RL, Seguin P, et al. 2012. Death on the battlefield (2001-2011): implications for

the future of combat casualty care. Journal of Trauma and Acute Care Surgery 73(6 Suppl 5):S431-S437. https://scholar.usuhs.edu/en/publications/death-on-the-battlefield-2001-2011-implications-for-the-future-of/ (abstract only).

21. EMJ 2018 review. Pre-hospital haemostatic dressings, systematic review. Emergency Medicine Journal 35(7):449. https://emj.bmj.com/content/35/7/449 (abstract via search summary only, authors not recorded [VERIFY]).
22. Hasegawa K, Watanabe K. 2007. Survey of medical care at Antarctic stations. Antarctic Record (National Institute of Polar Research), November 2007. https://doaj.org/article/35022c913b1f4615b1794a1b3551e4d5 (abstract via search summary only, title approximate [VERIFY]).
23. Hawkins SC, Williams J, Bennett BL, et al. 2019. Wilderness Medical Society clinical practice guidelines for spinal cord protection. Wilderness and Environmental Medicine 30(4S):S87-S99, with the 2024 update 35(1 Suppl):78S-93S. https://wms.imiscloud.com/magazine/1597/Spinal-Cord-Protection/default.aspx (WMS summary only). Also cited as WMS 2024 spinal summary.
24. Ikeda A, Ohno G, Otani S, Watanabe K, Imura S. 2019. Disease and injury statistics in Japanese Antarctic Research Expedition members during their stay in Antarctica, 1956 to 2016. International Journal of Circumpolar Health 78(1):1611327. https://pmc.ncbi.nlm.nih.gov/articles/PMC6493307 (read). Title approximate [VERIFY].
25. International Liaison Committee on Resuscitation. Control of severe life-threatening external bleeding in the out-of-hospital setting: haemostatic dressings, consensus on science with treatment recommendations. https://costr.ilcor.org/document/control-of-severe-life-threatening-external-bleeding-in-the-out-of-hospital-setting-hemostatic-dressings-ksu-tf-sr-costr (summary only). Cited as ILCOR.
26. King DR, et al. 2015. Tourniquet use at the Boston Marathon bombing: lost in translation. Journal of Trauma and Acute Care Surgery 78(3):594-599. https://asprtracie.hhs.gov/technical-resources/resource/458/tourniquet-use-at-the-boston-marathon-bombing-lost-in-translation (secondary summary only).
27. Kotwal RS, Montgomery HR, Kotwal BM, et al. 2011. Eliminating preventable death on the battlefield. Archives of Surgery 146(12):1350-1358. https://www.naemt.org/docs/default-source/education-documents/tccc/tccc-updates_092017/tccc-reference-materials/07-tccc-key-publications-(abstracts)/kotwal-eliminating-prev-death-arch-surg-2011.pdf?sfvrsn=2 (abstract only).
28. Kotwal RS, Howard JT, Orman JA, et al. 2016. The effect of a golden hour policy on the morbidity and mortality of combat casualties. JAMA Surgery 151(1):15-24. https://www.healthday.com/health-news/general-health/u-s-combat-deaths-declined-under-golden-hour-policy-study-703685.html (news summary only).
29. Kragh JF Jr, Walters TJ, Baer DG, et al. 2008. Practical use of emergency tourniquets to stop bleeding in major limb trauma. Journal of Trauma 64(2 Suppl):S38-S50. https://www.naemt.org/docs/default-source/education-documents/tccc/tccc-updates_092017/tccc-reference-materials/07-tccc-key-publications-(abstracts)/kragh-tourniquets-j-trauma-2008.pdf?sfvrsn=2 (abstract via search summary only).
30. Kragh JF Jr, Walters TJ, Baer DG, Fox CJ, Wade CE, Salinas J, Holcomb JB. 2009. Survival with emergency tourniquet use to stop bleeding in major limb trauma. Annals of Surgery 249(1):1-7. https://www.naemt.org/docs/default-source/education-documents/tccc/tccc-updates_092017/tccc-reference-materials/07-tccc-key-publications-(abstracts)/kragh-survival-with-emerg-tourniquets-ann-surg-2009.pdf?sfvrsn=2 (abstract read).
31. Lerner EB, Moscati RM. 2001. The golden hour: scientific fact or medical "urban legend"? Academic Emergency Medicine 8(7):758-760. https://researchconnect.buffalo.edu/en/publications/the-golden-hour-scientific-fact-or-medical-urban-legend/ (abstract only).
32. Lipman GS, Gaudio FG, Eifling KP, et al. 2019. Wilderness Medical Society clinical practice guidelines for the prevention and treatment of heat illness: 2019 update. Wilderness and Environmental Medicine 30(4S):S33-S46. https://www.femecv.com/sites/default/files/WMS%20golpe%20de%20calor_2019.pdf (full text read).
33. LITFL. Femoral traction splints, helpful or not? (commentary on a 2023 review). https://litfl.com/femoral-

traction-splints-helpful-or-not (secondary). Cited as LITFL 2023 summary.
34. LITFL. Auto-appendicectomy (on Leonid Rogozov, with reference to Rogozov V, Bermel N. 2009. Auto-appendectomy in the Antarctic: case report. BMJ 339:b4965). https://litfl.com/auto-appendicectomy/ (secondary only, the BMJ paper was not read). Cited as Rogozov 2009.
35. Lugg DJ. 2000. Antarctic medicine. JAMA 283(16):2082-2084. https://doi.org/10.1001/jama.283.16.2082 (citation confirmed from reference lists, content not read).
36. Lukiianchuk V, Linchevskyy O, Dorlac WC, Holcomb JB, et al. 2025. Morbidity and mortality associated with ischemia-reperfusion injury after prolonged tourniquet use: a wartime single-center treatment algorithm. Journal of Trauma and Acute Care Surgery 99(3S):S79-S85. https://journals.lww.com/jtrauma/fulltext/2025/08001/morbidity_and_mortality_associated_with.12.aspx (abstract and search summaries only).
37. Lyles WE, Kragh JF, Aden JK, Dubick MA. 2015. Testing tourniquet use in a manikin model: two improvised techniques. Journal of Special Operations Medicine 15(4):21-26. https://www.jsomonline.org/Citations/EJ4J-SS7L.php (abstract via secondary summary only).
38. McIntosh SE, Leemon D, Visitacion J, Schimelpfenig T, Fosnocht D. 2007. Medical incidents and evacuations on wilderness expeditions. Wilderness and Environmental Medicine 18(4):298-304. https://bioone.org/journals/Wilderness–Environmental-Medicine/volume-18/issue-4/07-WEME-OR-093R1.1/Medical-Incidents-and-Evacuations-on-Wilderness-Expeditions/10.1580/07-WEME-OR-093R1.1.full (read).
39. Nelson [VERIFY author]. 2025. Prevention and treatment of heat illness: guidelines from the Wilderness Medical Society (practice guideline summary). American Family Physician 112(6):700-702. https://www.aafp.org/afp/2025/1200/practice-guidelines-heat-illness (read).
40. Némethy M, et al. 2015. Everest Base Camp clinic presentations 2003 to 2012. Emergency Medicine Journal 32(5):418. https://emj.bmj.com/content/32/5/418 (search summary only, attribution of figures to this paper [VERIFY]).
41. NOLS. 2008. Improvised litters (blog). https://blog.nols.edu/blog/blog-new/2008/10/06/improvised-litt (teaching material, read via summary).
42. Omidi A, et al. 2025. What is new in altitude- and cold-related illnesses of travel: appraisal and summary of the updated guidelines from the Wilderness Medical Society. International Journal of Environmental Research and Public Health 22(2):284. https://pmc.ncbi.nlm.nih.gov/articles/PMC11855094/ (read). Secondary source for the 2024 WMS altitude (Luks) and frostbite updates.
43. Patterson J, et al. 2024. Life over limb: why not both? Revisiting tourniquet practices based on lessons learned from the war in Ukraine. Journal of Special Operations Medicine 24(1):18. https://jsomonline.org/product/life-over-limb-why-not-both-revisiting-tourniquet-practices-based-on-lessons-learned-from-the-war-in-ukraine/ (abstract only).
44. Queensland Health. 2023. Harm due to the use of pressure bandage immobilisation in patients bitten by snakes in Australia (letter, Clinical Toxicology). https://dora.health.qld.gov.au/qldresearchjspui/bitstream/1/5403/1/Harm%20due%20to%20the%20use%20of%20pressure% (read via summary).
45. Quinn RH, Wedmore I, Johnson EL, et al. 2014. Wilderness Medical Society practice guidelines for basic wound management in the austere environment: 2014 update. Wilderness and Environmental Medicine 25(4 Suppl):S118-S133. https://www.femecv.com/sites/default/files/uploads/files/WMS%20heridas_2014.pdf (full text read).
46. Remley MA, Loos PE, Riesberg JC. 2021. Prolonged Casualty Care guidelines, Joint Trauma System CPG ID 91, 21 December 2021. https://jts.health.mil/assets/docs/cpgs/prolonged_casualty_care_guidelines_21_dec_2021_id91.pdf (not read, the URL returned 404 on 10 October 2026, known only from secondary summaries).
47. Schlaich C, et al. 2009. Interim guidance on the ship's medicine chest under the International Medical

Guide for Ships, 3rd edition. Liberian International Ship and Corporate Registry, Marine Operations Note 08/2009. https://liscr.com/marketing/liscr/media/liscr/online%20library/maritime/marine-operations-note-08_2009.pdf (full text read).

48. Shlim DR, Houston R. 1989. Helicopter rescues and deaths among trekkers in Nepal. JAMA 261(7):1017-1019. https://jamanetwork.com/journals/jama/article-abstract/376369 (abstract only). The 1992 follow-up by Shlim and Gallie (Shlim and Gallie 1992) was known from secondary summary only.
49. SODIS method summaries. Akvopedia, UV treatment and solar disinfection (SODIS). https://akvopedia.org/wiki/Sodis (read via summary).
50. Stevens RA, Baker MS, Zubach OB, Samotowka M. 2024. Misuse of tourniquets in Ukraine may be costing more lives and limbs than they save. Military Medicine 189(11-12):304-308. https://pubmed.ncbi.nlm.nih.gov/38242075/ (abstract only).
51. Teixeira PGR, Brown CVR, Emigh B, et al. 2018. Civilian prehospital tourniquet use is associated with improved survival in patients with peripheral vascular injury. Journal of the American College of Surgeons 226(5):769-776 [VERIFY title and pages]. https://mdedge.com/content/prehospital-tourniquets-civilian-settings-significantly-decreased-mortality (news summary only).
52. Telegraph report via Yahoo News. 2025. "Cult" of tourniquets causing thousands of unnecessary amputations and deaths in Ukraine, say surgeons. https://www.yahoo.com/news/articles/cult-tourniquets-causing-thousands-unnecessary-151520303.html (press report).
53. US Army Aeromedical Research Laboratory. 2024. Technical Report 2024-39 on two-person litter carries with assistive devices. https://usaarl.health.mil/assets/docs/techReports/2024-39.pdf (read via summary, title approximate [VERIFY]). Cited as USAARL 2024.
54. Weichenthal L, et al. 2012. Improvised traction splint pilot study, as summarised in the Bowdoin Science Journal. https://students.bowdoin.edu/bowdoin-science-journal/tag/wfr/ (secondary student summary only).
55. WHO. 2015. Boil water. Technical brief WHO/FWC/WSH/15.02. https://www.who.int/publications/i/item/WHO-FWC-WSH-15.02 (summary read).
56. WHO Regional Office for South-East Asia (Warrell DA, ed.). 2016. Guidelines for the management of snakebites, 2nd edition. https://www.who.int/publications/i/item/9789290225300 (secondary summary only). Cited as WHO SEARO 2016.
57. WHO. 2007 and 2011. International Medical Guide for Ships, 3rd edition (ISBN 9789241547208), and Quantification Addendum (ISBN 9789241548021). https://styluspub.presswarehouse.com/browse/book/9789241548021/International-Medical-Guide-for-Ships-Quantification-Addendum (catalogue description only, the guide itself was not read). Cited as WHO Quantification Addendum.
58. Wilderness Medical Society. 2014. Lightning injuries guideline update, summary. https://litfl.com/lightning-injuries/ (secondary summary only). Cited as WMS lightning guideline 2014.
59. Outdoor Medicine (outdoormedicine.org). Use of space blanket improvised tourniquets (summary of a 2023 study). https://outdoormedicine.org/use-of-space-blanket%e2%80%92improvised-tourniquets/?lang=en (search summary only). Cited as Outdoor Medicine summary 2023.
60. Wikipedia. Jerri Nielsen. https://en.wikipedia.org/wiki/Jerri_Nielsen (secondary only).