Immersion Incidents
Surviving Cold Water Shock & Hypothermia

Kent Benedict, MD, FACEP

Pacific Cup Medical Seminar 2016

Low Speed Chase - April 14, 2012

"the worst tragedy in the history of Northern California offshore racing"
'Lectronic Latitude, August 8, 2012

Low Speed Chase sailing outside Golden Gate Bridge in 2012 Full Crew Farallones Race

Low Speed Chase
Capsize - Farallones
April 14, 2012 14:36:40 PDT

- Sea State - 15’ swells, 7’ wind waves
- Water Temp 51 Degrees F
- 90 seconds from Capsize to Vessel on Rocks
- 8 Crew
- 3 Survivors - 2 make it through waves/shore break, 1 stays with boat
- 5 Died - All in Water, All with PFDs
- USCG Helicopter On-Scene in 1 Hour
- Medical Examiner - Cause of Death - Drowning

…hours later, out of 8 crew only 3 survivors

Bryan Chong Narrative
“This is going to be bad.”

I see another wave approaching … it’s massive...this is unlike anything I’ve ever seen outside of big-wave surf videos.

It begins to face up, its front flattening as it crests. By the time our boat meets it, there’s no escape route. It breaks directly on us. I lock my right arm to the bottom lifeline and brace for the impact.

Bryan Chong Narrative(2)

The last thing I see is the boat tipping toward vertical with a band of water still above it. A single thought races through my head:

"This is going to be bad."

Bryan Chong Narrative(3)

I was underwater until the boat righted itself. Confused and disoriented I looked around while water cleared off the deck. Nick and I were the only ones still on the boat. The sails were shredded, the mast snapped and every flotation device had been ripped off.

Bryan Chong Narrative
“into the break zone”

…a second wave hit us from behind. This one ripped me off the boat and into the break zone…

Bryan Chong Narrative
“into the break zone”

I couldn’t tell if I was in the water for a minute or an hour, but according to Nick it was about 15 minutes. People have asked me if I swam for shore. The best way to describe the water in the break zone is a washing machine filled with boulders. You don’t really swim. The water took me where it wanted to take me…

Drowning is the Most Immediate Survival Problem Following Water Entry !!

If Victim of Cold Water Immersion Avoids Drowning in First Few Minutes, then Prevention of Hypothermia is Critical

Four Challenges of Cold Water Immersion

- Cold Water Shock
- Swim Failure
- Hypothermia
- Avoid Rescue Collapse

Four Challenges of Cold Water Immersion

#1
Cold Water Shock

- Involuntary gasp of air, whether or not your head is above water
- Can be triggered by cold water on the face
- Lasts about one minute
- Racing/irregular pulse and blood pressure increase

Cold Water Shock

The body's initial response to sudden cold water immersion

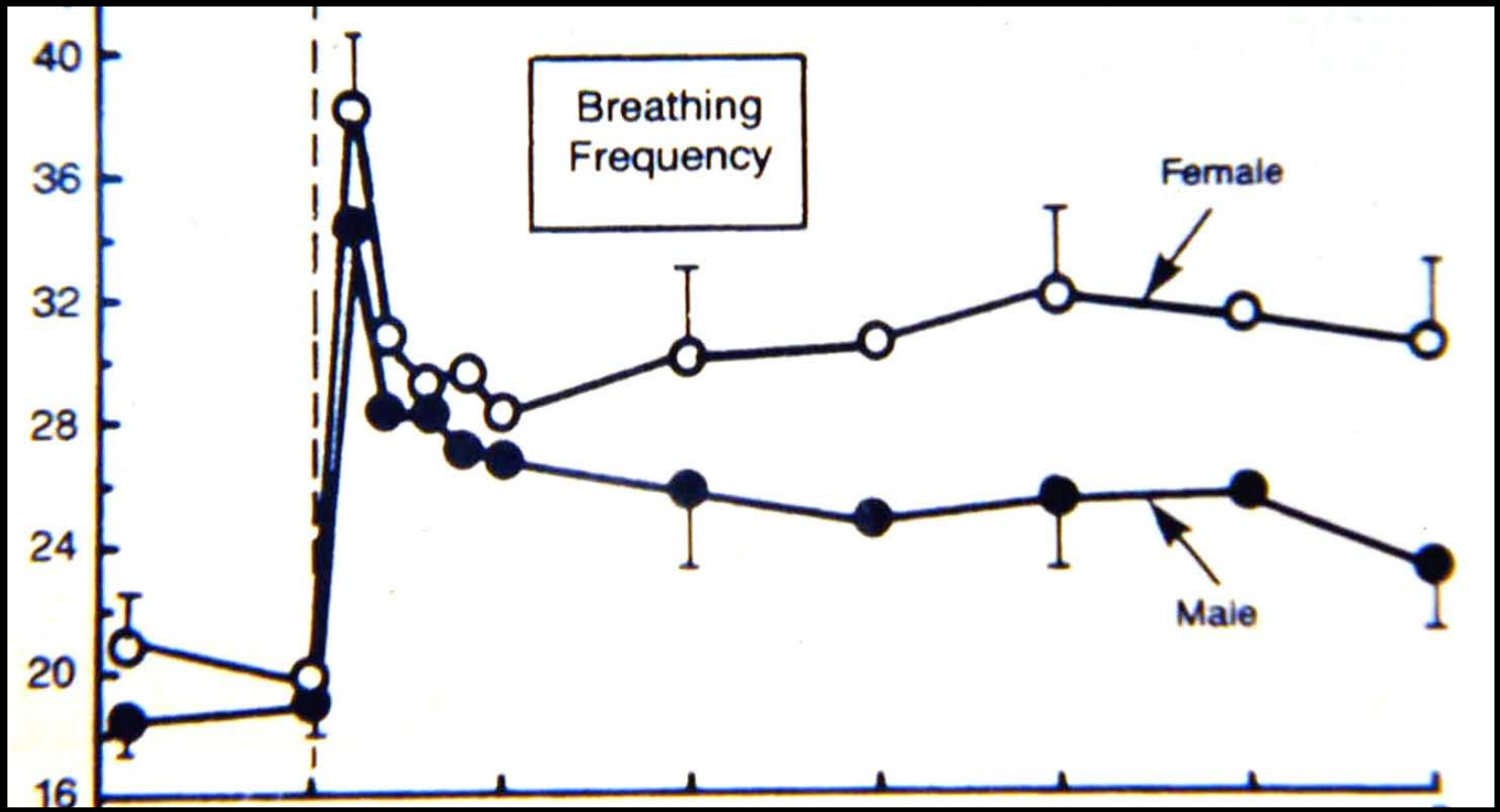
Breathing

Reflex Gasp and Gagging

Uncontrolled Rapid Breathing

Inability to Breath-Hold

Cold Water Immersion - Breathing Rate



Cold Water Shock

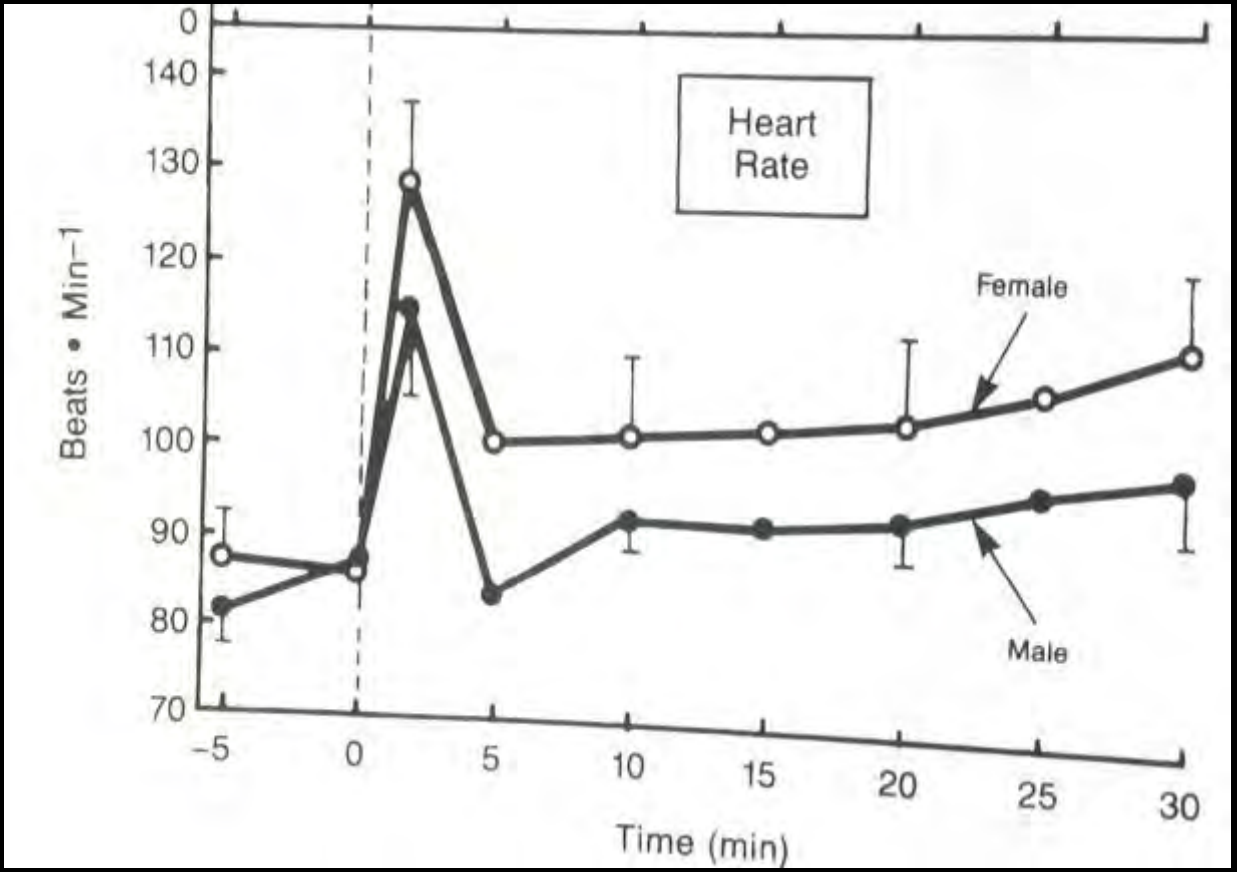
The body's initial response to sudden cold water immersion

Heart

Heart Rate

Heart Rhythms

Cold Water Immersion -Heart Rate



Cold Water Shock

The body's initial response to sudden cold water immersion

Brain

Reduced Blood Flow

Confusion

Disorientation

Loss of Consciousness

Four Challenges of Cold Water Immersion

#2
Swim Failure

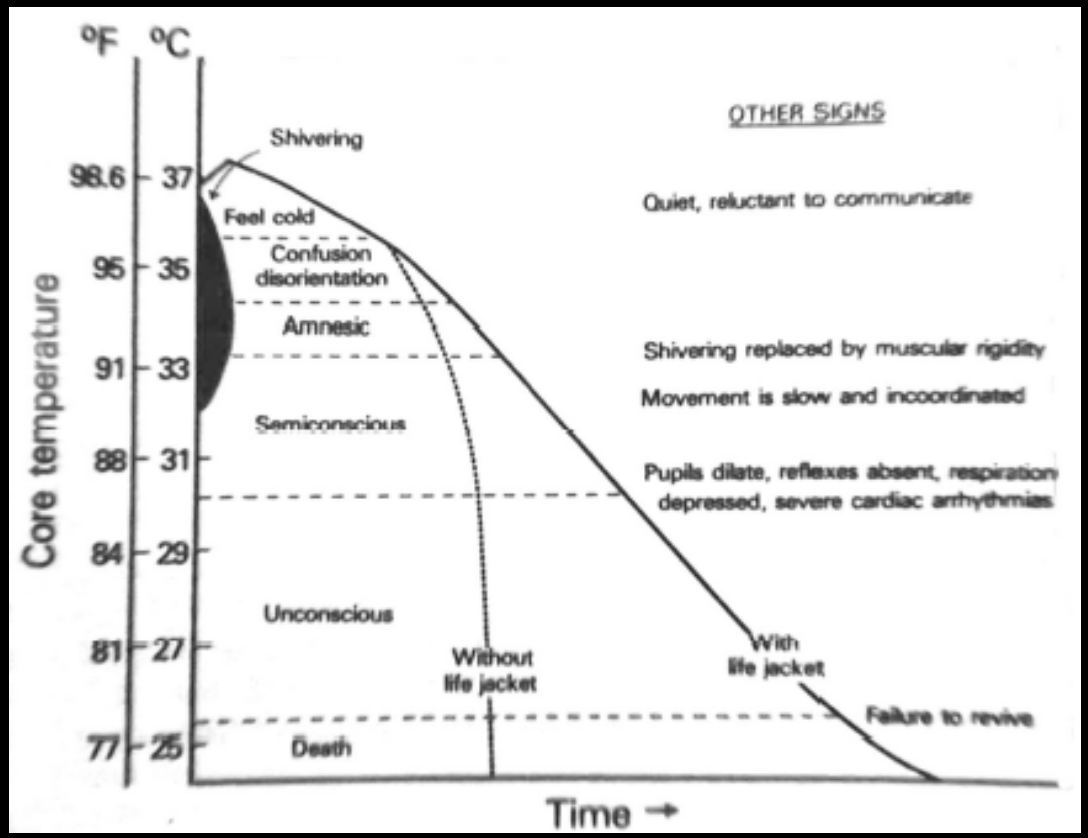
- Rapid breathing; can't time breaths with immersions
- Loss of coordination, strength and judgement

Four Challenges of Cold Water Immersion

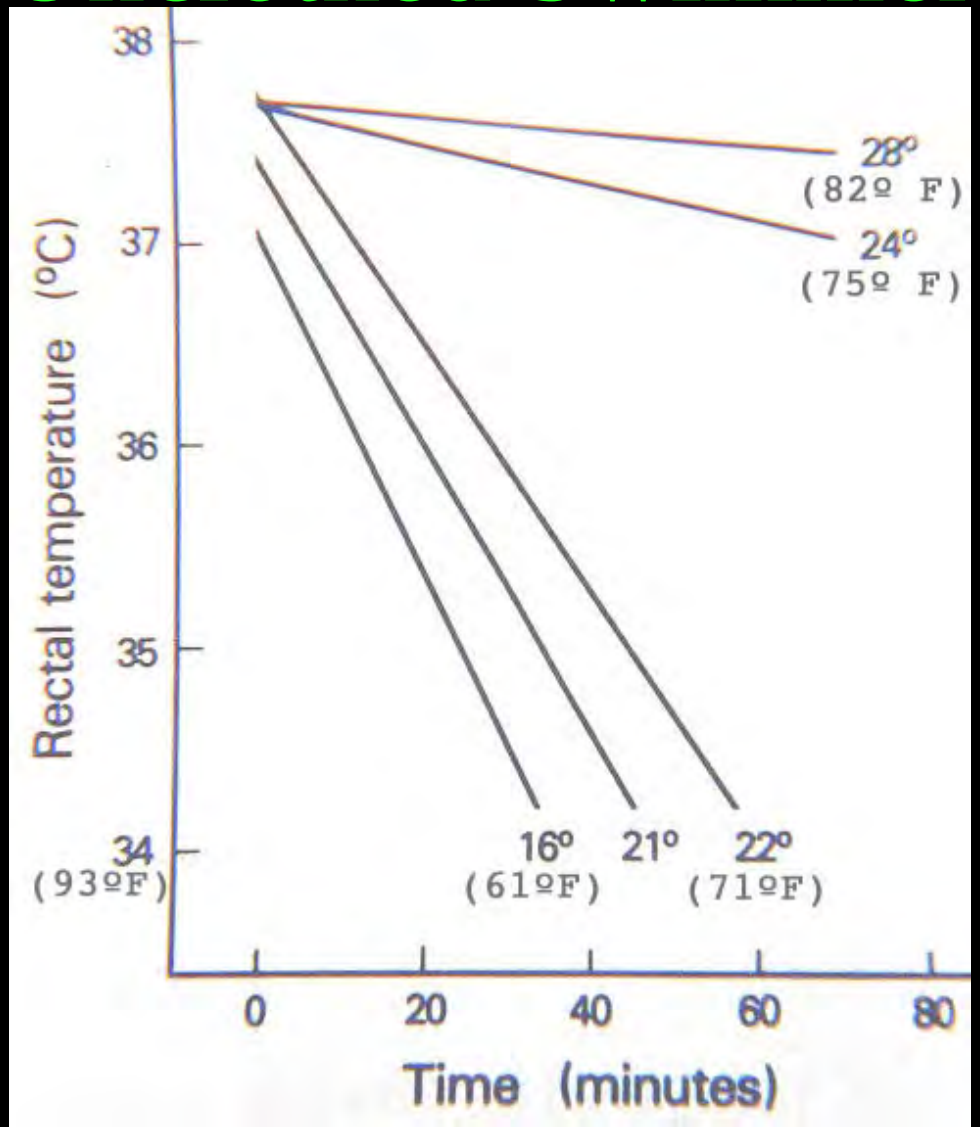
#3

Hypothermia

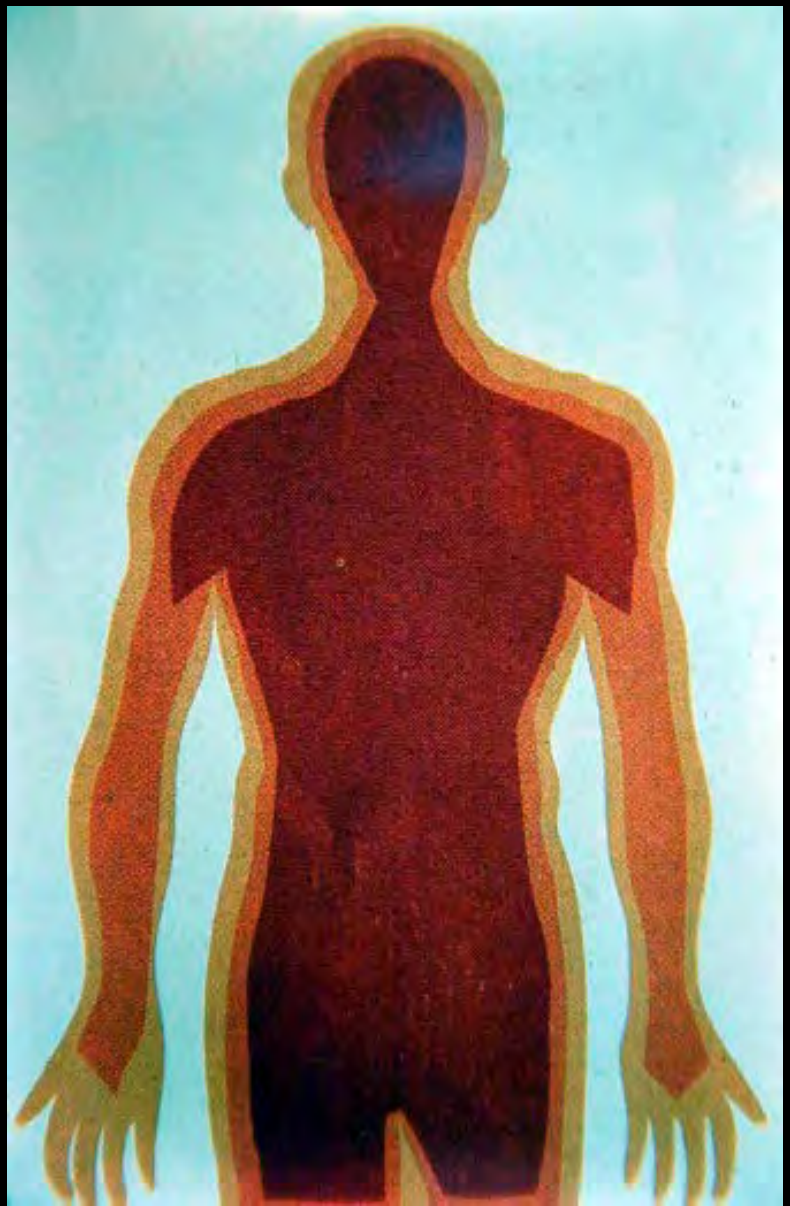
The slide towards death…



Body Heat Loss for Thin & Unclothed Swimmer



Thermal Insulation Shells



Mild Hypothermia

Core temperature 33°C to 36°C
92°F to 97°F

- Shivering
- Lack of coordination with hands and feet
  - –Reduced grip strength, stumbling
- Still alert
- Victim can self-recover without outside help

Mild Hypothermia
Treatment

- Prevent further heat loss
  - –Strip wet clothes, remove from cold environment
  - –Wrap in fleece, sleeping bag, dry insulating clothes
  - –Shivering is a good rewarming technique
- Give warm, non-alcoholic drinks
  - –Sugar content is more important than temperature
- Apply mild heat to armpits, side of chest
- Gentle exercise to generate body heat

Moderate Hypothermia

Core temperature 30°C to 33°C

86°F to 92°F

- Shivering stops
- Deteriorating coordination
- Confused, may be unable to follow directions, dopey
- Victim will not self-recover
  - –Temperature will continue to drop
- Lapsing into unconsciousness

Moderate Hypothermia
Treatment

- Victim requires more observation, 1:1 care
- Rough treatment -> ventricular fibrillation
- Only give fluids if conscious
- Re-warm with heat to torso, neck
  - –Do not apply heat to limbs; do not immerse or shower
- Consider using “buddy heat” by stripping and getting in bed or sleeping bag with victim
  - –Change rewarmers when helper shivers
- Seek medical attention even if victim recovers

Severe Hypothermia

Core temperature Below 30°C

Below 86°F

- No shivering
  - –Muscular rigidity may increase
- Unconscious
- Victim appears dead
  - –Unconscious
  - –Cold
  - –Slow/weak pulse, hard to detect

Severe Hypothermia
Treatment

- This is a medical emergency; seek care
- Handle victim gently; keep horizontal*
- Monitor victim; disregard protests
- If breathing and beating, even very slowly, don't perform CPR
  - –Maintain airway
- Don't give up the stiff!
  - –Don't presume death until warm and dead
  - –*Difficult to do when recovering someone from the water…

Cold Water Immersion Survival Factors

- Ability to Swim
- Ability to Keep Head Out of Water
- Ability to Avoid Panic
- Sea State
- Availability and Type of PFD
- Availability of Life Raft
- Availability of Other Floating Objects

Cold Water Immersion Survival Factors

- Water Temperature
- Physical Characteristics of the Victim
- Type of Protective Clothing
- Behavior of Victim in Water
- Availability of Signaling/Communication
- Proximity of Rescue Personnel

Cold Water Immersion Survival Factors

PFDs

- Any type better than none , high buoyancy best
- SOLAS-approved Type 1 Offshore Life Jackets
- Inflatable 150N(33.7lb) buoyancy models

Cold Water Immersion Survival Factors

PFD keeps victim on surface and not experience fatal drowning before rescue. How?

Cold Water Immersion Survival Factors
PFDs

Back to surface: Initially, a life jacket provides buoyancy so you bob to the surface. May keep face above water if unconscious

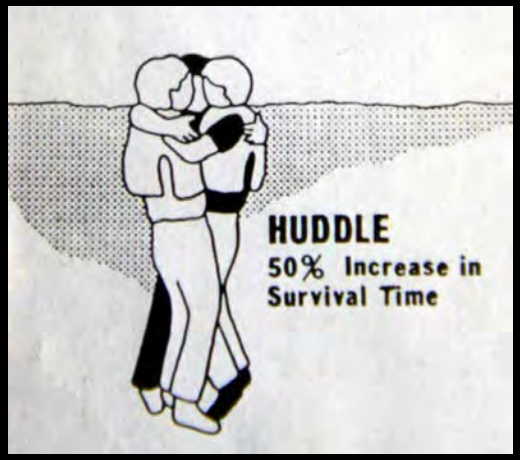
Cold Water Immersion Survival Factors
PFDs

Hypothermia reduction: Isolates high heat loss areas out of the water

Cold Water Immersion Survival Factors

PFDs

Buoyancy allows you to assume the HELP or HUDDLE postures



Cold Water Immersion Survival Factors
PFDs

Allows you to orient yourself to the waves so you don’t have to time your breaths

Cold Water Immersion Survival Factors

PFDs

A Note on “Heave Period”

This is the time it takes to get back to the surface after immersion. It determines how often your mouth is immersed

Cold Water Immersion Survival Factors
Signaling Devices

To locate and rescue more quickly

- PLBs(Personal Locator Beacon), AIS, whistles, lights, reflective tape on PFDs
- Rapid deployment of signaling from vessel (radio, phone, flares,etc)

Rescue & Management of Cold Water Immersion Victims

- Prevention of Cardiopulmonary Arrest
- Stabilization of Core Temperature
- Transportation to Definitive Care

Four Challenges of Cold Water Immersion

#4

Avoid Rescue Collapse

- Retrieval of Victim - with Caution
- Beware of Sudden Drop in Blood Pressure
- Attempt to Maintain Horizontal Positioning
- Minimize Physical Activity (Temp Afterdrop)
- Handle Gently - Cardiac Arrhythmias

Examination & Life Support

Take Vital Signs for at least 1 minute in VERY HYPOTHERMIC VICTIMS

- CPR by The ABC method - rescue breathing – 5 breaths-30 chest compressions once, then follow with 2 breaths-30 compressions – until warm or until rescuers exhausted
- Evaluate for Trauma

Insulation & Stabilization

- Prevent Further Heat Loss
- Minimize Conductive and Convective Loss
- Remove Clothing - Carefully
- Dry
- Protect with Insulation
- Active Rewarming in the Field?

Activation of Support Teams and Transportation

- Use Radio or Sat Phone
- Give position by GPS if Available
- Prepare for Transfer to another Vessel or Helicopter

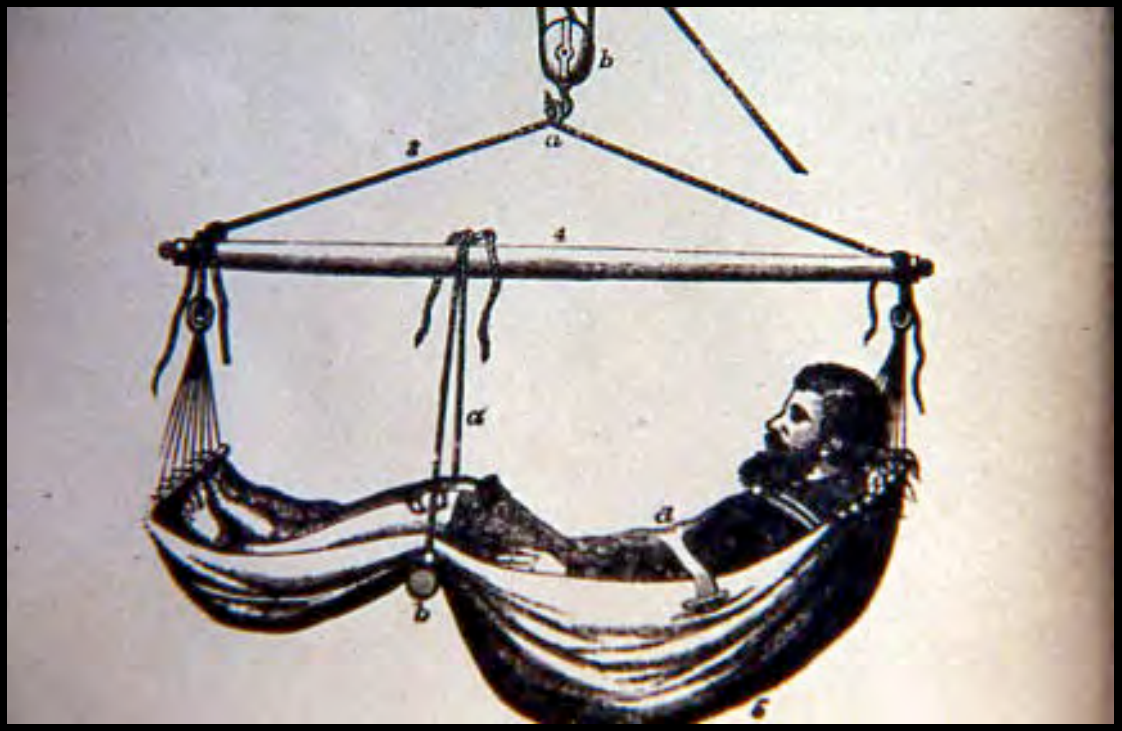
In conclusion…

- Stay out of cold water
- Act early when symptoms are present
- Dress effectively for your environment
- Wear a high buoyancy life jacket to maintain an airway
- Understand the treatment of hypothermia

Bryan Chong speaking On April 14th 2013, the One Year Anniversary of the LSC Tragedy

"On this anniversary, as we remember those we lost at the Farallones, let's also keep in mind that this is our moment to cement a culture of safety by continuing to invest in training and equipment that will save lives."

Illness & Injury-at-Sea



Kent Benedict, MD, FACEP

Pacific Cup Medical Seminar 2016

TransPac Tragedy 1967

1200 miles into the race

8 Los Angeles Times
Part III—WED., JULY 12, 1967

Stormvogel Holds Slim Yacht Lead

HONOLULU (AP) — The 73-foot ketch Stormvogel, piloted by Cornelius Bruynzeel, held a slim lead Tuesday in the annual Transpacific yacht race.

The South African craft has 975 miles to go to the finish line.

The Stormvogel is 29 miles ahead of the second place yacht, Serena. Orient is third, 1,031 miles from Honolulu.

Class B standings report Salaria in front, with 1,335 miles to go. She is followed closely by Simoon and Irish Mist.

Holiday Too is leading the Class C division with 1,380 miles to go to Diamond Head. Malbruguedor is five miles behind in second and Blue Marlin 13 miles behind for third.

Officials report a tie for first in the D division between Van Diemen and Carib II. They are 1,435 miles from the finish line. Sabha III is third, five miles behind.

Meanwhile, the U.S. Air Force has reported that a reconnaissance ship, the Longview, has picked up the skipper of the Blue Belle, Morgan M. Pattison, who is reported to have perforated ulcer. The ship is headed toward San Diego with a doctor on board who said Pattison "is doing fine." The ship said it is 900 miles west of San Diego.

Longitudes and latitudes of boats reporting:

NEW AMERICAN HOPE—The Intrepid, only new America's Cup sloop, makes a test run off Newport, R.I., in preparation for trial races against Columbia and Constellation, both previous Cup winners, and American Eagle. Fog forced postponement of fourth set of races until today, the weather permitting.

America's Cup Trials Postponed Day by Fog

NEWPORT, R.I. (UPI) —Dense fog, which cut visibility to less than 25 yards, Tuesday forced postponement of the fourth set of observation trials to choose the U.S. candidate to battle Aus-

be run today, weather permitting. Favored Intrepid will meet winless American Eagle in the first contest and Columbia and Constellation will vie in the second match.

The Second Emergency

48 hours later...

STORMVOGEL HAS SLIM YACHT LEAD

BY ALMON LOCKABEY
Times Staff Writer

HONOLULU — Stormvogel and Serena continued their nip-and-tuck battle in the Transpacific yacht race Thursday with Cornelius Bruynzeel's South African entry again moving ahead of Ken DeMeuse's 83-foot scratch boat.

Stormvogel reported a position 620 miles from Honolulu with Serena some 20 miles astern.

John D. Kilroy's sloop Kialoa II was 30 miles behind Serena under winds of 20 knots from the northeast. The heavier winds should favor the big double stickers, Stormvogel and Serena, as they are able to bend on more sail than the sloops.

Reports on the remainder of the fleet were held up until a late hour Thursday as word of another serious incident about the yacht Blue Bell was flashed through the fleet to race officials here.

Crewman Kirk Thomas of Los Angeles was reported to be in serious condi-

was being rushed to the aid of the Blue Bell for the second time.

The accident occurred less than 48 hours after the yacht's skipper, Morgan M. Pattison Jr., had been removed with a serious abdominal ailment.

Closest estimates of arrival here for the lead boats is Sunday afternoon if wind and weather conditions remain favorable.

Latitudes and longitudes of boats reporting:

Serena, 34-14, 146-38; Stormvogel, 34-11, 147-17; Nevis del Mar, 34-49, 143-31; Queen Mab, 35-27, 143-36; Kialoa II, 35-03, 146-39; Whistle Wing, 35-28, 143-50; Kamalii, 34-31, 143-13; Te Matial, 37-04, 140-52; Driver, 34-03, 143-11; Legend, 37-38, 140-38; Orient, 35-07, 143-08; Chinook, 35-27, 141-39; Argonaut, 36-31, 141-51; Pirate II, 36-46, 143-29; Bellwether, 36-42, 141-46; Celerity, 29-30, 141-13; Enchantress, 37-00, 141-47; Hollow Tree, 37-01, 143-44; Aksarna, 36-36, 141-37; Seabird III, 36-22, 141-17.

Aladruvaeder, 37-11, 142-31; Happy Warrior, 36-36, 141-15; Vencedo, 36-36, 141-36; Chiriqui, 38-38, 143-33; Spirit, 36-33, 143-01; Privateer, 36-36, 140-01; Ichiban, 35-34, 143-07; Sumatra, 35-06, 141-02; Westward, 34-43, 143-33; Malaguena II, 37-36, 143-40; Jubilation, 35-37, 142-01; Nimbus, 34-34, 141-41; Sterling III, 36-10, 143-33; Aloha, 35-31, 141-33; Cortica, 37-32, 143-13; Sea Urchin, 36-17, 139-07; Ranger, 35-32, 143-44; Blue Bell, 36-14, 138-41; Kanaka Boy II, 33-58, 142-34.

Flair, 36-32, 141-57; Argell, 34-46, 141-44; Mystic Isle, 35-43, 140-14; Rowena, 36-34; 140-00; Irish Mist, 34-30, 143-30; Simoon, 37-13, 140-17; Chrysanthe, 35-37, 140-43; Sierra, 36-30, 139-35; Intrepid, 38-43, 141-30; Whimsy II, 35-13, 140-31;

The Backstay Lever

Death of a Sailor

Death Takes Transpacific Yachtsman

Morgan M. Pattison Jr., who was removed from his yacht, the Blue Bell, because of illness last week during the Transpacific yacht race, died Monday morning at Santa Monica Hospital.

Pattison, 56, was taken from his yacht after being striken by a serious abdominal ailment.

Less than 48 hours after Pattison left the Blue Bell, Kirk Thomas, a crewman, suffered head cuts when hit by a backstay. But the boat is still in the race.

Pattison, 8101 Coletio, Westchester, leaves his wife, Lucille. Funeral services are pending.

Blue Bell Crossing the Finish Line Diamond Head

Patterns of Illness and Injury encountered in amateur ocean yacht racing

An analysis of the British Telecom Round the World Yacht Race 1996–1997

CJS Price et al. Br J Sports Med 2002;**36**:457-462

Patterns of Illness and Injury

365 amateur sailors on 14 identical vessels - 67’ Challenger

- 283 male
- 82 female
- Ages 21-60
- 14 crew aboard each boat (1 professional Captain, 13 amateurs)
- Six Legs of Race, Westerly “wrong way” route
- Six months of sea time

CJS Price et al. Br J Sports Med 2002;**36**:457-462

Patterns of Illness and Injury

- 685 cases of illness/injuries reported
- 299 injuries (44%)
- 386 illnesses (56%)
- 3 illness evacuations at sea by Royal Navy to Falklands(2), St. Helena(1)
- No deaths

Patterns of Illness and Injury

Vessels' Medical Resources

- One volunteer medic assigned to each boat, supported by qualified on-board and on-shore medical officers
- Inmarsat satellite phone/fax
- SSB radio
- On-shore support by Royal Naval Hospital, UK - fax & telemedicine

Patterns of Illness and Injury

On-board Medics' Capabilities

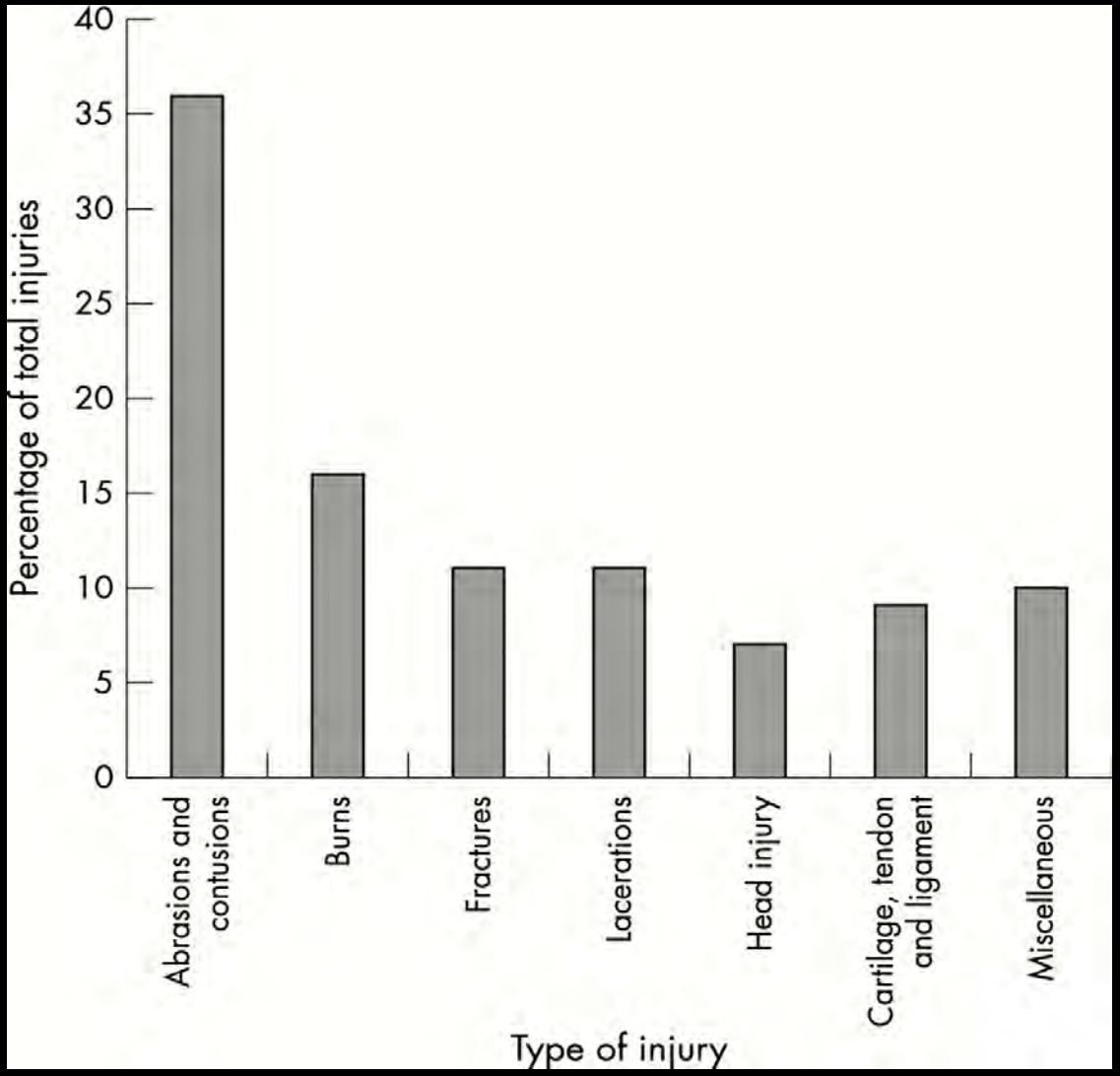
- Starting & managing peripheral IV lines
- Administer IV/IM drugs
- Administer IV fluids
- Suture

Patterns of Illness and Injury

On-board Medics' Capabilities

- Insert Chest tubes
- Splint & Cast Limbs
- Strap Joints
- Have ALS Skills

Subtypes of injuries as a proportion of total (299 injuries)



BJSM

Subtypes of injuries as a proportion of total injuries

Abrasions/Contusions(minor) (36%) - most common

Treatment: supportive dressings, NSAIDS

Subtypes of injuries as a proportion of total injuries

Burns (16%) – thermal, rope, sun
Treatment: supportive dressings, NSAIDS

Subtypes of injuries as a proportion of total injuries

Fractures (11%) - wrist, clavicle, ribs, tibial plateau

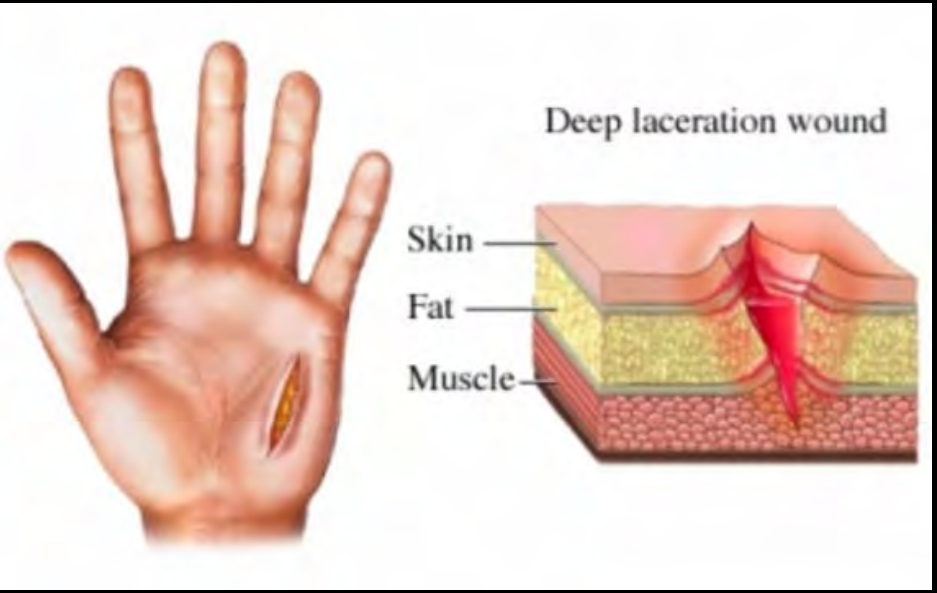
All closed, no open fractures

Treatment: reduced, splinted/casted, pain meds(tramadol, NSAIDS)

Subtypes of injuries as a proportion of total injuries

Lacerations (11%)

Treatment: most were sutured because of wet/cold conditions. But it was noted that “suturing can be difficult under rough conditions, and stapling devices will be added in the future”



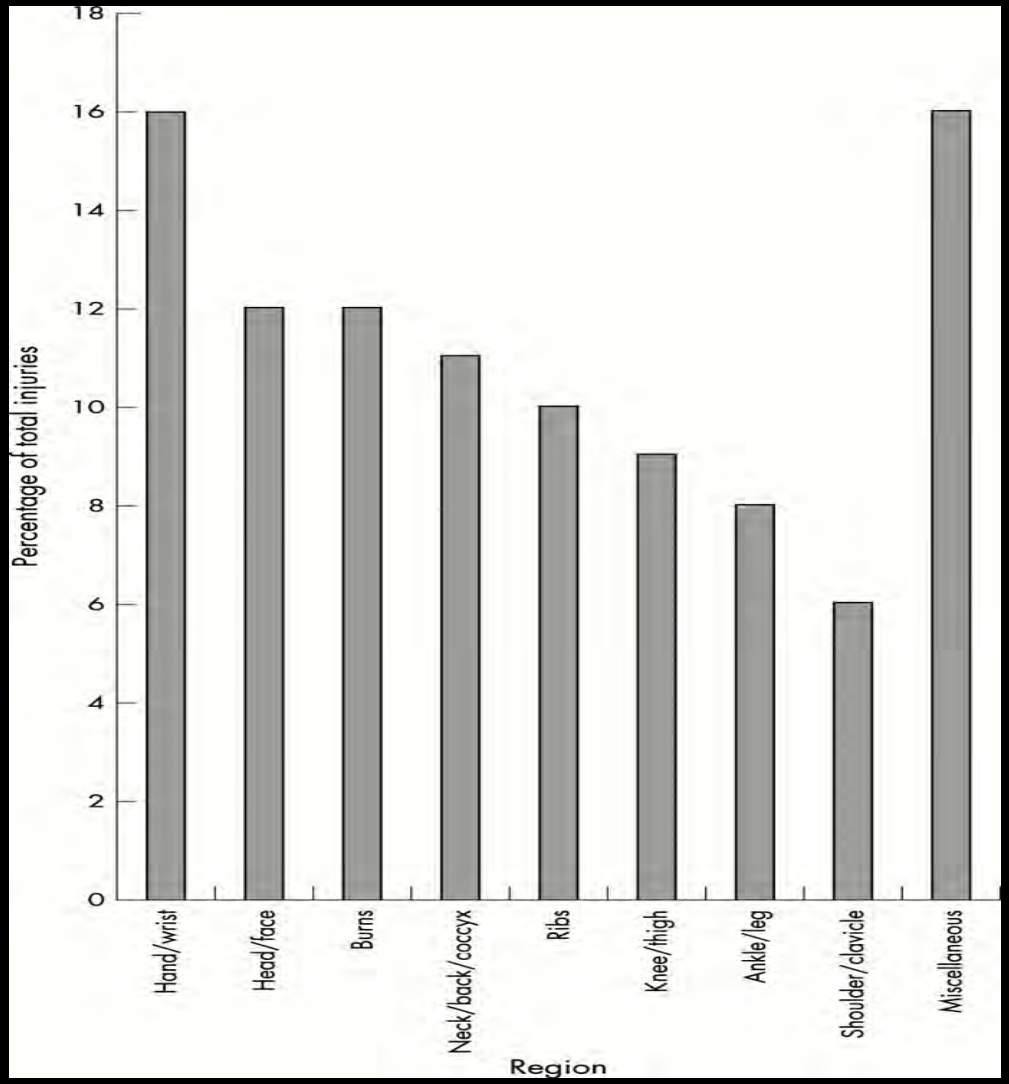
Subtypes of injuries as a proportion of total injuries

Cartilage, ligament, tendon damage(9%)
(Primarily ligament sprains)
Treatment: ligament injuries(sprains)
Immobilized(splinted) when severe

Subtypes of injuries as a proportion of total injuries

Head Injuries(7%) – no LOC documented

Breakdown of injuries according to anatomical region



Breakdown of injuries according to anatomical region (not including burns)

Hand/Wrist, (16%)

Head/Face, (12%)

Neck/Back, (12%)

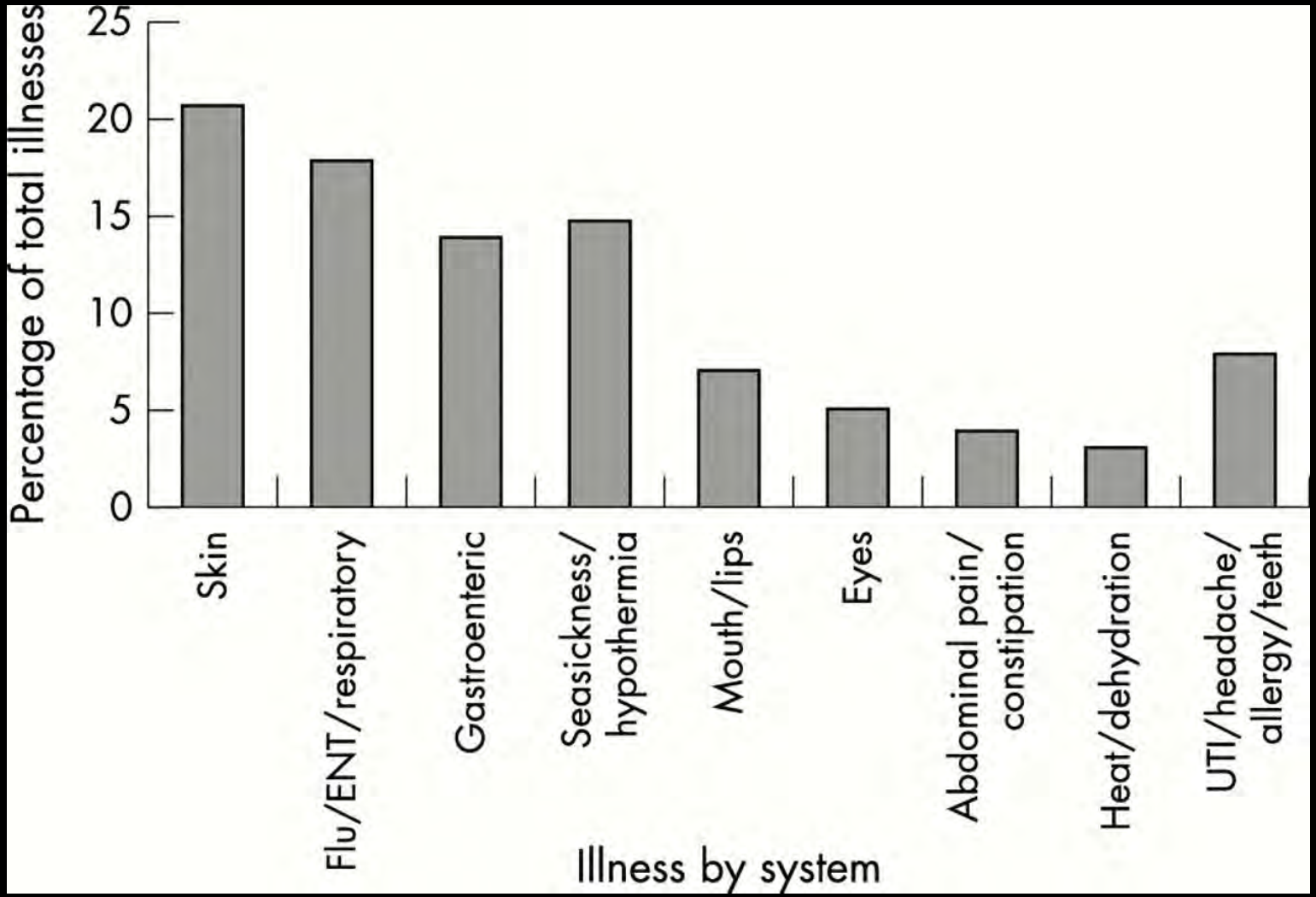
Ribs, (11%)

Knee/thigh, (9%)

Ankle/Leg, (8%)

Shoulder/Clavicle (6%)

Illness breakdown by system as proportion of total illnesses



Illness breakdown by system as proportion of total
The “top 4” in order of frequency account for 79% of all cases

#1: **Gastrointestinal/abdominal pain/urinary (23%)**

This group required 3 surgical emergency evacuations from the boats for a case of bloody urine, a case of acute GI bleeding, and a case of suspected appendicitis.

Treatment: 75% of all GI problems were gastroenteritis or gastritis – most successfully managed onboard with appropriate fluids/ranitidine/antacids. 10% of GI issues were constipation.

Illness breakdown by system as proportion of total – The “top 4” in order of frequency account for 79%

#2: Skin, not including sunburn (21%)

This group includes boils, “gunwhale bottom”, “jock itch”, eczema, etc .

Treatment: Improved hygiene(often lacking on boats), oral and topical antibiotics, topical anti-fungals, topical steroids.

Illness breakdown by system as proportion of total – The “top 4” in order of frequency account for 79%

#3: Respiratory (19%)

This group includes “flu” symptoms, congestion, cough, middle ear infections

Treatment: symptomatic, decongestants, cough suppressants, oral antibiotics

Illness breakdown by system as proportion of total. The “top 4” in order of frequency account for 79% of total cases

#4: Seasickness: (16%)

This group of 60 cases was probably under estimated where mild symptoms were unreported or where an affliction was not reported as a separate medical case(e.g. where there was also trauma or additional illness)

Treatment: ”a broad ranges of anti-emetics were used in prophylaxis and treatment, and were minimally effective”

When it happens...

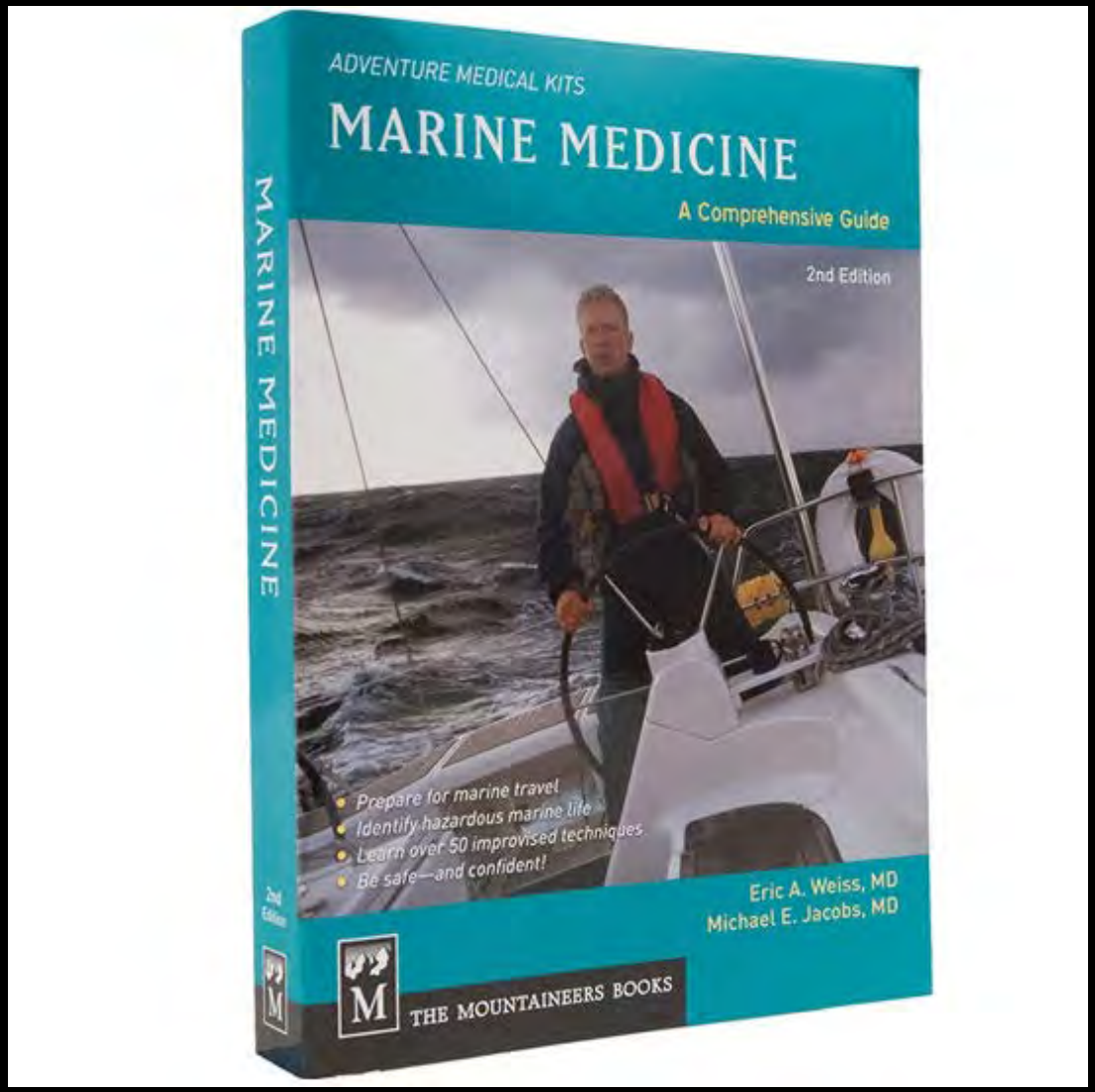
Equipment Failure

Rough Weather

Sleep Deprivation & Fatigue
Lack of Judgement

Seasickness

A Good Medical Guide



A Good Medical Kit

A Good On-board Medic

Good Communication Equipment

On-shore Telemedicine Consult

Conclusions

Trauma and Medical problems are relatively common in amateur long distance ocean yacht races. Most can be managed at sea, provided that optimal communication, training, and equipment are provided and maintained.

And Just When You Thought You Knew All That Could Happen...