Panel 3 – Cruise Ship Medical Rescue/Technology

ADAC Arctic-Related Incidents of National Significance (Arctic-Related IoNS) Workshop

Tuesday, June 21, 2016
Exposure and Survivability in the Arctic

Jonathan Power, PhD
National Research Council of Canada
St. John’s, NL
Canada
Estimated Exposure Time in the Arctic

• Eight locations across Canadian north selected based on current and expected marine traffic (Kennedy et al., 2013).

• Experts in both marine-based and air-based search and rescue (SAR) resources filled out questionnaires.
  • Were asked to rank several factors that could influence exposure time via survey.
  • Workshop was held July 2013 to receive feedback on data collected to date.

• Results show that rescue can range from 14 to 261 hours depending on many factors.
Predicted Survival Time in Arctic Conditions

• Predicted survival times (PST) for hypothermia were generated using the Cold Exposure Survival Model (CESM) across a range of clothing ensembles for 50th percentile 60-70 females (Power and Monk, 2012).

• Clothing ranged from cabin wear (jeans; flannel shirt) to anti exposure suits and sleeping bags.

• Thermal insulation (clo) measured by thermal manikins.
• PST generated in the following conditions:
  • Immersed up to neck in 0°C water.
  • In -15°C air with no wind and dry clothing.
  • In -15°C air with wind (25 km·h⁻¹) and dry clothing.
  • In -15°C air with no wind and wet clothing.
  • In -15°C air with wind and wet clothing.
• Variety of ensembles will provide sufficient protection – if dry and no wind.
  • If immersed: Majority provide < 5 hours of protection.
  • If wetted: Majority provide < 15 hours of protection.
  • If wind: Majority provide < 30 hours of protection.
  • Wet and wind: Majority provide < 10 hours of protection.
* If predicted survival time is > 36 hours, then factors other than hypothermia are likely to result in death.
Thank you

Jonathan Power, PhD
Research Associate – National Research Council of Canada
Tel: 1-709-772-8430
Jonathan.power@nrc.ca
www.nrc-cnrc.gc.ca
**Ensemble Descriptions**

<table>
<thead>
<tr>
<th>Ensemble</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabin Wear</td>
<td>Denver Hayes JMC61001 denim jeans; Cherokee 100% cotton long sleeve flannel shirt; 90% cotton socks (9% nylon + 1% Lycra Spandex); Denver Hayes 100% cotton boxer shorts; Dakota Style #MDNS308NST leather shoes.</td>
</tr>
<tr>
<td>Deck Wear</td>
<td>Cabin Wear + : Stanfield’s long underwear (long sleeve shirt [6623] and pants [6602]); Helly Hansen soft pile jacket and pants; Helly Hansen compass jacket (AJ301) and pants (U310); Wind River toque (style 47-2694HH with fleece lining), Wind River mittens (style 71-9-85905).</td>
</tr>
<tr>
<td>Expedition Wear #1</td>
<td>Deck Wear except: wool socks and Baffin Industrial ASTM 2413-05 Polar proven -40°C with five layer liner.</td>
</tr>
<tr>
<td>Expedition Wear #2</td>
<td>Expedition Wear #1 except: Helly Hansen compass jacket and pants replaced by Mustang Survival MS195 HX Integrity Suit (XL).</td>
</tr>
<tr>
<td>Abandonment Wear 1a</td>
<td>Deck Wear + : Helly Hansen P2000 Passenger Suit/Thermal Protective Aid; SOLAS life vest (Lalizas 70169 BV) (gloves replaced by fleece mittens because TPA has gloves); wool socks.</td>
</tr>
<tr>
<td>Abandonment Wear 1b</td>
<td>Deck Wear + : Mustang Survival Coverall (once only suit) Anti-exposure model MSD685; SOLAS life vest (Lalizas 70169 BV) (gloves replaced by fleece mittens because TPA has gloves); wool socks.</td>
</tr>
<tr>
<td>Abandonment Wear 2</td>
<td>Deck Wear with wool socks minus footwear plus Mustang SOLAS immersion suit, SOLAS life vest (Lalizas 70169 BV) (gloves replaced by fleece mittens because immersion suit has gloves); wool socks.</td>
</tr>
<tr>
<td>MAJAID #1</td>
<td>Cabin Wear without Dakota Shoes; parka; pants; mittens; toque; bots.</td>
</tr>
<tr>
<td>MAJAID #2a</td>
<td>MAJAID #1 ensemble inside Down filled casualty bag.</td>
</tr>
<tr>
<td>MAJAID #2b</td>
<td>MAJAID #1 ensemble inside Synthetic filled causality bag.</td>
</tr>
</tbody>
</table>

Marine Evacuation Systems
Performance in Wind and Waves

Jonathan Power, PhD
National Research Council of Canada
St. John’s, NL
Canada
Deployment of Evacuation Systems

• 1:7 scale models of evacuation slide and chutes.
• Evacuation systems deployed on both sides of vessel – leeward and windward.
• Tested in Beaufort 3 – 7 full scale equiv.
  • Wind: 12 – 61 km·h⁻¹.
  • Waves: 0.5 – 5 m.
Model Scale Video
• Model slide: Deployment on windward side resulted in catastrophic damage in a lower weather condition.

• Model chute: Deployment on windward side resulted in greater decreases in performance compared to leeward.

• Recommendations: Deploy evacuation systems on leeward side to reduce performance decrease.

• Knowledge gap: Effective deployment in weather conditions to ensure good performance.

• IMO LSA Code (2010): “..capable of providing a satisfactory means of evacuation in a sea state associated with a wind of force 6 on Beaufort scale”.

Use of Evacuation Systems

- Full scale tests of evacuation slide and chute performed with young, healthy participants (Height = ~179 cm; Weight = ~85.3 kg).
- Tested in calm water, sea state 1, sea state 2 regular and irregular waves (max significant wave height = 0.69 m).
Full Scale Video
• Total time to use system, cross collection platform and enter liferaft was recorded.

• Times:
  • Slide: 12.6 s in calm; 12.7 s in 0.69 m waves (learning effect).
  • Chute: 9.9 s in calm; 12.4 in 0.69 m waves.
  • For 1600 evacuees – need 12 slides/chutes simultaneously to evac in under 30 minutes (IMO, 2010) at ~12.7 s.
Panel 3 – Cruise Ship Medical Rescue/Technology

Robert Brown
Offshore Safety & Survival Centre
St. John’s, NL
Research must address *all three stages* – pointless to evacuate if you cannot survive until rescued!
Evacuation Research

• Assemble (Muster) / Board LSAs:
  • Passenger walking speeds in different conditions (heel, light, smoke) in SHEBA
  • Behaviour during assembly process (e.g. response to evacuation cues, walking speeds, knowledge of vessel) -> cruise passengers take longer to respond and longer to assemble than ferry passengers
  • People wearing immersion suits require more space in LSAs -> what are space requirements, considering PPE, for cruise vessels in the Arctic?
Evacuation Research Gaps

- Does Arctic survival PPE affect passenger ability to assemble efficiently? Board LSAs? Fit inside LSAs?
- Is there adequate space for 1,000+ people to don Arctic survival PPE onboard? How long does it take?
- Is the assembly/boarding time significantly hindered by need to use Arctic survival PPE?
- What is the impact of Arctic conditions on walking speeds (e.g. ice on outer decks)
- What about the non-ambulatory / stretcher cases?
- Can we define the response behaviour of passengers / crew at night?
- Can LSAs be safely launched onto the ice or in ice-covered waters? Manoeuvred?
- Are crew and passengers adequately trained? Particularly for Arctic environments?
Survival Research

• Thermal Protection in liferafts & lifeboats:
  • Liferafts are unlikely to provide adequate protection for expected survival times
  • LSAs must be regularly ventilated but not too frequently
  • Liferaft floor insulation and PPE crucially important
  • Lifeboats offer the best thermal protection for expected Arctic survival times
  • Ongoing research seeks to identify efficacy of shelters on ice for longer term survival -> medical teams and remote assistance important
Survival Research

- Liferaft thermal protection criteria for 36 hour survival at different ambient conditions:
Survival Research

- Lifeboat thermal protection criteria for 36 hour survival at different ambient conditions:

  - Add Engine Heat
  - Add Thermal Protective Aid
Survival Research Gaps

• Can evacuees be expected to remain in LSAs until assistance arrives? If not, what is the best combination of PPE and shelter to ensure survival?

• Are the new Polar Code regulations adequate? Recent exercise in Svalbard suggests no (reports to be released)

• Can adequate medical be provided to people at-risk until assistance arrives? Can it be supplemented by remote medical care?
Rescue Research

- Very little published research in this area, particularly as it pertains to Arctic scenarios
- Cannot rely solely on helicopters to perform rescue in Arctic
- Some research by MI using fast rescue craft in wide range of sea conditions while monitoring crew and recovery practices -> typical FRCs provide rescue options but are generally not ice capable
- SARINOR project offers interesting and ambitious solutions to SAR in the Arctic but is still in relatively early stages
Rescue Research Gaps

• Can autonomous rescue recovery craft (ARRC) be used in Arctic, at strategic locations? What are the requirements for an ice-capable vessel of this type?

• What is the most efficient and realistic means for recovering large numbers of evacuees to a place of safety?

• When assistance has reached the incident site, how much time is required to complete the rescue, assuming assistance is provided by ship / helicopter / ground-based resources?

• Training issues in Arctic survival – evacuees / rescuers?
Survival – LSA and CO2 Buildup

• From experiments in a 72 person lifeboat:
RURAL TRAUMA CHALLENGES IN ALASKA

Christie Artuso, Ed.D., RN, FACHE
Regional Director, Professional Practice, Education, Research
Providence Regional Medical Center Everett – Washington
Adjunct Faculty – University of Alaska School of Nursing
SIGNIFICANCE

- Leading cause of death and disability
- Significant healthcare costs
- Unique challenges in Alaska
  - 586,412 miles
  - Geographic barriers - distance
  - Rapid change in weather conditions
  - Extreme sports
  - Settings that promise unprecedented platform for emergency rescue, transport and resuscitation
- Limited acute care resources
PATIENT OUTCOMES

- Directly related to time between injury and properly delivered definitive care
- Improved mortality and morbidity related to rapid field assessment and triage
- Coordinated model for triage and assessment is essential
  - Communication
- Appropriate planning for rescue; transport; receiving institutions; communication
- Safety for medical crew [survival packs, cold-weather gear, MREs, emergency medical equipment]
RANGE OF INJURY

- Trauma
  - Minor musculoskeletal trauma
  - Major trauma – associated with motor vehicles

- Hypothermia and Asphyxiation
  - Asphyxiation primarily related with avalanche
  - Cold water hypothermia
  - Air temperature related hypothermia

- Pre-existing conditions
  - Age-related, diabetes, heart disease, cerebrovascular (stroke) disease, hypertension, osteoarthritis, mobility

- Alcohol-related
  - Alcohol acts as a vasodilator counteracting the body’s vasoconstrictive action to cold
  - Hinders shivering
HYPOTHERMIA

- Elderly more vulnerable [supported by current literature]
  - Response to cold less efficient
  - Sensation to cold blunted
  - Medication use for co-morbidities [underlying medical issues]
    - Increases risk for hypothermia
  - Overall smaller body mass index (BMI) than middle-aged adults
    - Loss of radiant heat more quickly
    - Less subcutaneous fat providing insulation
      - May be related to nutrition
- Elevated risk for mortality
  - Age related mental decline
HYPOTHERMIA

- Acute coronary syndromes and stroke
- Cardiac decompensation (in patients with pre-existing cardiac conditions)
- Diabetes
  - Decreased cold sensation (neuropathy)
- Physical exertion (usually seen in hikers or outdoor workers)
  - Core temperature increases with heavy exertion
  - Increased heat loss potential due to vasodilation;
  - At rest– core temperature stops increasing; response to cold is not immediate
  - Rapid hypothermia
SAFETY AT THE SCENE

- Potential risk for rescuers / transport
- Delay in response – distance
- Affiliated with military rescue
- Triage priorities
  - Communication barriers – telemedicine / technology assisted
- Consider transport
  - Snow machine
  - Air
  - Short distance helicopter to larger air strip
  - Challenges with distance, numbers transported
PRIMARY ASSESSMENT

- Triage priorities
- Baseline mental status and level of consciousness
- Hypothermia
- Source of injury
- Tissue perfusion and oxygenation
- Alcohol effects
**EARLY INTERVENTIONS**

- Removal of wet clothing [poor insulator]
- Assess injuries
- Minimizing additional heat loss
- Protection from further injury / exposure
- Transport / ongoing assessment
- Rewarming when possible
- Fluid resuscitation (consider temperatures)
SUMMARY - ARCTIC TRAUMA

- Distance
  - Available acute care facilities
- Demographics / geography
- Variable weather conditions
- Transport
  - Communication – exploring telemedicine / technology assisted communication
- Safety
- Patient specific
  - Hypothermia
  - Pre-existing / underlying medical conditions
  - Alcohol
  - Age related