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CONCEPTS

Emergency Medical Training for the Commercial Fishing Industry: An Expanded Role for Wilderness Medicine

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This article describes the conception, implementation, and evaluation of a wilderness medicine–based first aid class for the commercial fishing industry. Commercial fishing is a dangerous occupation in the United States. Currently, commercial fishermen often only have access to basic first aid classes. Because of its focus on austere environments, hazardous conditions, and distance from definitive medical care—hallmarks of commercial fisheries—wilderness medicine offers a more appropriate approach to decreasing morbidity and mortality in the industry. A 2-d, 16-h pilot wilderness medicine course for commercial fishermen, Fishermen First Aid and Safety Training (FFAST), conducted for Dungeness crab fishermen, was effective and well received, based on pre- and postcourse knowledge, skill, and attitude surveys. FFAST has been approved by the Coast Guard and is being made more widely available to commercial fishermen in the Pacific Northwest. The FFAST program offers an example of how wilderness medicine can improve safety and emergency medical response for a wide variety of austere environments not traditionally linked to the backcountry.

Keywords: occupational health, injury prevention, marine medicine

Introduction

COMMERCIAL FISHING—A DANGEROUS AND CHALLENGING OCCUPATION

In the United States, commercial fishing is one of the most dangerous occupations, based on fatality rates. There are approximately 115,000 fishermen (harvesters) in the United States fishing for different species and using different types of fishing gear and vessels.[1] A report from the US Bureau of Labor Statistics describes the challenging working conditions of commercial fishing as strenuous, with long hours and seasonal employment. Commercial fishermen can be at sea for extended periods of time and, depending on the harvest, may have to work on deck with little or no sleep or opportunity to rest. Fishermen are exposed to the elements, depending on the season, and work on vessels that are in constant motion owing to wind and sea conditions. Their work platform is in constant motion and requires balance and skill to complete work safely.[2]

The National Institute for Occupational Safety and Health (NIOSH) collects data on US commercial fishing fatalities and vessel disasters. The fatality rate of commercial fishermen is many times higher than that among all US workers. From 2000 to 2014, the most recently published data, the average annual fatality rate for commercial fishermen ranged from 21 to 147 deaths per 100,000 full-time equivalent workers.[3] Although it is clear that continued attention is needed to reduce the risk of fatal injuries in commercial fishing, nonfatal injuries, which can be life threatening and result in permanent disability, have remained largely unaddressed. This is an opportunity for austere medicine practice.

From previous commercial fishing safety research on the US west coast, data on fatal injuries among Dungeness crab fishermen were obtained from the existing NIOSH surveillance system, and data on nonfatal injuries were manually abstracted from US Coast Guard (USCG) investigative reports. This study found that 28 fatal and 45 nonfatal injuries were reported between 2002 and 2014 in the Dungeness crab fleet. Most fatalities were due to vessel disasters, and many nonfatal

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injuries occurred on deck when fishermen were working with gear, particularly when hauling the gear (47%). The most frequently reported nonfatal injuries affected the upper extremities (48%), and fractures were the most commonly reported injury type (40%). Severity of injuries sustained while hauling gear was predominantly classified as moderate (n=10, 56%) or serious (n=5, 28%) using the abbreviated injury scale.[4]

In unpublished research by the same study team, data from USCG reports for all commercial fishing fleets during 2002 to 2014 in Washington, Oregon, and California identified 208 nonfatal injury cases. Commercial fishermen are required by the USCG under 46 CFR §4.05-1 to report commercial fishing loss of life or injuries that require medical treatment beyond first aid.[5] The most frequent injury characteristics were as follows: by nature—fracture (26%) and laceration/puncture (16%); by body part—upper extremities (40%) and head/neck (18%); and by event/exposure—contact with objects and equipment (57%) and falls/slips/trips (16%). The most frequently injured workers were deckhands (51%) and processors (on larger vessels) (24%).[6] This is not a comprehensive picture of all injuries because underreporting of work-related injuries is recognized as a problem across all industries[7] and likely occurs in the commercial fishing industry. Given that these injuries may occur far from definitive care, first aid training specific to these injuries and settings may have a substantial effect on long-term morbidity and disability.

LIMITED EMERGENCY MEDICAL TRAINING AND RESOURCES

Adding to the challenges of these austere and hazardous conditions, to date, emergency medical training specifically for commercial fishermen is limited. Despite the high number of fatal injuries, the USCG requires under 46 CFR § 28.210 only that 1 or more crew members (depending on total crew size) be first aid and cardiopulmonary resuscitation (CPR) trained.[8] The training requirements are basic, covering both CPR and generic first aid in 8 h. This rudimentary level of training clearly becomes a liability when vessels can be many miles offshore, in poor weather and rough sea conditions, and with long working hours and physically demanding tasks. Commercial fishermen in Oregon raised the issue to the authors that first aid courses offered locally are too generalized and not relevant for being out at sea for an extended period of time; the Fishermen First Aid and Safety Training (FFAST) program described here was a direct response to that expressed need for more robust first aid courses tailored to commercial fishing settings.

ROLE OF WILDERNESS MEDICINE IN IMPROVING SAFETY AND EMERGENCY MEDICAL RESPONSE FOR COMMERCIAL FISHING INDUSTRY

The waters, conditions, and overall environment in which commercial fishers work clearly fall within the scope of wilderness medicine. However, despite the sobering statistics and obvious overlap, to date the practice of wilderness medicine has not included expertise on commercial fishing safety or offshore emergency medical response. Training and curricula exist for a number of specific environments (eg, sailing, mountaineering, and desert environments) and for disasters. Training for specific occupational groups is available (eg, through private companies, such as for the energy and mining industry), but until recently nothing has been offered for the commercial fishing industry.

Background

COMMERCIAL FISHERMEN FIRST AID AND SAFETY TRAINING DEVELOPMENT

To address the hazardous conditions and the need for more robust training, a new course, FFAST, was developed. This was supported by the Fishermen Led Injury Prevention Program (FLIPP), a translational research project being conducted by Oregon State University College of Public Health and Human Sciences and the Oregon Sea Grant. The goal of FLIPP is to understand factors related to nonfatal injuries in Dungeness crab fishery and to test ideas to reduce or prevent these injuries. FLIPP researchers partnered with the University of Colorado's Department of Emergency Medicine to develop the FFAST course.

In 2015, FLIPP held focus groups along the US west coast with crab fishermen to help design a survey to collect self-reported injury and safety perception information. In Washington, Oregon, and northern California, 426 fishermen filled in the survey in the fall (September−November) 2015 season. FLIPP survey results showed respondents thought awareness and drills/preparation were among the most common strategies for staying safe while commercial fishing.[9] The idea for commercial fisherman−specific first aid training came from fishermen who indicated that the community first aid classes offered were not relevant for at-sea emergencies.

DESIGNING THE FFAST CURRICULUM

Starting from a wilderness/austere environment perspective, rather than traditional first aid training based on "street medicine," and a setting in which emergency

medical responders are not immediately available, we developed a commercial fishing industry–specific first aid/CPR training, FFAST. FFAST was adapted from the lead author's experience in wilderness medicine training. The topics included in FFAST were from a standard wilderness first aid curriculum with adaptations to the setting and working conditions and was informed by the injury epidemiological data available.

The curriculum was designed around the extremes of a vessel-based marine environment and on injury data gathered from USCG reports and the FLIPP survey. The goal was to customize the training and better prepare fishermen to prevent and treat injuries likely to be encountered. To encourage participation, the curriculum was also designed to meet the minimum USCG requirements for on-board first aid training. The training was contextualized to the relatively small crews, common injuries, fishing boats, cold water, rough seas, and delayed emergency response times typical to North Pacific fisheries. Because of the experiential and skill-based nature of the class, the curriculum was designed for groups of 20 or fewer participants.

FFAST CURRICULUM

The FFAST curriculum consists of 16 h of training over 2 d, including basic CPR. It includes lecture, hands-on skill development, and scenarios in which knowledge and skills are put together to respond to a simulated accident or illness. The curriculum focuses on preparing participants to respond to common fishery injuries and illnesses ranging from mild, such as sea sickness or chapped hands, to life-threatening, including fall or crush injuries. Table 1 provides the main subject areas

Table 1. Fishermen First Aid and Safety Training (FFAST) content examples

Subject area	*Example commercial fishing–specific topic*
Response and assessment	The scene safety assessment must consider the waves, vessel (stability and flooding), gear, machinery (cranes/winches), and catch in addition to more typical austere hazards.
Orthopedic injuries (cumulative and traumatic)	Commercial fishing can involve prolonged exposure to forceful and repetitive motions while standing on slick decks. Discussion of preventative measures of microbreaks/rest and proper footwear/antislip mats is included.
Soft-tissue injuries	The use of bleach to clean gear and buoys is common and can result in chemical burns. Discussion of preventative measures such as substitution with less hazardous cleaners, use of appropriate personal protective gear, and best practices for minimizing exposure both preseason and on vessels is included.
Epidemiology and hazard assessment	Sharing results of injury epidemiological studies specific to commercial fishing fleets can help fishermen consider what needs to be prevented. A hazard assessment tool is taught to help fishermen break a work task down to consider how they could reduce the risk of injury. Fishermen are great problem solvers.
Head and spinal injuries	Head and spinal injuries need to be properly assessed within the at-sea context. This determines immobilization and the need for evacuation. Evacuation at sea involves calling the Coast Guard.
Environmental hazards	Understanding the prevention, signs, symptoms, and treatment of hypothermia and other cold injuries is important in the marine environment. Likewise, heat stress/strain from heavy physical labor is also a concern.
Abdominal injuries and illnesses	Abdominal illnesses such as diarrhea, cramping, and seasickness can all be common ailments at sea.
Patient packaging and carrying	Moving patients on board a commercial fishing vessel can be challenging. The spaces are tight and ladders are steep.
Drowning	Vessel disasters and falls overboard are a major concern for commercial fishermen. Prevention strategies and personal floatation devices specific to working on vessels must be discussed, along with treatment onboard vessels.
First aid kits	Having an appropriately stocked first aid kit can make treating injuries at sea more effective.
Respiratory and cardiac issues	Respiratory and cardiac issues are life-threatening conditions that are more common as the workforce ages. Practicing and considering the vessel environment for delivering CPR is important.

CPR, cardiopulmonary resuscitation.

and an example for each of the commercial fishing–specific topics covered.

In addition to providing details of the skills needed for an event, FFAST also includes information about what can be done before an incident happens. This includes injury and prevention strategies informed by discussing the injury statistics for commercial fishermen and considering the factors related to those injuries. This conversation identified common tasks and associated hazards and led fishermen to consider what controls or prevention strategies could be implemented. The scenarios and hands-on activities also were based on actual injury reports, allowing the instructor to discuss how the injury could have been prevented. An example scenario for reinforcing hypothermia treatment is shown in Figure 1.

To pass the course and receive certification, students must demonstrate basic skill and scenario proficiency and pass a final examination with a minimum score of 70%. FFAST complements another USCG-required training commonly known as the drill conductor course, in which fishermen learn how to conduct safety drills on a regular basis to prepare the crew for emergencies.

FFAST PILOT METHODS

The FLIPP project offered pilot FFAST classes in 2016 in 2 locations: Newport, Oregon, and Astoria, Oregon. These ports are the largest commercial fishing ports in Oregon and have active Dungeness crab fishing and resident Sea Grant staff. In 2017, FFAST training was again held in Newport, Oregon. Classes were held just before Dungeness crab openings, when fishermen were preparing for the season but still available. Volunteer participants were recruited through the connections that Oregon Sea Grant had with the commercial fishing communities in these locations via fliers posted at fishing docks, social media, and targeted phone calls. The pilot classes were offered at no cost to the participants.

Participants were asked multiple-choice questions on first aid knowledge and skills before (10 questions) and after the training (including the 10 pretraining questions, embedded in a more comprehensive 34-item assessment). The questions were taken from wilderness first aid trainings led by the lead author and had been used in previous courses. Participants were also asked to rate the training. Ratings were based on a scale of 1 to 5 (1=best, 5=worst) for the following questions: "How do you rate the information in today's training?"; "Would you recommend this training to other fishermen?"; and "How useful for your work will the information you learned today be?" Additional feedback was collected using open-ended questions regarding the training: "What did you like best?"; "What could be removed?"; and "What would you add?" Descriptive statistics were calculated, and data are presented as mean±SD with the range, as appropriate. All study procedures were approved by Oregon State University's institutional review board, and all participants gave informed consent.

FFAST pilot results

FFAST PILOT PARTICIPANTS

The 3 FFAST training sessions had 48 participants in total: 2 women and 46 men. The age (mean±SD with range)

Cold Crewman

A crewman gets caught up in a pot being set and gets pulled over the side of the vessel. He frees himself from the line and pot, and bobs to the surface. You quickly get him back on board but he was still in the water for a good 15 minutes.

Scene Assessment: No scene issues once he's back on board the vessel.

Primary Assessment: Crewman's airway, breathing, and circulation are okay.

Secondary Assessment: Crewman is soaking wet and largely nonresponsive. You find no cuts or bruises. He was violently shivering when first pulled from the water but has now stopped shivering.

SAMPLE: You do not get a useful response from him. His best buddy says he is allergic to latex and that he is on amoxicillin for some kind of infection.

Vitals: Heartrate = 54 beats·min^{-1}
Respiratory rate = 12 breaths·min^{-1} (very hard to determine)
Responsiveness scale = "verbal"

Figure 1. Cold crewman example scenario for hypothermia.

of participants was 39.0±13.4 (21−68) y. Thirteen participants were captains, 19 were deckhands, and 16 did not indicate a crew position. Two-thirds of participants had previously taken first aid training. Participants had been fishing for 16.0±11.9 (1−40) y and fishing for Dungeness crab for 10.6±9.7 (0−40) y. Participants were predominantly white and non-Hispanic.

FFAST PILOT TRAINING RESULTS

Results of the pilot programs demonstrated substantial participant learning. On the 10-question pretest, the mean score was 55±23% (20−100%); on the final post-class test (34 questions) the mean score was 86±9% (64−100%), indicating the fishermen learned key concepts. Results for the 10 embedded items were nearly identical to the 34-item findings.

The training was very well received by participants. The following ratings are based on a scale of 1 to 5 (1=best, 5=worst). When asked to rate the information, the mean rating was 1.5±0.8 (1−5). When asked if they would recommend the training, the mean rating was 1.5±0.6 (1−3). When asked how useful the information was for their work, the mean rating was 1.3±0.5 (1−2). When fishermen were asked what they liked most about the FFAST training, a common answer was that they appreciated the hands-on element of training. When participants were asked what they would change about the FFAST training, a common answer was that they would like to have the training on a vessel so that scenarios are more realistic. Table 2 shows the open-ended questions and unique responses (if the same comment was repeated, it is only listed once in the table).

Next steps

The FFAST curriculum is finalized and has gone through the formal approval process with the USCG. It is now registered as course OREG197 and meets all USCG requirements for first aid and CPR training. Our team

Table 2. Participant responses to FFAST training reaction questions

FFAST training reaction	*Participant responses*
What did you like best?	• Touches on all types of injuries that might be seen while fishing
	• 2-d format
	• Peace of mind that I won't be helpless if someone is injured
	• Learning about acronyms and what they represent
	• Scenarios with hands-on training prepares for real thing
	• Conducted so people can share and learn from others' experience
	• Informal style, good for creating a comfortable learning environment for a bunch of dirty crabbers
	• How knowledgeable the teacher was
	• Evaluating situations
	• Gives a plan—A, B, C, D, E
	• Certain things were repeated various times
	• I learned more than [land-based first aid] training
	• How to move someone who is hurt
	• Learning new and creative ways to treat injuries
What could be removed?	• Too much lecturing
	• We could have gotten a lot from a video
	• Long video on CPR *(note: this is required for certification)*
	• Time is long *(note: this is required for certification)*
What would you add?	• On-vessel scenarios
	• Talk from Coast Guard representative about how we could help them
	• More education on shock, stroke, heart failure, seizures
	• More stories of injuries on the water and how fishermen adapted
	• Combine more with marine safety
	• Take-home/to-the-boat laminated index cards with response checklists, reminders of evaluation procedures in different situations, CPR instructions
	• Add boat-specific situations regarding engine rooms, fish holds, and first aid in life rafts
	• Simulate calls to Coast Guard to gain a better understanding of the scenarios we worked through
	• Maybe train people to stitch and cut (suturing)
	• Maybe what to do if someone falls overboard

FFAST, Fishermen First Aid and Safety Training; CPR, cardiopulmonary resuscitation.

has received funding to train local first aid instructors and/or motivated commercial fishermen to become familiar with austere medicine. Through a FFAST instructor course, they will become certified wilderness first aid instructors and can use the FFAST materials to lead courses. In this way, the training can be offered to more of the thousands who commercially fish the Pacific Northwest and eventually to commercial fisherman on all coasts. By offering "train the trainer" programs, the cost of the classes will become affordable, and classes will be available in more locations. As more FFAST courses are offered, the team will expand its evaluation beyond knowledge and skill assessment, important though they are. With time and more participants, we will be able to assess downstream process (eg, changes in first aid readiness, responses to emergencies at sea) and outcome (eg, treatments provided, injury status) variables.

Discussion

Specific and relevant first aid and safety training for the commercial fishery industry could go a long way toward reducing the number and severity of injuries and toward saving lives in one of the most dangerous occupations in the country. With FFAST addressing first aid and CPR requirements, it complements the other marine and survival training programs and courses to which commercial fishermen already have access. The FFAST program demonstrates the utility of austere emergency medicine training for specific environments and activities not previously addressed nor commonly thought of as being part of the wilderness medicine field. It is a reminder that the knowledge, skills, and experiences of wilderness medicine go beyond the traditional backcountry venues many people consider, including even experienced wilderness practitioners.

The FFAST curriculum includes CPR to meet USCG requirements. Prolonged transport times are common and decrease the utility of CPR for commercial fishermen working at sea. Despite this, a number of situations such as close access to a medical facility while at the docks or drowning incidents support the inclusion of CPR in the curriculum. The decision to initiate and continue CPR in the remote setting is a complex topic beyond the scope of this article.

The initial success of FFAST suggests other occupations could benefit from the field of wilderness medicine: logging, rural farming, or wildland firefighting. Wilderness medicine can and should play a bigger role in ensuring workers are less likely to sustain debilitating injuries, even in high-risk occupations.

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