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Barriers and Facilitators to Adoption of Winch Safety Equipment in Two U.S. Commercial Fisheries

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ABSTRACT

Purpose: This study explored commercial fishermen's perspectives and decision-making process related to investment in winch safety equipment for fishing vessels.

Methods: The study employed semi-structured interviews during 2019–2021 with commercial fishing captains, owners, equipment manufacturers, and suppliers ($n = 19$) from two different commercial fisheries: the Pacific Northwest purse seine fleet, and the Southern shrimp fleet. Interview recordings were transcribed and qualitatively analyzed to identify themes related to adoption of winch safety gear.

Results: Overall, perception of risk from deck winches was high in both populations. Fishermen generally regarded safety engineering interventions for winches positively, in principle. However, cost, installation complexity, and competing safety priorities are often barriers to adopting such equipment. In discussing safety-related investments, fishermen commonly prioritized maintenance of the vessel and management of the crew over mechanical safety equipment for the deck winch, despite its potential for causing injury. We identified several potential facilitators of adoption of winch safety equipment, particularly for the Southern shrimp fleet.

Conclusions: Fishermen tend to view deck winch safety as part of a larger, complex set of safety considerations encompassing the vessel and crew as a whole. This risk balancing sometimes does not favor investment in safety gear specifically for the deck winch, even if it is perceived as a primary hazard. Fundamental economic conditions in these two fisheries continue to pose a challenge to widespread adoption of winch safety equipment. Reducing cost barriers would potentially be the most effective way to increase adoption, but additional work is needed to improve risk communication, increase awareness of available winch safety equipment, and address installation complexity barriers.

KEYWORDS

Fishing; occupational safety and health; traumatic injury; winch safety

Introduction

> That's four guys I know, that have been caught [in the deck winch] and survived. And then the one guy was killed. So that's the thing. Everybody knows those stories, they are all popular guys. Everybody, I tell you – this is a product that almost everybody talks about being good. But adopting it is … I don't know. Maybe the next generation of people will be more in tune to it. [Fisherman 7, Washington]

Commercial fishing vessels use winches – powerful machines with one or more drums on which to coil a rope, cable, or chain for hauling or hoisting – for a variety of work tasks. Occupational injuries caused by commercial fishing winches have been recognized in the United States and internationally for decades.[1–5] Evidence suggests winch entanglements and struck-by incidents are infrequent compared to other fishing hazards (e.g., vessel disasters, falls overboard, other on-deck injuries).[6–11] However, winches can still cause extremely serious injuries or death.[5,12–14] For example, a 2013 study found 35 winch entanglements among Gulf Coast shrimp fishermen over a 12-year period, including eight fatal incidents.[13] A more recent study from Alaska found 125 winch injuries over a 20-year period, which included amputations, avulsions, fractures, spinal injuries, and head trauma.[14]

The National Institute for Occupational Safety and Health (NIOSH) has undertaken efforts to improve winch safety on commercial fishing vessels, starting in the mid-2000s.[15] NIOSH engineers developed several interventions, including emergency stop systems and stationary guarding for fishing winches.[16,17] NIOSH engineering interventions have been developed for purse seine vessels in the Pacific Northwest and Alaska and for side-

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trawl shrimp vessels operating in the eight coastal states spanning Texas to North Carolina.[16,17]

Capstan winches, the main winches used for hauling nets on purse seine vessels, feature exposed winch heads, or capstans, allowing lines to be attached or removed by hand as they turn (Figure 1). Winch operating controls are commonly mounted outside the immediate reach of a fisherman who may become entangled while hauling in a line. NIOSH developed an emergency stop system, or "e-stop" for these winches to address this issue.[16] The e-stop incorporates a button mounted on the winch that, when pressed, cuts the flow of hydraulic fluid and stops it instantly. The system was commercially licensed and has been available for new winches or for retrofitting to older winches since 2007.[18] However, anecdotal evidence suggests adoption of the e-stop has been low. A 2017 dockside survey of hundreds of fishing vessels in Kodiak, Alaska found approximately 2% of purse seine vessels had installed an e-stop (NIOSH, unpublished data). Informal outreach to equipment vendors, fishermen, and other industry stakeholders has corroborated the low adoption.

Side-trawl shrimp vessels in the Southeastern U.S. employ mechanically driven drum style deck winches (Figure 2). They also use a smaller electric "try-net" winch for sampling catch (Figure 3). Both setups have risks for entanglement, either in the drums or the exposed capstans.[13,19] Some of these winches have guards, but guard quality varies widely. Some winches have no guarding (Figure 4), since regulations do not require winch guards on uninspected fishing vessels in the United States.[20] NIOSH engineers designed static machine guards for the most common drum winch models used in the Southern shrimp fleet.[17] NIOSH also developed an "auxiliary stop" system for try-net winches, featuring an electrical shutoff switch mounted at knee level (Figure 3).[17,21] NIOSH recently published guard fabrication and installation guides for one of the common drum winch models.[22,23] Prototypes for

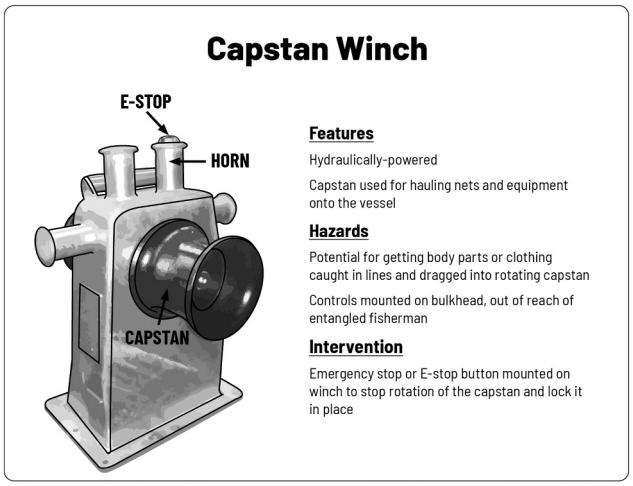

Figure 1. Purse seine deck winch design (capstan winch), typical of purse seine fishing operations in the Pacific Northwest and Alaska. (E-stop: emergency stop).

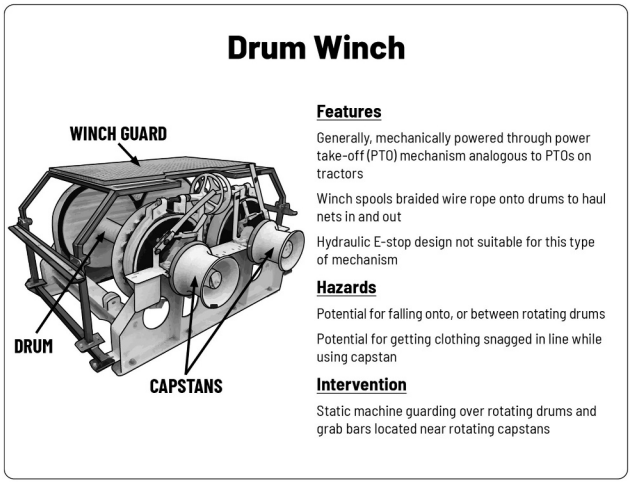

Figure 2. Double drum winch design, typical of shrimp trawl vessels in the southeastern U.S. Note: image shown with a NIOSH-designed winch guard installed.

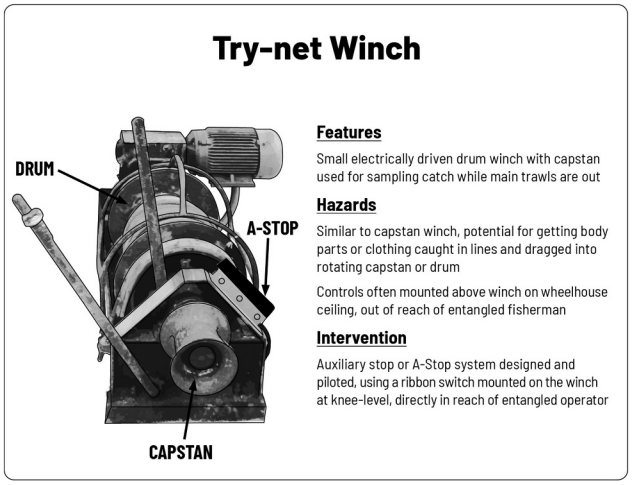

Figure 3. Try-net winch used on shrimp trawl vessels for sampling catch. (A-stop: auxiliary stop).

Figure 4. Double drum winch design with no guarding.

the auxiliary stop and guard designs for additional winch models have been pilot tested on several vessels.[21]

Since the commercialization of the emergency stop system in 2007, anecdotal evidence from discussions with fishermen and vendors pointed to cost as the primary barrier to adoption. However, a rebate program that partially reimbursed fisherman for the cost of the e-stop system did not overcome some fishermen's hesitancy to install it [Seattle Fisherman's Memorial, personal communication]. Hesitancy to install winch guards was a major impetus for the current study. Insights about barriers to adoption of the e-stop could inform future efforts related to adoption of winch safety interventions in the Southern shrimp fleet.

This qualitative study was designed to identify factors influencing adoption of these interventions in the commercial fishing industry. We focused on two commercial fishing gear types in two regions in the United States. We focused on purse seine vessels in the Pacific Northwest and Alaska, and side-trawl shrimp vessels operating in the eight coastal states spanning Texas to North Carolina. We chose these regions because of their documented histories of winch injuries and fatalities, and because NIOSH has developed engineering interventions targeted to vessels in each region.

The aims of this study were to 1) Identify barriers and facilitators to adoption of the e-stop in Pacific Northwest and Alaska purse seine fisheries, and 2) Identify barriers and facilitators of adoption of stationary guards and auxiliary stop devices for side-trawl shrimp vessels in the Southern United States and Gulf Coast. In both regions, we sought to understand fishermen's attitudes, perspectives, and decision-making processes related to investment in deck safety gear generally and winch safety equipment specifically.

Methods

Study design

This study used a qualitative approach employing in-depth, semi-structured interviews with vessel owners, captains, and other professionals in the commercial fishing industry. Interviews explored participants' perspectives on the risk of deck winches, familiarity with several types of winch safety gear, barriers to adoption of that gear in their fleet, and factors that might facilitate adoption of the gear in the fishing industry. Interview transcripts were coded, categorized, and analyzed for themes to help explain fishermen's decision-making process related to winch safety and investments in winch safety equipment.

Participants, eligibility, and sampling strategy

Participants represented commercial fishing fleets in two regions: The Pacific Northwest purse seine fleet (operating in Washington and Alaska), and the Southern shrimp fleet (operating off the Gulf Coast and southeastern coastal states from Texas to North Carolina). Participants were required to be at least 18 years old. For interviews in the Southern shrimp fleet, participants were eligible if they 1) owned or managed a commercial shrimp fishing vessel, or 2) served as captain of a commercial fishing vessel with authorization to make decisions about equipment installation, and the vessel used either an electric try-net winch, or a mechanically powered drum winch.

In the Pacific Northwest, participants were eligible if they 1) owned or managed a commercial fishing vessel geared for purse seining (regardless of species harvested) or, 2) served as captain of a purse seine fishing vessel, with authorization to make decisions about equipment installation, and the vessel used a hydraulically powered deck winch. Fishermen

did not have to be using the safety equipment in question to be eligible for the study. Vendors and suppliers were eligible if they worked at an organization that manufactures, fabricates, sells, or otherwise provides fishing vessel deck equipment.

We identified participants through research team members' professional networks, industry trade shows, and contacts shared by the NIOSH Center for Maritime Safety and Health Studies. Some contacts had participated in pilot programs field testing prototypes of NIOSH-designed winch safety equipment. We identified additional participants in the course of interviews through snowball sampling.

Data collection

We conducted individual interviews between October 2019 and September 2021. The first five interviews were in-person, and all others by phone, due to COVID-19-related travel restrictions implemented after March 2020. Our goal was to continue interviewing participants until we reached "saturation" – the point at which no new ideas were being contributed. An interview guide was developed with input from industry partners and peer reviewers. We used question stems to begin interviews but allowed discussions to proceed naturally based on participants' individual experiences and familiarity with the safety interventions in question. Topics included:

- Participants' background in fishing
- Types of vessels and fishing gear used
- Typical workflow
- Perceptions of injury risk from winches
- Concern about winch injuries relative to other fishing hazards
- Training new crewmembers
- Familiarity with e-stops (for purse seiners), machine guarding, or auxiliary stop devices (for shrimpers)
- Opinions about the equipment listed
- Perceived barriers to adoption of the safety equipment in question
- Factors that could facilitate uptake of this equipment

We audio recorded interviews and transcribed recordings using NVivo software. We manually reviewed transcripts for accuracy.

Conceptual framework

Because we had specific questions about certain types of equipment and preexisting knowledge of the industry, we conducted a thematic analysis using Rogers' Diffusion of Innovations theory[24] as a framework. In this framework, diffusion of new technology through a population is impacted by five key *"attributes of adoption"*: Relative advantage, Compatibility, Trialability, Complexity, and Observability. We used this framework to conceptualize barriers and facilitators to adoption of winch safety gear. However, we were also interested in broader contextual factors affecting how fishermen make decisions about investing in safety gear. Our approach to gathering, coding, and interpreting data used elements of grounded theory methodology as articulated by Corbin and Strauss.[25]

Data coding, development of categories and themes

Two reviewers read the interview transcripts separately and coded fishermen's statements line by line. We used open coding and *in vivo* coding (that is, assigning codes using participants' own words as spoken in the interviews) to capture the fundamental idea behind each statement.[26] We analyzed interviews sequentially, formulated ideas in memos, and incorporated insights from earlier interviews into subsequent interviews. We treated the *attributes of adoption* as provisional explanatory categories, subject to ongoing scrutiny, while remaining open to other concepts as interviews continued.[25] The two reviewers discussed and compared codes, agreed on a set of consensus codes, and then grouped codes into broader conceptual categories. Many statements could be coded as one of Rogers' *attributes of adoption*. For statements that did not align neatly with those attributes of adoption, we created additional categories to capture the meaning in participants' statements. Reviewers refined

categories over numerous discussions, assessing how prominently they appeared in the interviews, to generate broader themes in the dataset.

Human subjects review

This study protocol was reviewed by the Institutional Review Board at NIOSH and determined to be exempt from full board review (protocol ID 19-NIOSH-01XM).

Results

Between October 2019 and September 2021, we completed 19 interviews: ten from Washington and Alaska fisheries, and nine from the Southern shrimp fleet, distributed among Texas, Louisiana, Mississippi, and Florida. Interviews typically lasted 30–60 minutes. Of participants, 16 were current captains or owners of commercial fishing vessels. One was a former commercial fisherman working with a nonprofit safety organization, with direct knowledge of a rebate program that reimbursed fishermen for installing an e-stop on their vessel, one was a safety manager for fishing vessels at a seafood company who had been involved in the e-stop rebate program, and one was employed at a commercial fishing equipment manufacturing and supply company, which was one of the only vendors of the e-stop system at the time of the study. We refer to these last three participants as vendors/suppliers, because they played a role in providing e-stops to fishermen (in addition to other professional roles). Seventeen participants were male; two were female. All had substantial experience in the commercial fishing industry, ranging from 10 years to more than 50 years (Table 1).

Table 1. Participants interviewed about adoption of winch safety equipment, by fishing region and job title ($n = 19$, total).

Pacific Northwest/Alaska Purse Seine Fishery (N = 10)		
Job title	Male	Female
Owner/captain*	5	2
Equipment manufacturer/supplier	1	–
Nonprofit safety organization manager	2	–
Southern Side-trawl Shrimp Fishery ($N = 9$)		
Participant	Male	Female
Owner/captain*	4	–
Owner**	5	–

*Owner/captain refers to a participant who owned a vessel, and also served. as vessel captain at time of interview.

**Owner refers to a participant who owned one or more commercial fishing vessels and licenses, but who did not actively fish themselves at the time of the interview (they hired captain(s) and crew).

Conceptual categories

We grouped interview data into categories describing how fishermen manage risk from deck winches and decide whether to invest in winch safety gear. Some of Rogers' *attributes of adoption*, [24] *relative advantage, complexity, and compatibility*, fit well as organizing concepts. Factors related to *observability* of the safety gear in question were mentioned occasionally but were less prominent. Statements about *trialability* (the ability to test a new technology on a limited basis) were almost totally absent. Three other concepts appeared repeatedly and significantly, which in our view were distinct enough to require additional explanatory categories: risk perception, cost, and administrative controls. Potentially, these could be considered as part of *relative advantage*, but in our view, treating each separately provides deeper insight. We present each major conceptual category below, in order of prominence in the interviews. Additional quotations are provided in Supplementary Table S1.

Risk perceptions

A primary question was how much physical risk fishermen perceived from working near deck winches. For the most part, fishermen overwhelmingly considered the winch to be a primary safety hazard, certainly worthy of a safety intervention. This was true in both fisheries: Seventeen of 19 participants considered the winch a major hazard, often *the* most hazardous piece of equipment they use.

> The most dangerous piece of equipment … Most of the time it's the winch. Because that thing, it's got a lot of power, and human flesh and bone, it means nothing to it, you know? That would be the #1 most dangerous piece of equipment. [Fisherman 8, Mississippi]

> … In the hierarchy of safety topics, it's, uh, it's at the top. … You could get wrapped up in it, and it would end things. Quickly. So. It's- rotating

> machinery is probably the worst thing you can be around. [Fisherman 6, Alaska]

> I just lost my cousin. Three years ago, I think. And he got tangled up in the cathead. With the rope. We use a cathead to wrap a rope around it, pick up large lifts, and he got wrapped around in that, and ugh - cut his leg off, and he bled to death. No, it was his arm, I'm sorry, not his leg, his arm. I have a friend that lost a leg. But no, he bled to death and, he was on the boat by himself. [Fisherman 11, Texas]

There were two exceptions in this regard. One shrimp fisherman questioned how often winch entanglements happen, and whether something like a guard around the winch could prevent such an event:

> Any kind of accidents that ever happen, it's never been because them guys are picking up using the winches. It's been dumb stuff, because something broke down, you're trying to modify something, to make it pick up. So again, your safety gear's going to work fine under your normal conditions … So is it going to prevent it? Of course, you know, but I guess maybe one in a billion accidents would actually be preventable. [Fisherman 9, Texas]

Another captain dismissed the entire premise:

> Once again, if you're dumb enough to get yourself caught up in that damn thing, you probably don't belong on a boat. [Fisherman 10, Texas]

However, overall these viewpoints were in the minority.

A notable aspect in the interviews was how many fishermen had direct knowledge of someone who had been severely injured or killed by a deck winch. Among the shrimp fishermen, four out of nine participants mentioned other fishermen they knew who had been caught in a winch, causing loss of limbs or death. In the Pacific Northwest, four out of ten participants knew of people severely injured or killed, and several more told us about close calls they observed involving the winch.

Cost

Unsurprisingly, cost was a major theme in our discussions. Usually this was the first barrier to adoption mentioned and was emphasized heavily in both fisheries. Twelve of nineteen fishermen interviewed discussed cost barriers.

Some vessel owners simply cannot afford to pay for a non-mandatory safety intervention:

> Well, this industry here is extremely strapped for money to do any improvements. Imports from India the last few years have just beaten this industry down to … you know? So it is definitely a monetary problem. [Owner 2, Louisiana]

> I do believe that the emergency stop for capstan winches can be a lifesaver. And the fishermen that I have talked to about installing it, that have been reluctant to, when I've been able to have a personal conversation with them, they've been reluctant to install them because of cost. [Vendor 3, Washington]

> So you can see that the profit margins are SO small. You know? Are so small for most guys. That they're just struggling to stay in the business. [Fisherman 3, Washington]

For other fishermen, the issue wasn't necessarily the absolute cost, but the cost exceeded their notion of a reasonable price for a winch add-on:

> To improve my boat, something reasonable - two, three grand is something more reasonable to me, for a safety feature. When you're looking at four, five, six, it's like, 'I can put that towards my refrigeration, or whatever'. [Fisherman 1, Washington]

Fisherman 1's point, *"I can put that toward refrigeration,"* echoes a sentiment voiced repeatedly: owning a fishing vessel is a constant, expensive maintenance effort. Participants weighed the cost of winch safety gear against numerous competing costs. Some of these costs are also safety related. We asked fishermen, hypothetically where they would spend a few thousand extra dollars, if they had to spend it on safety. Updating the winch was not always the clear choice:

> I'd spend it on that E-stop. Where would a lot of guys spend it? God, I don't know. I think a lot of guys would spend it on their life raft maintenance. That's where they're going to spend their money, because it's something that HAS to be done. Just to be in compliance with Coast Guard regulations. And have your survival suits checked. And then you know, EPIRB, EPIRB batteries. Those are the safety things that the Coast Guard's looking for. That's

what they're going to spend it on. Not on mechanical safety equipment. [Fisherman 3, Washington]

If I had the money, and this probably isn't going to be very popular with the guys in the industry, but: I would spend more time – substantially more time, on training crew members. Training could go a long ways. [Fisherman 4, Washington]

Relative advantage

Relative advantage refers to the amount of improvement an innovation offers over existing options.[24] As expected, this concept featured prominently in fishermen's perspectives on winch safety gear. Almost all the fishermen interviewed endorsed the idea of doing anything they can to make the deck winch safer. E-stops, winch guards, and auxiliary stop switches for try-net winches, generally were seen as beneficial in both fishing regions.

I think it's definitely going to save lives and limbs by putting, placing these guards aboard these winches. Without a doubt, definitely. Very beneficial, so an individual not be getting harmed when operating these winches. [Owner 2, Louisiana]

Dude, absolutely! Every fucking boat should have one! There's no question. [Fisherman 3, Washington]

However, in the Pacific Northwest interviews, a few fishermen wrestled with the degree of safety advantage of an e-stop. They agreed that the winch was dangerous. They questioned whether someone would have time to hit the button if they got tangled in a line, even with a shut-off button mounted in easy reach. A fisherman from Washington explained:

It's not that I'm not excited about the e-stop and I would definitely have one, but I still see lots of potential for getting wrapped up in the deck winch even with one. … It's not automatically going to be like, 'Oh, you have one of those! The winch is safe now.' … It's like: 'You have one of those. The winch is now slightly more safe. But still dangerous'. [Fisherman 2, Washington]

Another participant knew a fisherman whose rain gear had been caught between the purse line and the winch capstan, dragging him into the winch as it turned. He wasn't sure an e-stop could have prevented this, although he still thought it was a worthwhile investment:

I don't know, 'cause it grabbed him from behind, whether he'd have been able to to reach around and get it. Even though [the e-stop button] is on top. And I mean, it's the best possible place. But some people go, "Eh, that wouldn't save me anyway." But you know, it's worth a try. That's why I got it. You have no chance otherwise. [Fisherman 7, Washington]

Both of these fishermen eventually did install e-stops. But their perception of a modest safety advantage delayed the purchase. One participant's wife finally decided for him:

My wife went to Fish Expo with me, and she says: 'You're buying one of those'. [Fisherman 7, Alaska]

The other captain installed an e-stop after winning a free retrofit kit in a trade show raffle, and getting the installation subsidized:

Once they said, 'Oh, and we'll pay for the install also,' I was like, okay, well I guess I have to do it in that case. Because then I would just be a negligent jerk for not installing it, if I said 'no'. [Fisherman 2, Washington]

Complexity

Complexity describes how easy or difficult a new technology is to adopt.[24] Complexity came up repeatedly as a barrier to adoption, primarily for the e-stop. Although not complex in principle, installing an e-stop requires additional hydraulic plumbing, making penetrations in the bulkhead for the wiring, and finding a place to mount the hydraulic valve. For some fishermen we interviewed, the deck winch was sufficiently hazardous to justify the effort. But it was fairly complex:

You know, when it comes to plumbing and these hydraulics, they're very complicated. It's going to be custom pipe bending and fittings … And these hydraulic repair shops in Ballard, I mean, dude they're VERY proud of their work. From a financial standpoint. [Fisherman 3, Washington]

"How'd the installation go?" [Interviewer]

Um, kind of a pain in the ass. It's just a lot. … I thought it was going to be like, one box, easy, disrupt the flow, get the flow going again. I didn't

> realize it was so many different pieces and they're all over the boat – in the engine room, up on deck … [Fisherman 5, Washington]

Among shrimp fishermen, complexity issues didn't stand out as prominently, at least for winch guards. Shrimp fishermen described having crew who could cut and weld, or at least having access to metal fabricators who could build a winch guard easily enough. One captain from Mississippi described building a winch guard that he designed himself, based on his assessment of the hazard:

> You can fabricate - all of mine were homemade guards, just basically pieces of pipe and metal stock that, I get it cut, you weld it, and you know, it wasn't nothing fancy, but it served a purpose. [Fisherman 8, Mississippi]

For the auxiliary stop, complexity barriers were harder to assess because only three of nine interviewees had ever retrofitted something like an auxiliary stop to their try-net winch (two had trialled NIOSH prototypes). One vessel owner who had trialled a NIOSH auxiliary stop prototype gave positive reviews, but cautioned:

> If it's not gonna be in a kit, it won't get put on. Not saying that it's not a good product. It's just that if they've got to put together all these electrical boxes, and this little wire and this switch and this relay … It's just not gonna happen. Unless it directly involves the catching of shrimp. [Owner 1, Texas]

Competing safety priorities

This category is related to risk perception, but it adds valuable context in its own right. The deck winch looms large as a hazard, but even if it is the biggest hazard, other dangers also need to be managed. Some of these appeared more immediate in terms of likelihood (e.g., falls overboard). Some other safety "wins" may be easier to achieve.

> What are the top things that come to mind on your vessel when you think about safety? [Interviewer]

> Oh my God, there's so many of them. Man overboard is just scary as hell … One of the issues that just recently happened is, we had two crewmembers here had to be evacuated off of a boat last week, where they got down in the hold, and I think they must have gotten impacted by sodium bisulfide. And it knocked 'em out. That's a preservative chemical we use, and it can displace air and, really, really create a problem. It's killed several people. That worries us. There's just so many things. Fire, collisions, my God! [Owner 11, Texas]

> Falling asleep at the wheel [laughing]. I installed a second watch alarm this year. [Fisherman 1, Washington]

> Well, and you know this [e-stop] system lowers one risk. It's not something that lowers 27 risks, or that kind of thing. [Vendor 3, Washington]

Several fishermen emphasized overall vessel maintenance. Some of these responsibilities overlap with cost concerns, but they also give a deeper view into how fishermen think about maximizing safety. Considering everything, maintaining the vessel as a whole can take priority over a specific risk like from the deck winch.

> There's other things involved like your rigging and, for example this year we rebuilt my boom pins. Well, I mean, certainly you don't want your boom falling down and crushing you! There's an extra, I don't know, three thousand dollars? So it doesn't sound like a big deal. But by the time you throw in everything, it's a hundred thousand dollars. Or at least that's what I spent this year, before I even left the dock, was a hundred grand. [Fisherman 3, Washington]

> You have to make sure you have an up to date first aid kit, make sure your SOLAS life raft gets inspected once a year. Make sure your fire extinguishers are checked out. Make sure your flares are up to date. Make sure all your lights work, your navigation lights, your everyday lights. You go through the boat itself … all your gears and guards. Your shackles. Your ropes … [Owner 14, Texas]

Administrative controls

Administrative controls (that is, rules or operating procedures) emerged as a critical strategy for managing risk around winches. This impacts the question of whether an investment is worth the price, given other things it could be spent on. For example, most captains talked about limiting who is allowed to operate the winch. Usually, only highly experienced deckhands would be permitted to operate the deck winch. Sometimes, only the captain runs the winch.

> I only let my most experienced guys operate the deck winch because it is the most dangerous piece of equipment. And it takes 'em a while to develop a feel for it. [Fisherman 3, Washington]

Fishermen described strategies like making sure they had no loose clothing, not wearing gloves, making sure two people were present at all times, and staying alert and focused while operating the winches.

> Like I said, it's just, those guys down there got to be sober, and straight, that eliminates 90% of the problem, and uh, the dress attire … think about what you're doing, stay away from the direct line of injury. [Fisherman 12, Florida]

A theme that emerged, through statements about administrative controls, was a strong sense of self-reliance and personal responsibility. Some of the fishermen seemed to emphasize administrative controls because they trust their own caution, experience, or physical ability. For the deck winch specifically, they often manage risk to the crew by taking that risk on themselves (by not allowing others to operate it).

> What happens if we get a new crew member, they don't touch the winch stuff. … You need to see what that individual's about. If they're accident prone, or if they have a level head that they can understand the dangers, you know? [Owner 13, Louisiana]

> Every time I wind up with a new crew I go through the whole boat with them, not just winches but everything, the man overboard drills, everything, the winches, and equipment, over and over again. And I mean, I don't like anybody back there by themselves. Got two people, at all times … [Fisherman 12, Florida]

Compatibility

Compatibility was relevant to adoption of the gear discussed, primarily for winch guards for shrimp vessels. No off-the-shelf guards are available. There are numerous different winch models in use, and even winches of the same model can have different dimensions depending on how they are mounted, where they are mounted, and post-market modifications that have been made over the years. Among the nine fishermen we interviewed in the Southern shrimp fleet, at least five different brands of winch were being used. So adoption of winch guards has never been a matter of simply deciding to buy an available product.

> If you could say, go down to your local marine hardware store and buy it, I think that's a little far-fetched … I think it's gonna have to be basically a custom, you know? [Fisherman 8, Mississippi]

Facilitators of adoption

Mitigating cost barriers.. In addition to in-depth commentary about barriers to adopting winch safety gear, we also received a few suggestions about facilitators of adoption. Several participants talked about lowering cost barriers. One of the administrators of a rebate program for e-stops told us:

> The two that we subsidized the installation: Boom. They were done. So the economics was totally taken out of the equation. And they're done. [Vendor 3, Washington]

In the same vein, we asked fishermen in the Gulf Coast whether a rebate or subsidy program could motivate shrimpers to install winch guards. Several vessel owners told us this would help:

> Yes, without a doubt. Definitely, yes. In other words, if you had a grant or something to where, if a fisherman can get this installed on his boat: Yeah. That would definitely be an incentive. [Owner 2, Louisiana]

Increasing observability of interventions

Observability (the degree to which the benefits of an innovation are visible to others) was mentioned less frequently in our interviews. However, we did receive some comments suggesting that reminders about the e-stop could be beneficial. For example, a Washington fisherman stated:

> Everybody knows it's a thing. I don't think it's on the forefront of very many minds. So anything to remind people and get it up there and get it talked about, noticed, is a good idea. 'Cause I do think it's great. [Fisherman 5, Washington]

Discussion

The purpose of this study was to identify factors impacting adoption of winch safety interventions in two commercial fishing regions. We identified

a range of barriers to adopting this equipment, including cost, complexity issues, and competing safety priorities. There was some nuance to the cost concerns. Fishermen's concerns were not necessarily about the price of the safety equipment. The bigger issue seemed to be the cost of everything else associated with maintaining a fishing vessel. Winch safety gear was often viewed as an opportunity cost: money spent on mechanical safety for the winch is money not spent on something else that could need attention.

Participants also noted complexity barriers, particularly for the e-stop for purse seine winches. For winch guards on shrimp vessels, complexity appears to be less of a barrier. Shrimp trawl vessel owners typically have crew who can cut, weld, and fabricate steel guarding, which is less involved than the hydraulic modifications needed to install an e-stop. For the auxiliary stop, it was less clear how much complexity barriers might impede adoption. Only two participants interviewed had experience with the NIOSH auxiliary stop, having trialled prototypes on their vessels. One owner commented, *"If it's not in a kit, it won't get put on … " [Owner 1, Texas]*, suggesting complexity could be a factor in future adoption. But for the time being, the more important issue for the NIOSH auxiliary stop is that there is no current vendor for it. Future work could evaluate the practicality of publishing the auxiliary stop designs, similar to what was recently done for winch guard designs.[22,23] In sum, a variety of barriers exist to wider adoption of the interventions in question. Cost is not the only barrier, but from the data we gathered, it appears to be the most prominent. Mitigating the cost barrier would likely be the most meaningful way to increase adoption of this safety equipment in the commercial fishing industry.

Practical implications

An intervention that could address both cost and complexity barriers would be a program similar to the National Rollover Protective Structure Rebate Program (NRRP) for the agricultural sector.[27] The NNRP is run by a consortium that provides financial rebates for approximately 70% of the cost of purchasing and installing tractor rollover protection kits.[27] Rollover protective structures (ROPS; rollbars) share some similarities to the winch safety equipment studied here: Like winch entanglements, tractor rollovers have been a serious and persistent hazard for workers. As on fishing vessels, equipment designed without modern safety features is still in common use on farms, and farmers face competing safety priorities, time constraints, and economic barriers that can limit their ability to upgrade older equipment.[28] An analogous program for the fishing industry could, for example, facilitate connections between vessel owners, hydraulics contractors, and fabricators to handle the more complex aspects of system installation. It could also provide guidance for self-installation of winch safety gear, and could offset the costs of purchase. Similar tactics have been used by the National ROPS program to connect farmers with professional installation contractors for tractor rollover protection systems.[29]

Although observability appears to be less of a barrier to adoption, efforts to increase observability might still be helpful in both fishing regions. One fisherman specifically suggested that more could be done to raise visibility of the e-stop, even though many fishermen are aware of it: *"I don't think it's at the forefront of very many minds … " [Fisherman 5, Washington]*. For shrimp fishermen, the specific NIOSH interventions studied have not been commercialized, and several fishermen in our interviews had not heard of them. A reasonable future step would be to promote awareness of the newly publicized fabrication and installation guides for the winch guards. Even if fishermen do not build guards to precise NIOSH specifications, seeing the NIOSH designs could inspire some shrimp fishermen to build their own versions, which would be an improvement over no guard.

It is also important to disseminate accurate information about winch-related injuries in fishing, including how frequently they happen and how severe they can be. Several fishermen showed skepticism about how often entanglements happen. Others saw the inherent potential for injury from their deck winch, but had never seen any statistics about such injuries. NIOSH has published reports about winch injuries in both

Alaska and the Gulf Coast regions.[13,14] However, publications in scientific journals may have limited reach into fishing communities. Efforts could be made to present this information in channels and formats more likely to be seen by fishermen. Examples of more visible channels might be state Fish and Wildlife Department web pages, industry trade publications, and social media channels. The national ROPS program described above, began with work in individual states to promote awareness of tractor rollovers and the benefit of rollover protection systems.[28] Social messaging about winch entanglements might prompt some fishermen to action.

Finally, whether vessels incorporate mechanical safety interventions for deck winches or not, safer practices can also be promoted through things like focused training for crew members working around winches, and policies about loose clothing and working alone on deck. This aligns with the well-established hierarchy of controls in occupational health, which seeks to reduce hazards through elimination, substitution, engineering controls, administrative controls, and personal protective equipment. Administrative controls have a place in workplace safety, although engineering controls are considered to be more effective.[30]

Strengths and limitations

Participants shared their opinions enthusiastically during interviews. They spoke at length about issues related to choosing and using different winch setups. Nearly half of the participants had personally known someone maimed or killed by a deck winch, which was reflected in their sincere engagement with the topic. However, it is possible that this background resulted in opinions more favorable toward winch safety interventions than we would have found in a broader cross-section of the fishing industry. Furthermore, we conducted these interviews in only two U.S. fishing regions, among fishermen using specific vessel gear types. The findings cannot necessarily be extrapolated to the U.S. commercial fishing industry overall. We attempted to continue interviews until reaching "saturation" – the point at which no new information emerges.[31] But in practice, it can be difficult to know when this point has been reached. By the 7th or 8th interview in each region, most opinions being shared were variations on themes discussed in earlier interviews. But we were also limited by resources available for the project, and fishermen's willingness to make time for the uncompensated study.

Conclusion

This study found that while fishermen generally acknowledge winches as a primary safety hazard on deck, this recognition does not always translate into investing in winch safety interventions. The decision-making process regarding safety investments is influenced by the broader context of vessel operations and maintenance and the need to balance other risks to the entire vessel and its crew. Factors such as competing costs and the perception of the risk posed by winches as manageable contribute to the hesitation in adopting winch safety equipment.

The industry can implement several strategies to facilitate the adoption of winch safety interventions. First, increasing risk perception through the publication of winch injury data can continue to raise awareness among fishermen about the importance of addressing this issue. Additionally, improving observability by providing installation guides and resources specific to different regions can enhance understanding of the systems and encourage action. Installation complexity is another crucial aspect to address, for example, by facilitating connections between fishermen, hydraulics contractors, and fabricators to handle the complex parts of system installation. Winch manufacturers could consider integrating safety features like emergency stops or machine guarding as standard features on new winches to eliminate the complexity barrier. In addition to adoption of engineering controls, communication of effective administrative controls such as focused training for crew members working around winches, or policies about working alone with deck equipment, can help raise awareness of entanglement risks and promote safer practices, whether vessels incorporate winch safety technologies or not.

In conclusion, this study highlights numerous barriers to adopting winch safety measures. It is

clear that more work needs to be done to overcome these challenges. Industry stakeholders and safety organizations can potentially facilitate adoption by providing technical and financial support to fishermen for installing winch safety equipment, such as through rebate programs analogous to the National ROPS rebate program. However, even with the cost barrier fully eliminated, factors such as complexity and risk perception still remain potential barriers to widespread adoption of this equipment. Sensitizing fishermen to the risks from winch entanglement injuries, and increasing observability of interventions are additional strategies that could drive change.

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References

1. Norrish AE, Cryer PC. Work related injury in New Zealand commercial fishermen. *Br J Ind Med*. 1990;47(11):726–732. doi: 10.1136/oem.47.11.726.
2. Törner M, Karlsson R, Sæthre H, Kadefors R. Analysis of serious occupational accidents in Swedish fishery. *Saf Sci*. 1995;21(2):93–111. doi: 10.1016/0925-7535(95)00046-1.
3. Piniella F, Soriguer MC, Walliser J. Analysis of the specific risks of the different artisanal fishing methods in Andalusia, Spain. *Saf Sci*. 2008;46(8):1184–1195.
4. Zytoon MA. Occupational injuries and health problems in the Egyptian Mediterranean fisheries. *Saf Sci*. 2012;50(1):113–122. doi: 10.1016/j.ssci.2011.07.010.
5. Thomas TK, Lincoln JL, Husberg BJ, Conway GA. Is it safe on deck? Fatal and non-fatal workplace injuries among Alaskan commercial fishermen. *Am J Ind Med*. 2001;40(6):693–702. doi: 10.1002/ajim.10010.
6. Lincoln JM, Lucas DL. Occupational fatalities in the United States commercial fishing industry, 2000–2009. *J Agromed*. 2010;15(4):343–350. doi: 10.1080/1059924X.2010.509700.
7. Lucas DL, Lincoln JM. Fatal falls overboard on commercial fishing vessels in Alaska. *Am J Ind Med*. 2007;50(12):962–968. doi: 10.1002/ajim.20509.
8. Case S, Bovbjerg V, Lucas D, Syron L, Kincl L. Reported traumatic injuries among West Coast Dungeness crab fishermen, 2002–2014. *Int Marit Health*. 2015;66(4):207–210. doi: 10.5603/IMH.2015.0041.
9. Day ER, Lefkowitz DK, Marshall EG, Hovinga M. Utilizing United States Coast Guard data to calculate incidence rates and identify risk factors for occupational fishing injuries in New Jersey. *J Agromed*. 2010;14(4):357–362. doi: 10.1080/1059924X.2010.510104.
10. Kucera KL, Loomis D, Lipscomb H, Marshall SW. Prospective study of incident injuries among southeastern United States commercial fishermen. *Occup Environ Med*. 2010;67(12):829–836. doi: 10.1136/oem.2009.053140.
11. NIOSH. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH). Commercial Fishing Safety Regional Summaries. https://www.cdc.gov/niosh/fishing/data-research/regional-summaries/commercial-fishing-safety.html. Accessed November 13, 2024.
12. Schroeder FA, Viegas SF, Carmichael K. Shrimp winch injuries. *J Trauma*. 2008;65(1):142–146. doi: 10.1097/TA.0b013e3180a02ee0.
13. Lucas D, Woodward C, Lincoln J. Fatal and nonfatal injuries involving fishing vessel winches—southern shrimp fleet, United States, 2000–2011. *MMWR Morb Mort Wkly Rep*. 2013;62:157–160.
14. Victoroff TM, Case SL, Robertson LD, Syron LN. Workplace injuries caused by commercial fishing winches—Alaska, 2000–2020. *J Agromed*. 2023;28(3):433–443. doi: 10.1080/1059924X.2023.2171524.
15. NIOSH. The most powerful thing … deck safety awareness for purse seiners. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health. https://www.cdc.gov/

niosh/docs/video/seining.html. April, 2007. Accessed October 10, 2024.
16. Lincoln JM, Lucas DL, Rw M, Woodward CC, Bevan JE. Reducing commercial fishing deck hazards with engineering solutions for winch design. *J Saf Res*. 2008;39(2):231–235. doi: 10.1016/j.jsr.2008.02.027.
17. Lincoln JM, Woodward CC, King GW, Case SL, Lucas DL, Teske TD. Preventing fatal winch entanglements in the US southern shrimp fleet: a research to practice approach. *J Saf Res*. 2017;60:119–123. doi: 10.1016/j.jsr.2016.12.007.
18. Kolstrand Marine [Internet]. https://kolstrand.com/kolstrand-e-stop-emergency-stop-switch-kit-for-purse-winch/. Accessed November 14, 2024.
19. U.S. Coast Guard Marine Safety Alert 07-24, Open rotary machinery hazards. United States Coast Guard, U.S. Department of Homeland Security Inspections and Compliance Directorate. Washington DC: https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/INV/Alerts/USCGSA_0724.pdf?ver=khHDpqEEmMZrWgijo_qptQ%3d%3d. October 28, 2024. Accessed December 4, 2024.
20. NARA. Code of Federal Regulations. 46 CFR §28.215. Requirements for commercial fishing vessels: guards for exposed hazards. https://www.ecfr.gov/current/title-46/chapter-I/subchapter-C/part-28/subpart-C/section-28.215. 2024. Accessed November 13, 2024.
21. NIOSH. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH). Reducing winch entanglements with auxiliary-stop device. https://www.cdc.gov/niosh/docs/2016-105/default.html. Accessed November 15, 2024.
22. NIOSH. Fabrication guide: McElroy/Catchot Model 505 winch guard. By Sweet D, Alexander J, Wimer B, Teske T, Kloczko D, Victoroff T. Spokane, WA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) publication No. 2024-110. 2024. http://doi.org/10.26616/NIOSHPUB2024110. Accessed November 15, 2024.
23. NIOSH. Installation guide: McElroy/Catchot Model 505 winch guard. By Sweet D, Alexander J, Wimer B, Teske T, Kloczko D, Victoroff T. Spokane, WA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) publication No. 2024-111. 2024. http://doi.org/10.26616/NIOSHPUB2024111. Accessed November 15, 2024.
24. Rogers EM. *Diffusion of Innovations*. 5th ed. New York: Free Press; 2003.
25. Corbin J, Strauss A. Grounded theory research: procedures, cannons, and evaluative criteria. *Qual Sociol*. 1990;13(1):3–21. doi: 10.1007/BF00988593.
26. Saldaña J. *The Coding Manual for Qualitative Researchers*. 3rd ed. Los Angeles, CA: Sage Publications; 2016.
27. National rollover protection system [ROPS] rebate program. [Internet]. https://www.ropsr4u.org/. Accessed December 20, 2024.
28. Tinc PJ, Ayers P, May JJ, et al. Implementing a national tractor safety program: using "whole system in a room" to mobilize partners and implement solutions. *J Agromed*. 2016;21(2):127–131. doi: 10.1080/1059924X.2016.1142916.
29. National Rollover Protection System [ROPS]. Self installation. https://www.ropsr4u.org/self-installers.php. Accessed December 20, 2024.
30. NIOSH. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH). About Hierarchy of Controls. https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html. Accessed March 21, 2025.
31. Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods*. 2006;18(1):59–82. doi: 10.1177/1525822X05279903.