# Lifeboat Design Improvements

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I often watch a programme on UK TV (BBC2) called “Saving Lives at Sea” and it is clear that there are a number of design issues that compromise the effectiveness and efficiency of many rescues by the lifeboats of the RNLI, (Royal National Lifeboat Institution). I believe that these issues could all be addressed by some changes to lifeboat design. These issues can be summarised as follows:

1. Swimmers in the water. Lifeboats cannot get too close to swimmers for fear of the lifeboat’s propeller injuring the feet, legs, arms or other body parts. Boats need to manoeuvre sideways to approach swimmers safely. Getting an exhausted heavy casualty over the side of a lifeboat can be very difficult.
2. Overturned or capsized sailing boats with sails or ropes in the water, trawlers and other fishing boats that have lost power with tackle in the water. Lifeboats cannot easily get close to the stricken vessel because of fear that ropes, sails or nets in the water will foul the propellers. Propellers can also become fouled on the lines to lobster and crab pots simply because the crew cannot easily avoid every marker buoy.
3. People stranded on a rock or at the base of a cliff. There can be significant difficulty getting close to the casualty for fear of propeller or hull damage against submerged rocks, especially where there is strong wave action. Also manoeuvring in tight rocky inlets or sea caves can be very tricky.
4. Ships in trouble a long way from shore. With speed often limited by sea conditions to 25-30 knots, it can take an hour or more to reach some ships in urgent need of assistance.
5. People with suspected spinal damage. Getting them out of the water without risk of exacerbating the spinal damage can take a long time, thus risking hypothermia.
6. People with hypothermia. At present there are limited facilities in the lifeboat to warm a hypothermic person safely.
7. Fighting fire at sea. There is very little fire-fighting capability on most lifeboats.
8. Finding casualties in the water. Only the top of the head may be showing and when the wave height is more than a few centimetres, the head is only in view for part of the time. A much higher viewpoint is needed.
9. Getting a tow rope to a vessel in distress. This can be difficult in heavy seas or in a contrary wind.
10. Transferring a person to or from a stricken vessel can be tricky in heavy seas, especially if the person is injured. Wave action can suddenly separate the two vessels without warning.

These problems can all be addressed with some improvements in the design of the boat and of the equipment carried. The numbers in brackets refer to issues in the above list that are addressed by the proposal.

- Waterjets can be used to propel boats instead of propellers. If two are provided, one at the front and one at the rear of the lifeboat, independently steerable, the lifeboat can easily be turned around in its own length or propelled sideways. The suction for the pumps must be provided with a grid or mesh that prevents ropes, nets and other debris from being sucked in. This allows a safe approach to people in the water (1); to sailing boats or fishing boats with ropes sails or nets in the water (2); having the waterjet flush with the hull makes damage from submerged rocks much less likely (3); and facilitates manoeuvring in tight spaces. When transferring a person from one vessel to another in heavy seas, waterjets can be used to force the lifeboat up against fenders between the vessels and minimise the risk of sudden separation (10). Waterjets can be used on rigid inflatable boats, (RIBs), instead of outboard motors, by providing two vertical cylindrical structures through the rigid hull to contain them.
- Every lifeboat has a considerable volume of buoyancy material to prevent it sinking even if filled with water. By covering the hull on the outside with a flexible outer hull of closed cell foam 10-12 cm thick with a tough neoprene cover, manoeuvrability is not compromised and speed is slightly increased. The hull is then far more resilient to crashing against submerged rocks, (3). The inner hull would then be about 10-12 cm smaller all round, but there is no net loss of space because the closed cell foam outer hull provides sufficient buoyancy that further buoyancy within the hull is not needed. The lifeboat station could carry a spare outer hull so that it can easily be replaced in the event of significant damage. Replacement of the outer hull would require the lifeboat to be lifted off its cradle, so a crane in the lifeboat station would be needed.
- Speed through the water in seas up to about 2 metres peak to trough can be nearly trebled without loss of range by the use of hydrofoils (4). These can be designed to retract completely into the hull when not required or for manoeuvring in shallow water. The waterjet suction inlets clearly need to be kept submerged, and a hydraulically powered telescopic system would achieve this. These suction inlets can double as hydrofoils by fitting them with hydraulically controlled wings. The waterjet propulsion nozzles lose very little efficiency when out of the water and so can remain flush with the hull. A lifeboat with a top speed of 35 knots should be capable of 90 knots or more on hydrofoils without increasing fuel consumption.
- For people with suspected spinal damage, a semi-submersible stretcher could be used (5). This can take the form of a cradle with buoyancy in the upper edges of the cradle sides, and hinged ends. Additional inflatable buoyancy is provided on the underside. With the additional buoyancy deflated, the cradle can be slid under the casualty in the water. When the additional buoyancy is inflated, the patient is lifted to the surface of the water. Then the hinged ends can be raised and locked into position and the casualty can be safely lifted clear of the water without risk of exacerbating the spinal damage.
- For people with hypothermia, once the core temperature drops below a certain point, (which depends on age and general fitness), the ability to self-heat is lost and no amount of warm blankets will help. Gentle heat, just above the core temperature, must be provided. Enveloping the casualty in a blanket with built in flexible tubes will allow warm water to be pumped through the tubes at the

right temperature to facilitate safe recovery. This may save valuable time compared with the time taken for return to shore and transfer by ambulance to a specialist unit (6).

- For fighting fire at sea, a lifeboat with waterjet propulsion can simply divert half of the propulsion water to a water cannon (7). The remainder of the propulsion water is used in the propulsion jets to counter the reaction from the water cannon and to control the lifeboat's position relative to the stricken vessel. For oil fires, cylinders of a foaming compound could be carried on the lifeboat and titrated into the water cannon at the appropriate concentration.
- Getting an exhausted heavy casualty over the side of a lifeboat can be very difficult. A few very recent lifeboats have stern-boards that drop down to form a platform flush with the water. This could and should be done on all lifeboats including RIBs and this would be facilitated by having waterjets instead of outboard motors (1).
- Finding casualties in the water. This is easier with a much higher viewpoint. A drone with a camera that can look down from above could be helpful, especially if it has an infrared imaging camera, as a live casualty will always be warmer than the water (8). Some professional drones have the capability of handling winds of 60 knots and can stay in the air for 20-40 minutes, depending on wind-strength. A drone with a tether to the lifeboat, where the tether carries electrical power, could stay in the air indefinitely, perhaps 50 or 100 m above the boat.
- A drone could also be used for getting a tow-line to a vessel in distress (9). By attaching a light line, (similar to a monofilament fishing line), to the drone and pulling it over the vessel, this could be used to pull in a stronger throw-line and thence the tow rope. An alternative would be to use a throw-line catapult. I recently watched a tree surgeon catapult a bob on the end of a light line over a branch more than 50m up in a tall tree, and then use it to pull up a line that would support his weight. A similar catapult could surely send a throw-line much further than a man can throw, perhaps up to 100m between two vessels.

Implementing these proposals would go a long way towards solving the problems seen on "Saving Lives at Sea" and would greatly facilitate the tasks faced by lifeboat crews. Ultimately, more lives could be saved.