



DUTCH
SAFETY BOARD

Summary

Investigation of a
diving accident and
the provision of
medical assistance
on the North Sea



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The Hague, July 2016

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Dutch Safety Board

When accidents or disasters happen, the Dutch Safety Board investigates how it was possible for them to occur, with the aim of learning lessons for the future and, ultimately, improving safety in the Netherlands. The Safety Board is independent and is free to decide which incidents to investigate. In particular, it focuses on situations in which people's personal safety is dependent on third parties, such as the government or companies. In certain cases the Board is under an obligation to carry out an investigation. Its investigations do not address issues of blame or liability.

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NB: The full report, including the summary, is published in the Dutch language. If there is a difference in interpretation between the Dutch and English versions, the Dutch text will prevail.

Summary 5

Consideration 8

Conclusions 10

Recommendations 11

The diving accident

On the morning of Saturday 11 July 2015, two recreational divers made a dive from a ship moored 18 kilometres off the coast of Noordwijk. The objective of the dive was a shipwreck on the bed of the North Sea, which is 20 metres deep at this spot. A few minutes after they had reached the seabed, one of the divers noticed that the other one was moving somewhat uncertainly. Using sign language, she enquired whether everything was all right. The answer was 'not sure'. The two women decided to return to the ship. First they swam to the buoy line, intending to find their way upwards along it. Suddenly, the diver who was experiencing problems grabbed at her head, fell back down to the seabed and did not move any more. The other diver picked her up, inflated her stab jacket (buoyancy compensator) and immediately rose to the surface with her. Those on board the ship pulled the unconscious woman out of the water. While the captain sent an emergency call to the Coastguard Centre, fellow divers started resuscitation on the deck of the ship.

The Coastguard Centre initiated a rescue operation and sent several rescue units to the spot but did not subsequently succeed in keeping a grip on events. This ultimately led to the removal of the woman from the ship in a helicopter which was not equipped to give the correct pre-hospital care. An hour and eleven minutes after the report of the emergency situation, the helicopter crew transferred the woman to the Erasmus Medical Centre (Erasmus MC) in Rotterdam. She was still being resuscitated at that time. Because the Erasmus MC does not have a hyperbaric tank, which is necessary for the treatment of victims of diving accidents, the woman was taken by ambulance to the University Hospital Antwerp later in the afternoon. On arrival, her condition had deteriorated to such an extent that the doctors decided not to treat her in the hyperbaric tank. The woman died in the course of the evening.

The cause of the diving accident

The victim's diving equipment was included in the investigation to ascertain whether the accident could have been caused by a technical abnormality. There were two abnormalities in the diver's mask (known as a full face mask): the oro-nasal breathing mask was not firmly attached to the full face mask and the breathing resistance of the breathing regulator was heightened. The increased breathing resistance was caused by dirt and corrosion on the inside of the breathing regulator.

Both the loose oro-nasal breathing mask and the heightened breathing resistance could have led to the woman re-inhaling too much carbon dioxide from her exhaled air. This can lead to carbon dioxide poisoning with loss of consciousness and incapacitation as a result. Whether these technical defects were already present on the day of the accident has, however, not been established. It is therefore not certain that carbon dioxide poisoning caused the diver to become unwell, but it is a possible explanation.

The diver became unwell on the seabed shortly after the beginning of the dive, before the ascent took place. Decompression illness can therefore be excluded as the cause. After weighing other possible medical scenarios against one another, the Dutch Safety Board has arrived at the conclusion that it is likely that the diver died from oxygen deficiency resulting from diving-related pulmonary oedema or carbon dioxide poisoning, or a combination of both.

The assistance provided

During his call to the Coastguard Centre, the captain sketched the picture of an emergency situation: a diver had been pulled out of the water unconscious and would be resuscitated. The Coastguard Centre realised the urgent nature of the request for assistance, but did not really succeed in converting this into an appropriate deployment strategy. Several emergency units were sent, but the Coastguard Centre had no control over their actions and thus how events were handled. Neither of the two objectives which should have been laid down, that is, the giving of the best pre-hospital care and the transfer of the victim to a hospital which could provide the care she needed given the circumstances at that moment, were realised.

The first problem occurred on the calling out of a rescue helicopter. The Coastguard has two different helicopters at its disposal, one with and one without an ambulance officer and medical equipment. After some confusion, the Coastguard Centre opted in the first instance for the helicopter with, but subsequently for the helicopter without an ambulance officer, because the latter would be able to get to the site of the accident faster. The helicopter from Den Helder with medical personnel on board, had already turned out. The operator at the Local Coordination Centre, who is responsible for calling out rescue helicopters, decided to have this one fly on because she was unable to reach the helicopter from the Maasvlakte (helicopter without medical personnel). As a result, due to decisions which were taken without consultation with the Coastguard Centre, both helicopters ultimately made their way to the diving ship.

On the advice of a Radio Medical Service doctor, the Coastguard Centre also sent a Royal Netherlands Sea Rescue Institution rescue boat, with an ambulance officer on board, to the diving ship. The Royal Netherlands Sea Rescue Institution had not one, but two boats leave for the site of the accident. From that point in time, four units were on their way to the site: two helicopters (one of which had ambulance facilities on board) and two rescue boats (again, one of which had ambulance facilities on board).

The helicopter without an ambulance officer was the first to arrive on the spot. Due to a combination of inadequate information exchange, misunderstandings and confusion, this helicopter took the victim on board without the Coastguard Centre having given orders to do so. The other units were subsequently sent back by the Coastguard Centre. Despite this, the crew of one of the two Royal Netherlands Sea Rescue Institution boats decided to continue to the ship and ultimately took the victim's buddy to the shore for any aftercare that might be necessary.

The Coastguard Centre asked the Radio Medical Service for advice regarding the best destination for the victim, but did not receive a concrete answer to this question. The Coastguard Centre subsequently tried to secure a place for the victim at the Academic

Medical Center (AMC) in Amsterdam. After a ten-minute conversation, the AMC refused to accept the victim because of a lack of space in the Intensive Care Department.

The helicopter with the victim on board urged the Coastguard Centre to take a decision regarding the hospital to which the victim should be taken. When the Coastguard Centre hesitated for too long a period, the helicopter pilot took the independent decision to fly back to the home port on the Maasvlakte. During the flight, the helicopter crew made a new suggestion, that is, to take the victim to the Erasmus MC in Rotterdam. The Coastguard Centre agreed and contacted the Erasmus MC by telephone. Personnel at the Erasmus MC only had a few minutes to prepare for the arrival of the victim.

The Dutch Safety Board has established that the Dutch Coastguard, which is tasked with coordinating the parties involved in providing assistance at sea, had no control over the operation at any time. In the absence of any central coordination, the participating parties took independent decisions and, without the consent of the Coastguard Centre, independent action. Communication with the Radio Medical Service and AMC did not take place in an appropriate manner for action in an emergency situation. The Dutch Safety Board has concluded that the emergency response did not lead to the victim of the diving accident receiving the best possible medical care.

Points of departure of care

Everyone who is in the Netherlands may, in the event of an emergency, count on effective, safe and timely medical assistance. The government has formulated these three points of departure for care for all Dutch territory, that is, including the Dutch part of the North Sea. The investigation into the diving accident which took place on 11 July 2015 has, however, exposed a considerable discrepancy between the medical assistance provided at sea and how it is organised on land. The Dutch Safety Board realises that the circumstances at sea restrict the possibilities for providing assistance; nonetheless it does not see why this should mean that the *points of departure* for care should not be applicable at sea. After all, these points of departure do not imply a level of care, but the intention to provide it as well as possible.

Emergency medical assistance is implemented on land by ambulance services that follow strict protocols, under the direction of ambulance control rooms. Ambulance services and control rooms fall under the Regional Ambulance Services which, in turn, make up part of the safety regions. The Ministry of Health, Welfare and Sport and the Netherlands Healthcare Inspectorate jointly monitor the quality of the healthcare provided on the basis of the aforementioned points of departure.

When medical assistance is required at sea, the Coastguard Centre acts as an ambulance control room which coordinates the deployment of sailing and flying units, if necessary equipped with ambulance officers and medical equipment. And that is the only similarity with the situation on land. The operators at the Coastguard Centre are not medically trained. There is, moreover, no safety region to take care of the set-up of the organisation, the Ministry of Health is not a member of the board of the Dutch Coastguard and the Netherlands Healthcare Inspectorate does not supervise the functioning of the medical assistance chain at sea.

Administrative situation

The Dutch Coastguard implements a broad package of enforcement and service-oriented tasks, medical assistance being one of them. Because of the varied nature of these tasks, the central government is represented by five ministries in the Coastguard's board. As mentioned above, the Ministry of Health is not one of them. With its implementing agency Rijkswaterstaat (the Directorate-General for Public Works and Water Management), the Ministry of Infrastructure and the Environment, which acts as the coordinating department, is a technically oriented governmental segment which knows little of the provision of medical assistance. The result of this administrative situation is that the task of providing medical assistance at sea has fallen through the net. Because of the lack of involvement of the Ministry of Health and the Netherlands Healthcare Inspectorate, a chain has yet to be set up based on the points of departure: effectiveness, safety and timeliness.

Gaps in the organisation of medical assistance

An absence of administrative attention has affected all the sections, the management and the Coastguard's workplace. As regards the provision of medical assistance, neither policy objectives nor performance indicators have been set up with a view to ensuring good care and there are no protocols for emergency assistance, medical evacuations or deployment of the Radio Medical Service, either. The Dutch Safety Board has established that, in fact, the Coastguard has never been provided with the means to be able to fulfil its coordinating task in providing medical assistance. No investments have been made in terms of staff, resources or the requisite technical infrastructure. Nor has the Coastguard been encouraged to prepare for this task with its chain partners. No scenarios have been drawn up for providing medical assistance at sea, let alone practised. Joint evaluations are not performed. Agreements between chain partners are incomplete, not clear or not known. As a result, the Coastguard is unable to ensure that the chain actually functions as a chain.

Need for improvement

The lack of administrative attention and resulting lack of preparation for providing medical assistance at sea, failing cooperation between chain partners and omissions in the organisation mean that patients do not always receive effective, safe and timely care. The Dutch Safety Board has taken note of other incidents, in which the urgency of the request for assistance was not immediately clear and where inadequacies in the organisation of medical assistance also led to those needing help not receiving the best possible care. In previous years, when the performance of the Coastguard was frequently the subject of investigation by the Dutch Safety Board, similar shortcomings emerged. The Dutch Safety Board has established that lessons from the past have not led to systematic improvements. The ministries which participate in the Coastguard's board have allowed this inadequate status quo to continue. The fact that the Ministry of Health has so far not been involved in the provision of medical assistance on the North Sea also plays a role in the situation. The Dutch Safety Board therefore orders the Minister of Health, Welfare and Sport, in cooperation with the Minister of Infrastructure and the Environment, to live up to her administrative responsibility regarding medical care for citizens on the Dutch part of the North Sea as well as those on land in the Netherlands.

Joint action

On the operational side, it is the Coastguard's task, along with the Royal Netherlands Sea Rescue Institution and other chain partners, to take the correct measures to improve the provision of medical assistance at sea. After all, the investigation has shown that operating on its own, instead of jointly with the other relevant organisations, has not led to the desired result. Only by specifying common ambitions, exchanging and coordinating mutual expectations, making clear agreements, carrying out joint drills and jointly learning from incidents will the final objective, that is, the provision of medical assistance at sea which is effective, safe and prompt, come within reach.

The cause of the accident

- Based on the available information, it is not possible to determine with full certainty what caused the diving casualty to become unwell and die.
- The technical investigation established two abnormalities in the full face mask: a loose oro-nasal breathing mask and a heightened breathing resistance. It is not clear whether the two abnormalities were already present at the time of the accident.
- The most likely cause of the victim becoming unwell and dying is progressive oxygen deficiency due to acute pulmonary oedema resulting from the diving (immersion pulmonary oedema) or carbon dioxide poisoning, or a combination of both.

Medical care of the victim

- The diver did not receive the best possible medical care. She received specialist resuscitation care later than could have been the case and was not transported to the hospital with the most appropriate profile.
- The emergency medical assistance provided did not, therefore, fulfil the government's points of departure that care must be effective, safe and prompt.

Organisation of medical assistance

- The Ministry of Infrastructure and the Environment does not manage the Coastguard on the basis of the government's points of departure, that is, that medical care must be effective, safe and timely and does not provide the organisation with the staff and resources needed to do so.
- The Ministry of Health, Welfare and Sport is not involved in the process of providing medical assistance on the North Sea, so there is no incentive to organise the care process in accordance with these points of departure.
- The Coastguard's current process organisation is not appropriate for providing emergency medical care. Furthermore, the organisation does not have the staff, resources or technical infrastructure to be able to act in an authoritative manner as coordinator in the event that emergency medical assistance is required. Problems therefore arise in the implementation of the process.
- The parties involved in providing medical assistance on the North Sea do not function as a well-coordinated care chain in which the various parties are familiar with each other's work processes. Neither do they have the authority required to improve the organisation of the chain and keep it in order.
- Chain-wide learning simply does not take place.

RECOMMENDATIONS

The Dutch Safety Board has ascertained that there are systematic shortcomings in how medical assistance is provided on the North Sea, which can lead to sick and wounded people not receiving effective, safe and prompt care. The Dutch Safety Board sees possibilities for the parties involved to work together to remedy these shortcomings and thus improve the safety of all those at sea.

The Dutch Safety Board makes the following recommendations to this end:

To the Minister of Infrastructure and the Environment:

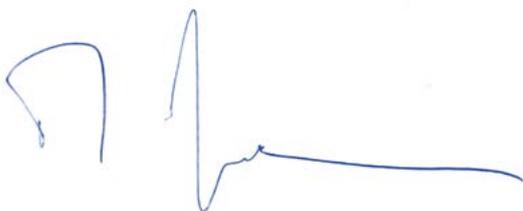
- Ensure that the process of providing medical assistance on the North Sea meets both international agreements and the points of departure of medical care in the Netherlands and ties in with the care chains on land. Facilitate and position the parties involved such that they are able to carry out their tasks properly.
- Involve the Minister of Health, Welfare and Sport in the implementation of this process.

To the Minister of Health, Welfare and Sport:

- Ensure that the process of providing medical assistance on the North Sea meets the points of departure of medical care in the Netherlands and ties in with the care chains on land.
- Encourage and support the chain parties in the development of standards for the provision of medical assistance on the North Sea and organisation of the related care process.
- Ensure that the Netherlands Healthcare Inspectorate supervises the process of providing medical assistance on the North Sea on the basis of this framework of standards.

To the Director of the Coastguard:

- Organise the process of providing medical assistance on the North Sea such that it ties in with the care chains on land and fulfils the points of departure for medical care in the Netherlands. Coordinate this with the relevant cooperation partners and particularly with the Royal Netherlands Sea Rescue Institution, Radio Medical Service, NHV Group (helicopter emergency medical service), emergency rooms and hospitals.
- Given the central position of the Coastguard in this process, take responsibility for the continual improvement of this provision of assistance.



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