IN-DEPTH REVIEW

Offshore industry: medical emergency response in the offshore oil and gas industry

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Background
The hunt for oil and gas has taken workers into new more distant locations including those offshore. The remoteness of the offshore platforms and vessels coupled with the potential risk of being cut off by bad weather presents particular challenges for medical emergency response (MER).

Aims
Firstly to define the challenges for MER in terms of locations, population and epidemiology of injuries and illnesses in the offshore environment. Secondly to give examples of legal requirements and industry standards to manage MER. Thirdly to look at existing and emerging practice to manage these challenges.

Methods
A review of published literature was supplemented with a summary of current practice in the industry.

Results and discussion
Medical professionals (medics) working offshore on installations and vessels are primarily responsible for the medical care of the workers. The medics have clinics with suitable medical equipment for managing emergencies as well as providing limited primary care. Some countries have legislation that stipulate minimum requirements. Where there is no national legislation, industry and company guidance is used to define the MER standards. Supervision of the offshore medics is often provided by doctors on shore via radio and phone links. These methods of communication are now being augmented with more sophisticated telemedicine solutions such as the Internet and live video links. These newer solutions allow for prompt high-quality care and provide the scope for a variety of new treatment options to be available for the offshore workforce.

Key words
Medical emergency response; medics; offshore industry; oil and gas industry; telemedicine.

Introduction
The offshore oil and gas industry operates all around the globe in often very remote and inhospitable locations, such as the North Sea, the Caspian Sea, the Gulf of Mexico, the Gulf of Guinea, Sakhalin Island and the Arctic Circle. These locations present challenges in terms of medical emergency response (MER) because of their remoteness from secondary and tertiary medical care as well as the likelihood that poor weather may delay evacuation.

Offshore development started in the Gulf of Mexico and the Caspian Sea after World War II [1]. Off the coast of Azerbaijan, the oil developments were set in shallow water and roadways built over the sea linked the wells. A whole town (Oily Rocks) including a hospital was built offshore. In the second half of the twentieth century, the increasing demand for oil drove exploration into deeper water and more remote locations. These locations will require different solutions for MER to those used in Azerbaijan 60 years ago.

The offshore workforce
The numbers of people working offshore can be considerable. In 2006, a survey by Oil and Gas UK (OGUK), formerly known as United Kingdom Offshore Operators Association (UKOOA), found that there were 19,568 workers who spent >100 nights/year offshore. A further 33,947 workers spent >25 nights/year offshore [2]. Working offshore has been traditionally a male-dominated environment but this is beginning to change with ~1800 women travelling offshore in the UK sector.

Offshore installations can vary greatly in size and function and may serve different functions. Crews in excess of 200 persons on board (POB) are not uncommon. Some installations are normally unmanned and only visited by work parties from time to time. While the offshore workforce is thought to be ageing, the OGUK study [2] showed that the average age was 41 years. This is

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the expected average for this population rather than an indicator of an ageing workforce.

**Epidemiology of injury and illness offshore**

There has been a change in pattern of medical emergencies over time in the UK sector of the North Sea. Norman [3] studied the records of 2162 evacuations from offshore installations between 1976 and 1984. In the early years, there were substantially more injuries than illnesses. From 1980 onwards, the cases of illness equalled those of injury. A follow-up study by the Health & Safety Executive in the UK sector of the North Sea from 1987 to 1992 [4] reviewed 3979 evacuations. Illnesses were reported to account for 55% of cases and injury for 45% of cases. In the last year of the study, illnesses accounted for 65% of all evacuations. The reasons for this were thought to be due to increased safety management and also a move away from exploration and construction towards operations and maintenance. Similar patterns have also been noted in offshore operations undertaken by Italian companies [5].

From Table 1, it can be seen that gastrointestinal problems and dental combined were a major cause of evacuation. The UKOOA addressed this by introducing the need for a dental fitness certificate; however, this did not prevent the high numbers of dental evacuations. This led to the conclusion that the screening standard was being inconsistently applied [6], and the requirement was withdrawn after a few years. During the study, 208 medical cases were evacuated for back pain. The respiratory emergencies were largely due to infections and there was only a small number of cardiovascular cases (3%). A total of 8/42 routine cardiac cases and 14/19 emergency cardiac cases were due to ischaemic heart disease. Only 4% of evacuations were due to mental disorders.

The majority of fractures (165/255) and crush injuries (62/72) were to the upper limb, which typically can occur during drilling and construction. The move to operations could have resulted in a fall of such injuries [4]. This trend to improve safety offshore has also been confirmed in statistics published by the International Oil and Gas Producers Association (OGP) [7].

As shown in Table 2, the types of illness and injury occurring in these locations necessitate the availability of medical staff and facilities that are able to cope with a broad range of medical emergencies in addition to the management of minor ailments.

### Legislation and training

The legal requirement for the provision of medical care to employees normally falls under the health and safety legislation of the country in which the company is operating. Some governments may make specific requirements for oil and gas exploration, recognizing the requirements of the industry, others have very little or no health and safety legislation. In addition, companies may have to consider the health and safety legislation of their parent country. Several countries have legislated minimum medical equipment levels at remote sites and some have requirements for minimum numbers of medical personnel [8]. This may range from holders of first aid certificates to one or more ‘medics’ depending on the size, location and hazards associated with the operation. The UK has seen a move from prescriptive requirements to a risk assessment-based approach [9].

### Industry standards

As a result of the disparity of health care requirements worldwide, industry groups have produced guidance
Organization of MER

It is usual to carry out a risk assessment for MER in remote locations, and in some countries, it is required by law [9]. A medical emergency plan can then be drawn up which should be documented and make up part of the overall emergency response plan for the facility.

Medical emergency response often is divided into tiers or levels. The following scheme is recommended by OGP (Box 1) [10], and many companies follow a similar system to organize MERs [11,12].

On manned offshore installations, there is typically one Level 3 medic who is supported by a number of advanced first aiders. Often, many or all the crew have some basic first aid training. The medic is also supported and supervised remotely by a Level 4 doctor who is based onshore. There are also often specific target times for MER, such as provision of first aid within 4 min of the incident [11], which tend to be company specific.

Each installation above a certain size (often POB >25) has a dedicated MER professional, usually called a medic. The term 'medic' is a loose one within the industry and, in general, refers to an individual with medical or nursing training, who is in charge of medical care at the offshore location. The level of training can vary from advanced first aid training to a medical degree. In many cases, paramedics, emergency medical technicians or nurses who have had training and experience in emergency medicine are employed. In Africa, the Middle East and Asia medical doctors are often found working as offshore medics.

The method by which emergency care is provided to these workers is broadly similar regardless of the location. The offshore installation will have a provider of medical care who is in contact (by telephone or radio) with a medical supervisor at another location (usually on shore). This remote medical supervisor is often referred to as the topside support, signifying their responsibility to provide advice for employees working above the surface of the sea (i.e. not diving operations). Emergency treatment is provided on site either autonomously or under remote supervision, depending on the situation and, where necessary, the patient will be removed from the site for further treatment.

The traditional management of a remote site emergency involves the on site health care practitioner providing treatment based on local observations relayed to a remote medical supervisor who provides advice and, where necessary, authority to undertake specific procedures or administer specific drugs. This produces certain limitations in terms of treatment, as the risk of administering a drug or undertaking a procedure must be weighed by the remote supervisor against the information that can be provided from the remote site.

A significant difference between emergency care offshore and that which takes place within a ‘normal’ health care system is that the medical provider at site may be working alone for several hours before assistance arrives and without direct access to advanced medical facilities that would be available in an urban environment. This can provide particular difficulties for those who have not been prepared for it.

To mitigate this problem, some medical provider companies provide additional training designed to prepare paramedics for working offshore [13]. Norway [14], Holland [15] and the UK [9] have enacted legislation, which requires that individuals take and pass a specific training course for offshore medics. These courses have become internationally recognized by the oil industry and represent a solid, basic qualification for work in the field of remote health care. A Diploma in Remote and Offshore Medicine [16] is in development and is planned to run with the Royal College of Surgeons of Edinburgh to enable existing medics to demonstrate further education within the area.

The lack of an overall identifiable qualification requirement coupled with the need to find practitioners willing to work in isolated environments for weeks at a time can lead to competency issues. Many offshore medics are not sourced or managed by medical professionals and a lack of understanding or awareness of the need for specialized training may compound this issue.

Retention of even basic emergency skills can be problematic [17]. Some companies require their medics to have specific training in advanced cardiac and trauma life support. However, most remote sites will only rarely have a medical emergency. Most of the medical work is routine with a daily ‘sick call’ and hygiene rounds. The opportunities to use medical emergency skills do not often present themselves. Refresher courses may be some years apart (the UK course is every 3 years). The infrequent use of emergency skills leads to degradation in technique. Many operational sites require that medics train the first aid team on a regular basis. This may alleviate the problem to a degree.

The offshore medics can be asked to undertake other roles. This is sensible as the routine medical care of the
crew may take up only a small amount of time. It is, however, important that any secondary role adopted by the medic should not conflict with their primary role as the installation medic [18].

Facilities and equipment

OGUK [19] and OGP International Petroleum Industry Environmental Conservation Association (IPIECA) [10] are both industry organizations that have issued guidelines on medical equipment and facilities for offshore installations and remote locations. On most offshore facilities there will be a sickbay: this usually comprises a treatment area that should have facilities for a seated consultation, a resuscitation couch with 360 degree access, with suction, oxygen and medical equipment easily accessible in cupboards and a sink with running water. There is often a bed for short-stay in-patient treatment. There should also be toilets and showers for the patients, and the medic’s cabin should be located close by. It is essential to have communication facilities (phone, fax and email), so the medic can discuss cases with the supervising doctor. The facility should have easy access to the rest of the installation and the helideck to facilitate movement of the casualty in an evacuation. Ideally, there should be a large area (gym or canteen) adjacent to the sickbay available for conversion in case of mass casualties. The above represents the ideal; however, because of the constraints of space and the operational requirements of the design, it may be necessary to make compromises.

The medical equipment and drugs should be suitable to provide a limited primary care service for minor ailments that present while workers are offshore and also to provide emergency care and stabilization for more serious illnesses and injuries. It is also necessary to stock enough medical items to deal with a major emergency with several casualties. The OGUK guideline [19] includes a recommended drug and equipment inventory. Vessels also have to comply with country of registration flag regulations regarding the medical stores on board. There should be systems in place to manage pharmaceutical stocks and for the medic to order new stocks and dispose of unwanted out of date stock. It is also required to have a system to monitor the storage and use of controlled drugs.

Developments in medical emergency response offshore-telemedicine

Telemedicine is defined by the American Association of Telemedicine as ‘the use of medical information exchanged from one place to another to improve a patient’s health status’ [20]. By applying this definition, we can see that telemedicine has been used in supporting medical care in the offshore industry for many years. In 1985, it was reported that of 743 cases dealt with by the remote site medical support doctors on shore, 29% of cases only required advice given over the radio to the offshore medic [21].

Formerly, this telemedicine support was achieved using radio and telephone links, supported with faxes and more recently with the Internet and images from digital cameras. However, the improvement in telecommunications is allowing the practice of telemedicine to become more sophisticated. The basic philosophy of telemedicine is to move the information instead of patient. If this can be fully implemented, telemedicine can be of great help in improving patient care in remote locations.

The requirements to implement a telemedicine system are shown in text Box 2.

When to use telemedicine in an emergency situation

Telemedicine must be considered as a support to emergency management and not as a final solution. In a medical emergency situation, the real-time communication and data exchange can be used applying one of the following models as:

- First opinion—e.g. X-ray or electrocardiogram (ECG) interpretation.
- Second opinion to define whether the case is an emergency, or to define the level of urgency, and need for evacuation or for advice regarding the treatment before and during evacuation.

Box 2. Requirements to implement a telemedicine system

| Equipment | medical equipment to download data, which can be transmitted. ECG, X-rays, spirometry, oxygen saturation, vital parameters, laboratory tests, etc. can be registered in one part of the world and interpreted in another [29–33]. The ability to send pictures and to have a visual communication via a live video link. |
| Communications | wide bandwidth communication lines through either cable or satellite systems. These systems can easily accommodate the requirements of telemedicine (medium bandwidth, 128–384 kb) [34,35]. |
| Platforms and organization | Telemedicine is based on the data exchange and communications between a remote site (patient/medical officer) and a referral centre. To facilitate communication both parties have to use the same or compatible algorithms to exchange medical data. Standardization and the development of common protocols are required [36]. |
| Medical personnel | Studies have shown that the effective use of telemedicine is dependent on the skill training and experience of the operators [22,23]. Despite the fact that many of these technologies are familiar in daily life (mobile phones and the Internet), many medical professionals are still reluctant to use telemedicine and are unaware of its advantages. |
• ‘Shared clinical management’—when the diagnosis is not obvious, the case can be managed together with a ‘Coordination Unit’, usually located in a specialist referral centre. With a comprehensive view of the case, this telemedicine approach is very appropriate for the management of emergencies at remote sites [22–24] as it assures ‘single case-single connection-multiple response’ model.

Regardless of the model of telemedicine applied in an emergency situation, the real-time telemonitoring of patients during their transport can reduce the time for initiating treatment and allow the emergency crew waiting for the casualty to be better prepared for further management [25].

There are increasing numbers of workers offshore with chronic medical conditions such as diabetes. Telemedicine can facilitate monitoring such conditions while at work in remote locations.

The future of telemedicine offshore

Telemedicine continues to offer opportunities to improve medical emergency management in remote locations. It brings the patient closer (virtually) to a medical specialist and gives the potential for earlier appropriate treatment. Other advantages include prevention of unnecessary medical evacuations, improved remote health care, its use in teaching, and economic benefits for the employee, the company and the society [26–28]. The use of telemedicine is facilitating the deployment of new medical treatments offshore, such as the use of thrombolysis in the case of myocardial infarction. There are still many obstacles to full implementation of telemedicine in the offshore industry, such as different approaches by the operating companies, differing national law, non-standard operational protocols and differing levels of training of medical personnel. Steps should be taken to increase cooperation and standardization in remote medicine to obtain the full benefits of telemedicine and achieve continuous improvement in health and medical management across the industry.

Conflicts of interest

None declared.

References