

Mapping the knowledge base for maritime health: 3 illness and injury in seafarers

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ABSTRACT

Recent studies of illness and injury in seafarers and of disease risk factors have been mapped. There is a good knowledge base on some aspects of health, especially on causes of death. By contrast there are very few studies on aspects of current importance, such as illness at sea, the scope for its prevention, and its treatment and outcome.

Results are presented in terms of the settings in which the investigations were conducted: medical fitness examinations at recruitment and periodically, illness and injury at sea, telemedical advice, evacuation and urgent port referrals, repatriations, illness at other times in serving seafarers, health related cessation of work, and illness after cessation of work. Mortality studies were mapped in a similar way, as were population-based surveys of health and of risk factors.

The scope for valid extrapolation of the results from studies in other populations to seafarers is discussed. A more immediate problem of extrapolation relates to the current knowledge base, which is largely derived from own nationality seafarers of the traditional developed world maritime nations. It is uncertain whether this can be validly extrapolated to seafarers from the major crewing countries, who come from populations with very different patterns of illness.

Existing studies mirror the priorities of those who commissioned them, in that many of the most valid ones relate to the overall lifetime risks of seafaring in developed countries. These enable comparisons to be made with other occupational groups. The major concerns of many interest groups in the maritime sector about health are now focused on the risks within a single contract period and how these can most efficiently be minimized. Studies on this are limited in scope, are of uncertain validity, and are often used for operational purposes rather than entering the scientific literature.

Gaps in knowledge about health risks over a relatively short timescale in seafarers from the major crewing countries have been identified, and the uncertainties about extrapolating from studies in traditional maritime nations to the majority of the world's seafarers means that a major redirection of effort is needed if maritime health practice is to have a sound knowledge base on illness and injury risks in the future.

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Key words: maritime, seafarers, seaman, health, illness, injury, epidemiology

INTRODUCTION

The main reason for studying the health of seafarers has been to obtain information on their patterns of illness and injury. The results of such studies have been used to determine who should be considered fit to work at sea, in terms of their excess risk of becoming ill while aboard; to determine what training, facilities, onboard guidance, telemedical support, and medications and medical equipment are needed to manage acute illness and injury at sea; to investigate illness and injury risks in seafarers in order to identify preventative priorities. All these requirements have strong political and economic overlays as they place costs and constraints on ship operators while affecting the employment and financial security of seafarers.

The two previous articles have shown how the knowledge base on seafarer health has developed over the last 150 years and identified the ways in which health data can be collected, the settings in which this is possible and the uses to which it can be put. This article will use the framework presented in the second article to review the current state of knowledge on illness and injury in seafarers and to identify some of the more important knowledge gaps that could provide pointers to improved prevention and care.

METHODS AND APPROACH

This objective of this article is to map the current state of knowledge about the health of seafarers; it does not aim to be a formal evidence-based review. A review covering many of the topics discussed and using critical appraisal techniques to address questions about the health care needs of seafarers living in the UK will be published shortly [1]. It will look instead at the information available using the headings in Tables 1 and 2 of part 2 of the series. In doing so the scope for integration of information from a range of sources and settings will be considered for a number of common conditions.

The material included comes from a search for articles that include quantitative information in the last 15 years of references on PubMed. Selected earlier articles have also been included. In addition, the abstracts from the last four International Symposia on Maritime Health have been hand searched [2]. The web-based Textbook of Maritime Medicine has also been searched for additional articles [3]. Information that comes from less publicly available sources and that has been identified, such as dissertations, governmental and other statistics, and unpublished commissioned studies, are noted as examples.

The review will focus on sea transport. A limited number of investigations on fishing and naval personnel will be noted for comparison. Non-English language sources have not generally been included.

Much of the available health information is collected because of contact between a seafarer and a health service provider. Some has been collected in the course of special investigative studies on health where a population is assessed in a systematic way. Studies of this sort are less dominant in maritime health than in many other areas of healthcare, and so the review will categorise the knowledge available in terms of the setting in which it has been collected. Studies of contacts with health professionals can be looked at using a sequential approach to the health of seafarers in the course of their career:

- this starts with an initial medical fitness assessment;
- it proceeds through alternating periods of work, mainly at sea but with times in port, and leave:
 - during this time medical fitness is periodically re-assessed,
 - illness or injury may arise at sea, in port or on leave,
 - it may lead to advice from telemedical services, to evacuation or to repatriation.

All of these contacts with health professionals have the potential to provide sources of information on illness and injury, as have records of illness and injury and treatment onboard;

- after ceasing work at sea, contacts with health professionals will normally be the same as for other members of the population, and seafarers will not be distinguished unless funding for care comes from occupational social security or equivalent arrangements;
- deaths may occur in any of these settings, and how they are recorded will depend on the setting.

Studies of the initial selection process are important when comparisons are made with non-seafaring populations as they will show the nature of the selection and can explain differences between seafarer health and that of reference populations. Investigations of those who have ceased to work are needed both to indicate the role of medical conditions in decisions to cease work at sea (not all of these will be identified from periodic medical examinations as a person may take the decision to cease and so not be re-examined) and to provide valid data on illnesses with long latent periods in the seafaring population. For deaths an occupational description is normally found on death certificates, but an earlier career as a seafarer may be obscured by a subsequent occupation.

RESULTS

A. MORBIDITY — HEALTH CARE CONTACT INFORMATION

1. Initial medical fitness assessment

Statistics on the outcomes of medical fitness examinations are published as official summaries by a few maritime authorities, but such datasets often do not distinguish between new seafarers and those returning for periodic examinations [4]. Some of the employer and P and I club information has been presented at conferences but is not available in a published format. Studies have been done on those entering maritime training [5]. The sole published study identified relates to the prevalence of varicella antibody levels in the population examined at a single clinic [6]. It is, however, likely that a number of the studies that claim to be cross sectional or longitudinal population studies have, in reality, been derived from initial and periodic medical fitness examinations.

Studies of initial medical fitness assessments are the main source of information on the extent to which the seafaring population differs from other groups because of medical selection. Time trends may indicate changes in the health of the populations from which seafarers are drawn. The information can also be used to investigate the effect of the use of differing selection criteria on subsequent patterns of performance or illness at sea.

2. Illness and injury at sea

A wide range of study methods has been used and research questions asked about illness and injury at sea. Both morbidity and mortality investigations have been undertaken. A few have been based on analysis of cases seen by ship's doctors [7].

Studies of injuries show differences between the risks in different types of work and on different ships and routes [8–10]. There are also differences in injury frequency among different ethnic groups [11, 12]. Studies conducted over a long time period show declining rates of injury [13]. Methods of investigation vary widely and range from presentations of case series to studies that make detailed comparisons using incidence rates. In most studies personal injury fatalities exceed those from vessel catastrophes. Few of the studies in the biomedical literature look in detail at the causes of injury, with the exception of the contributions of alcohol and fatigue [14]. The relative frequency of different injuries is noted: find-

ings include a high incidence of drowning fatalities, a major contribution made by slips, trips, and falls and information on the frequency of different types of fracture [15–19]. There are no reports on the frequency of rarer forms of injury that require special treatment, such as burns, gassing accidents, and eye damage. The ratio of injuries to illnesses requiring medical attention at sea varies widely between studies. One methodological study indicates that the rules used by different countries for reporting accidents have a big influence on the numbers or incidents recorded and that those recorded are only a minority of the total number requiring medical care aboard [20].

Three conditions: myocardial infarction, malaria, and dental pain have been the subject of specific investigations.

- Myocardial infarction, diagnosed or presumed, is the commonest disease causing death in a number of studies. In some cases 80 per cent of all disease-related deaths at sea are attributed to it [21]. While the incidence at sea is not markedly different from ashore the lethality is higher and this is attributed to the lack of access to specialized medical care [22].
- Malaria is one of the best characterized health risks, with several studies indicating the at-risk ports, the role of inadequate prophylaxis in contributing to cases, and the high fatality rates, especially when illness arises mid-ocean [23–25].
- Studies on dental emergencies have mainly been done on cruise liners. They have been found to be one of the commoner causes of temporary disability as well as the most frequent reason for urgent referral on arrival in port. Such studies rely on the presence of medical or dental staff on board [26, 27].

A few old studies have investigated the reasons for temporary unfitness for duties at sea on non-passenger vessels and have shown that accidents and illness contribute about equally to temporary unfitness, while minor mental health problems are the commonest form of ill health. There were small differences in the overall frequency of unfitness, with rates lowest in deck officers and highest in engine ratings [28, 29]. No comparable recent studies are available. Indeed the sources of data used to study illness and injury at sea appear to indicate that data are usually only collected as a consequence of requirements to report illness, injury, and death or because of care needs on arrival in port [30]. Surprisingly only one article and one conference pre-

sentation were identified that used log book records of illness and injury aboard the ship [31, 32].

Given the importance of illness and injury at sea, in operational, financial, and crew welfare terms, and of the need to find ways of minimizing its impact by prevention and treatment as well as to make rational decisions about the medical criteria to be used for employment at sea, it is curious that there has not been far more work on this facet of maritime health, especially as the records held aboard will include real time information on events, treatments, and outcomes.

3. Telemedical advice reports

Requests for telemedical advice can provide an indicator of the nature and frequency of serious medical conditions and injuries occurring at sea. Considering the number of descriptive articles on maritime telemedical services there are relatively few studies that give information on the pattern of calls received [33–39]. Acute heart disease is a major reason, especially where there are passenger ferries operating [40–44]. The proportion of accidents recorded varies from around 50 per cent, and more in fishing, to a small fraction where services are not directly linked to medevac calls [45]. Infections are a significant part of the workload, and antibiotics, together with minor analgesics, are the most frequent treatments that are recommended. One study has related radiomedical contacts to the prior fitness status of the person, but very few of the surveys have followed up the cases on which advice has been given, to determine their outcomes [46].

4. Evacuations and urgent port health referrals

There have been few studies on urgent treatment ashore, other than in the cruise industry, where the high frequency of dental problems and the ethnic differences in referral rates have been studied [47–51]. There have also been investigations on infectious diseases that have come to the attention of port public health services [52–57]. Given the usefulness of this sort of information in determining health care needs at sea and priorities for prevention, it is unfortunate that the importance attached to this sort of information in the past is no longer leading to the publication of case series from port clinics.

5. Repatriations

Access to repatriation data is limited as much of it is in the hands of commercial insurers and P and I clubs who treat it in business confidence. It has

been analysed internally by some cruise companies [58, 59]. In a few countries such data is available from social insurance or other centralized organisations and can provide a perspective on the relative frequency of different conditions as causes for repatriation [60, 61]. Such studies are particularly relevant to decisions on the fitness criteria applied to those working at sea as they can indicate the extent to which changes to the criteria have the potential to reduce repatriations.

6. Illness during leave periods/in serving seafarers

There are a number of studies of ill health in seafarers as recorded in hospital and other healthcare sources ashore; most are either from a single hospital or from Scandinavia where occupational and health service record linkage is possible [62–65]. A few relate to specific occupational risks, such as dermatitis, hearing loss, or asthma from allergens [66–69]. Most concern cancer incidence and, while some of these show excesses of lung cancer and leukaemias that are related by the authors to exposures at sea, others indicate that lifestyle risks such as smoking may be more important [70–76]. Infectious disease investigations include those on HIV and hepatitis A and B, indicating excess frequency in seafarers [77–79]. One study of TB shows that it is contact ashore rather than transmission between crew members that is the main source of infection [80]. The continuing importance of TB in seafarers is indicated by one hospital case series [81]. Two studies of accidents ashore suggests that the excess risk seen at sea persists into leave periods [82, 83].

7. Periodic medical fitness assessment

There are no scientific publications reporting the results of periodic fitness assessments but some maritime authorities produce annual summaries. These are usually in terms of decisions taken about restricting duties or not issuing a certificate as a person is considered unfit [84]. The results can provide useful information on the development of long-term illness or risk factors for illness in the course of seafarers' careers [85]. However, those who choose to leave the industry because of health problems will not be included, and so the data do not provide a comprehensive overview. Time trends can indicate changing patterns of illness or its diagnosis and both trend and cross sectional analyses will indicate the scope for preventative activities to reduce the number of seafarers having their careers terminated or restricted.

8. Health related cessation of work at sea

There is little specific information about the role of ill health as a reason for ceasing to work at sea other than that from periodic medical fitness assessment data [86, 87]. This is an important topic given the shortages of trained seafarers. It could also inform decisions on the basis for determining the criteria to be used in assessing fitness and the priorities for preventative initiatives. An important sub-set of this would be information on the role of occupational accidents and diseases as causes of cessation, as this could indicate areas where improvements to working conditions could be expected to have direct benefits.

9. Illness in those who have ceased work at sea

A number of studies on cancer in seafarers that use cancer registry sources have provided important information on the contributions of occupational and lifestyle factors to disease. These studies encompass serving seafarers as well as those who have retired (see section 6). Few other causes of morbidity have been investigated in former seafarers, almost certainly because of the problems of tracing a former occupation and linking it to current health records [88].

B. MORTALITY – DEATH CERTIFICATION AND RELATED INFORMATION

10. Death from illness and injury at sea

In contrast to morbidity studies, the fact that death, and sometimes its cause, is relatively reliably recorded means that there is a body of knowledge about deaths in seafarers. As this often comes from state registries it is not always separated by the setting in which it occurred but for longer-latency causes this is of limited relevance.

There have been a number of studies that have looked at deaths at sea, either from all causes or restricted to accidents, deaths from illness, and those from causes such as suicide and alcohol [89–98]. Most studies use relatively time limited cohorts, and those by Roberts are exceptional in being able to look at trends over a period in excess of 50 years. Comparative studies of seafarers on ships of different type and flag have been performed [99–101]. The derivation of population denominators has only been possible in some studies, where the total population of seafarers can be measured or estimated.

Mortality from accidents shows a clear and consistent pattern across a number of studies. It con-

tributes to over half the deaths at sea, and the number dying from injury accidents is almost always in excess of the number lost in maritime catastrophes [102]. Where time trends are available the incidence of fatal accidents can be seen to be declining, but it is still orders of magnitude in excess of that for other shore-based jobs, although exceeded by fishing [103–105]. Fatal accident risks vary with the nature of employment at sea and with the flag of the vessel.

Far and away the largest cause of disease-related death at sea is arterial disease [106–108]. Most cases do not have any prior indication of risk, while around half are found dead, from a presumed cardiac event. Some studies indicate that the incidence is comparable with the general population but others indicate an excess. One study of trend data shows an increase in frequency between the 1920s and 1960s and then a subsequent decline [109]. Liver disease and suicide are consistent excess risks in seafarers, but there is no consistency in the levels or how they relate to incidence onshore.

Commentary both on accidental deaths and on those from presumed cardiac events points to a higher fatality rate at sea because of the limited facilities available for medical care. Such information can contribute to decisions on the type and level of medical training and equipment that are needed to deal with medical emergencies aboard.

11. Death from illness and injury in serving seafarers

Because of the design of mortality studies they do not, in general, distinguish between serving and former seafarers. There is, however, some evidence that fatal accident rates remain higher than those in the general population when seafarers are ashore. The incidence of fatalities in those recorded as seafarers who are of a working age can provide relevant information, but the incidence recorded for those ashore may be raised because those with long-term conditions cease to work at sea from an early age. The excess risk of death from arterial disease in seafarers ashore as compared with those at sea could well reflect self or medical selection out of the seafaring population by those with early stage disease.

12. Death from illness and injury after ceasing to work at sea

Many of the risks from working at sea, notably those from trauma, cease immediately. Others may persist and there have been a number of studies of cancer mortality, some with associated morbidity data,

which have identified continuing risks. Results, particularly in relation to lung cancer, can be controversial as asbestos and chemical exposure as well as smoking all contribute [110]. Several studies have found lung cancer excesses associated with cases of mesothelioma, indicating effects from asbestos [111–113]. Others have shown excess risk associated with work on chemical tankers, suggesting a role for chemical exposure, especially where there are also increases in leukaemia or lymphoma [114]. Lifestyle risk has been suggested by association of lung cancer excesses with increases in obesity, smoking habit, and alcohol-related liver disease. One study suggests that the effects of such risks can be seen across genders with female seafarers conforming to a male pattern of risk and having mortality rates that differ from those of the onshore female population [115].

It is the mortality studies that have provided most of the valid comparisons between the health of seafarers and that of the rest of the population. They also have the potential to provide an indication of priorities for prevention. Their limitations do need to be recognized, notably that chronic disabling but not fatal conditions, such as mental health problems, noise induced deafness, and musculo-skeletal pain are inherently missed. As many of the deaths from arterial disease occur when seafarers are alone in their cabins, provision of defibrillators, even if effective, will only be a partial solution [116, 117]. By contrast, improvements in prevention by alteration of lifestyle have the potential to benefit everyone.

C. POPULATION-BASED HEALTH AND RISK FACTOR INVESTIGATIONS

13. Pre-sea

There is one study that used prior information on fitness for military service to assess whether seafarers are a group with an inherently high risk of subsequent ill health [118]. Some elevation in risk is found but not enough to fully explain the elevated levels of morbidity in serving and retired seafarers. The only other area where pre-sea population studies have been identified relates to the use of psychometric tests to predict the outcome of training. As these are not directly linked to health end-points they are not considered here.

14. Serving seafarers

There have been a few studies of workplace exposure to potentially harmful agents including oil

mists and carcinogens in engine rooms, chemical and carcinogen exposure during cargo handling on tankers, and bacterial contamination in air conditioning systems [119–124]. Asbestos exposures and noise levels have been investigated [125, 126]. Accident risks from acute exposures to harmful agents have also been studied [127].

By contrast, there have been a wide variety of studies on personal risk factors for disease in seafarers and on the patterns of illness. While the studies reviewed have been presented as population-based investigations it would appear that in a number of cases the population has been drawn from those making contact with maritime health professionals for periodic medical examinations. It is possible to build up a picture of some of the patterns of illness in seafarers from the results, and authors have often indicated whether the risks they are considering are present at more than the expected level in seafarers. This appears to be the case for dental problems [128–130]. Studies may be concerned with the specific occupational risks of seafaring, the role of seafarers' lifestyles as contributors to risk, or may look more widely at the overall pattern of health risks and harm in seafarers [131–133].

Occupational health studies cover asbestos disease, decrements in lung function, and noise induced hearing loss – all showing excesses in engineers [134–137]. Neurobehavioural changes are associated with exposure to hydrocarbons [138, 139].

A number of studies address risk factors for arterial disease, including ECG changes, hypertension, obesity, smoking and alcohol misuse, and biochemical markers [140–151]. All conclude that risk factor measurements indicate that seafarers can be expected to have a greater frequency of arterial disease than the general population. These studies are addressing, in the main, aspects of the lifestyle of seafarers and tend to indicate a common set of behaviour changes that are needed and the sort of modifications to diet and other aspects of life at sea that could reduce the risks [152, 153].

Infections were investigated as occupational risks from the presence of disease-carrying vector species on board [154]. They were also investigated in relation to venereal transmission of HIV and also for hepatitis [155–157]. Studies here looked at behaviours and practices as well as at infection rates. In general, the findings showed a lack of safe sex practice and an increased frequency of infections compared to reference groups [158–160]. A small number of studies were concerned with other forms of infec-

tion, such as Tinea infections, or with sensitization from the presence of allergens on board [161, 162].

Most studies were cross sectional or short-term incidence investigations but a few did look at time trends [163]. Efforts to relate changing voyage patterns and job demands to health changes did not provide any consistent results.

15. After cessation of work at sea

Only two population studies of former seafarers have been identified. Both were investigating the frequency of asbestos related pathology, and both found levels in seafarers above those in the general population, with higher frequencies in engineers and in ratings than in deck officers [164, 165].

D. EXTRAPOLATION FROM OTHER POPULATIONS

There is a far larger medical literature on prognosis and case management ashore than there is for seafarers. Extrapolation from studies ashore may provide the best estimates of the risk of disease recurrence or progression occurring at sea, particularly for those conditions that are not related to living and working conditions. In addition such information is inherently more up to date on developments in treatment and therapy. Thus the risks of a cardiac event given different combinations of risk factors can be estimated much more precisely using the results of onshore studies. A practical obstacle can be persuading those solely concerned with the maritime industry and seafarers that for most disease risks seafarers are no different from other people of a similar age and gender and who have a similar pattern of ethnic, social, and geographical backgrounds.

DISCUSSION

The investigations that have been noted and categorized provide a wealth of information about the health of seafarers, but they present it in ways that do not lend themselves to making a clear and convincing case about the nature and severity of health problems and injuries among seafarers and the means by which they can either be prevented or their effects ameliorated. For instance, the largely consistent studies on cardiac events, malaria risks, and dental problems at sea have not led to comparably consistent approaches to prevention or treatment.

The majority of the studies identified have been performed in the traditional maritime nations of Europe and North America and most relate to maritime populations from these countries. This pattern may, to an extent, reflect a selection bias in the collection

of information for this review. This may arise from the focus on English language articles or in the way in which different cultures use scientific publications and symposia as the forums for presenting the results of studies, but this information base is nevertheless real in terms of ready international access to evidence on maritime health.

The evidence on ethnic differences in risk, although limited, suggests that the studies referenced should only be extrapolated with great care to the major suppliers of maritime workers in Asia. The lack of studies from these areas also means that there is no valid information on their health risks and on prevention that is directly applicable to those for whom it is now likely to bring the greatest benefits.

There can be little doubt from the studies reviewed that, when compared with the rest of the population, seafarers are a group with a substantially increased risk of accidents and with an increased risk of some forms of disease. A proportion of this disease is attributable to specific occupational risks, but a large part relates to the lifestyle of the seafarers studied. Much of the information is derived from mortality studies and so cannot reflect the much less well-documented contribution of disabling but non-fatal accidents and illnesses.

These patterns of accident and disease risks are well known by the maritime sector, and as has to be noted, implicitly accepted. The trend data that are available do indicate that accident risks, including fatal ones, are declining. The pattern is less clear for disease. Trends in deaths from arterial disease may have peaked but the changing population of seafarers, with many Asians who are at the same time experiencing major changes in incidence as their patterns of diet change to become more similar to those of European cultures, means that extrapolation is difficult. Extrapolation from onshore populations suggests that active management of arterial disease risk factors can bring benefits. This is one of several areas where the evidence from the onshore setting has yet to be widely applied in the maritime setting.

As the maritime sector has become more international in its crewing, the time relationship between work at sea and illness has changed from concern about the lifetime risks of a national population of seafarers to a focus on fitness for the next contract period and the financial and personal implications of illness arising during this limited period. While many of the studies cited focus on long-term risks in a national seafaring workforce, the knowledge base on the probability and consequences of illness and

injury during a single contract period is weak. Notably there are very few studies that look at the non-fatal illnesses and injuries that arise at sea and on which information should be readily extractable from medical and other logs and from telemedical contacts or from the use of medication aboard. Similarly there are few studies of referral of seafarers for acute and sub-acute treatment in port or on repatriation, rehabilitation, and return to work. Where such studies exist they look at only a single facet, such as telemedical advice, and do not investigate either the antecedents to this or the eventual outcome from the illness or injury recorded.

Information on illness in serving seafarers is important for a number of reasons. It can help inform the needs for crew medical training, equipment, and facilities on board. It can assist with better provision of telemedical support, port clinic services, and repatriation and rehabilitation arrangements. One of the main purposes of medical fitness assessment prior to embarkation is to reduce the risk of illness at sea, so better information on what arises in practice and the scope for risk reduction can lead to standards that provide protection, and are only restrictive where there is evidence to support it. Improvements in all these areas have the potential to benefit both seafarer and employer. Information on patterns of illness and injury at sea can also be the basis for better prevention on board, whether to improve safety systems to reduce injury or to ensure, for instance, that malaria risks are minimized.

The barriers to collection of better information on illness and injury at sea are in part a reflection of the shore-based focus of most of those who investigate maritime health and their concentration in areas such as NW Europe that are less and less representative of the locations where seafarers live and are recruited from. The emphasis on commercial medical services and the lack of a viable academic base in the major crewing countries means that any concerns that do surface are not readily converted into research questions and investigative studies. The second barrier to investigation is the diffusion of responsibility within the maritime sector with aspects such as recruitment, medical assessment, and repatriation handled through contracts between commercial providers who do not necessarily have any interests beyond their own financial advantage. Barriers are even more apparent where costly illness and accidents arise and insurers and P and I Clubs become involved, each concerned with maintaining the commercial confidentiality of its flow of funds from premiums to payouts.

Lifetime risks in seafarers remain important, but the scope for their investigation in any but a few developed countries with good population databases is limited. For long-term risks it would appear that there is at present no alternative to continuing to extrapolate from data sets in the locations where they are available to the rest of the world. The natural history and prognosis of most diseases arising in seafarers, except where it is modified by the ease of urgent access to health care facilities, is similar to the same diseases when they arise in comparable onshore populations. Extrapolation from onshore datasets plays a large part in determining fitness to start a career as a seafarer or to continue working at sea. There would be benefits if a similar pattern of extrapolation were applied to prevention of illness in seafarers.

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