

The profound impact of the COVID-19 pandemic on seafarers' health and medical care. The experience of maritime tele-medical assistance services during 2020-2021

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ABSTRACT

Objective: The access of seafarers to health care services ashore and proper medical care by specialist doctors has been established through an extensive legal framework, which dictates that seafarers are entitled to the same quality of medical care as other employees working onshore. However, during the COVID-19 pandemic, international travel and trade were significantly disrupted, and port restrictions and border closures imposed unprecedented barriers to medical referrals of seafarers ashore, resulting in serious consequences for their health and well-being.

Objective: The objective of this study was to present the serious difficulties and complications faced by telemedical assistance services in managing medical cases on board during 2020-2021.

Methods: The study analyzed all cases reported to Med Solutions International, an international telemedical assistance company, during the two years of the pandemic. It specifically focused on delays and denials of medical referrals ashore, which led to most cases being exclusively handled through telemedicine.

Results: The study demonstrated that only a minority of cases had the opportunity to be referred ashore for medical examination, while many cases were repatriated for further investigation and treatment when ashore referrals were denied. The absence of diagnostic testing and treatment ashore posed significant challenges and frequently endangered the lives of seafarers.

Conclusions: The overall medical care of seafarers and their access to healthcare facilities ashore were severely affected by the COVID-19 pandemic. Telemedical assistance services were tasked with the challenging responsibility of replacing shoreside medical care. The detrimental impact on seafarers' health and human rights calls for corrective measures from international institutions.

Keywords: seafarers, maritime medicine, telemedicine, telemedical assistance, COVID-19 pandemic.

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INTRODUCTION

It is estimated that 90% of the volume of international trade is carried by merchant ships, including both raw materials and finished goods. The world merchant fleet consists of more than 90,000 vessels, while more than 2 million seafarers are occupied at sea (officers and ratings) (UNCTAD, 2021)(1). The maritime industry is vital to the global economy and trade, and its significance requires special regulations. On the other hand, the seafarers' profession is high-risk, involving exposure to numerous hazards. Crews constantly face various hazards at work, including extreme weather conditions, hazards of operating equipment, contact with toxic substances, smoke inhalation, noise, vibration, fatigue, varying time zones, overwork, accidents, injuries, exotic diseases, and lack of prompt access to qualified medical care. The mortality rate of seafarers is 25-30 times higher than that of workers onshore. In the past, working at sea exposed crews to significant morbidity without access to medical care or healthcare services. Today, an extensive network of institutions, conventions, regulations, and international laws protect seafarers from injury and illness, aiming to provide them with medical care equivalent to onshore employees and ensure access to effective healthcare services when needed.

Notwithstanding international law, an emerging infectious disease evolving into a pandemic by the end of the second decade of the 21st century has breached those rights and severely affected the health of seafarers. The COVID-19 pandemic posed unprecedented restrictions on international travel and trade, significantly impacting the global economy, social life, and all aspects of health services. Borders closed, lockdowns and quarantines were imposed in practically every corner of the world as an attempt to limit the spread of the infection. The maritime industry experienced severe repercussions due to trade restrictions. Seafarers were compelled to remain isolated on board without the ability to disembark and return to their countries, and most importantly, without access to shore healthcare services. Many crew members with medical conditions and injuries were unable to disembark for medical examinations and had to rely solely on telemedicine for medical consultations. The maritime industry was ill-prepared for such unprecedented circumstances, and in numerous cases, the available drugs and equipment on board were insufficient or depleted after prolonged periods of isolation. The medical management of illnesses and injuries relied exclusively on telemedicine, which essentially depends on medical history, without the possibility of conducting clinical examinations or laboratory or imaging tests. Ships typically do not have medical personnel on board (unless they have more than one hundred crew members). Despite mandatory training in first aid and emergencies, the crews and masters of the ships are not equipped to handle medical conditions independently or evaluate a patient's clinical condition.

Due to port restrictions, especially during the initial months of the pandemic, disembarkations and referrals for medical consultations ashore were denied by port authorities. Disembarkation was allowed Only in life-threatening conditions, but not everywhere. At times, evacuation was only achieved after persistent and prolonged requests, often involving third parties such as P&I clubs and embassies. Consequently, serious medical conditions could worsen on board without adequate treatment and without a definitive diagnosis. Many cases of simple medical conditions escalated into complicated matters due to a lack of timely and appropriate treatment. Injuries remained untreated on board for extended periods, causing prolonged suffering and pain. There were instances where medical conditions were monitored on board for months because they were not considered serious enough or life-threatening to warrant a referral to specialized care ashore. Additionally, the presence of crew members off duty for extended periods compromised the functioning of the ship, as the remaining crew had to shoulder the responsibilities of the ill seafarers.

The study initially refers to the legal framework protecting seafarers' health and the existing literature on the management of seafarers' health during the pandemic. While much has been discussed about the impact of the pandemic on the maritime industry and maritime health, there has been limited research on the challenges faced in case management on board from the perspective of telemedical assistance services, considering the barriers imposed on disembarkation and referrals to specialists ashore. This study aimed to highlight the delays in medical care, illustrate their impact on the health of seafarers, and shed light on the pain, suffering, and discomfort they experienced. Furthermore, the study

aimed to demonstrate the extent to which seafarers' human rights were violated.

The legal framework

The IMO (International Maritime Organization), established in Geneva in 1948, and the ILO (International Labor Organization) have played a significant role in promoting measures and regulations to protect the health and welfare of seafarers over the past decades. Various conventions have been established, forming a framework of rules to be applied and respected within the context of international law (see **Table 1**).

Table 1. Legal framework for seafarers' health protection.

• Legal framework for seafarers' health protection
• 1958 ILO recommendation 106
• SAR Convention 1985
• 1987 ILO convention 164
• 1992 EU Directive 29/92
• 2000 IMO Maritime Safety Committee Circular 960
• 2006 MLC Convention
• 1978-1995-2010 STCW Convention

In 1958, the ILO introduced Recommendation R106, which emphasized the importance of radio medical advice at sea (ILO, 1958)(2). This marked the first discussion on the necessity of providing medical advice to seafarers through radio communication while at sea.

The International Convention on Search and Rescue (SAR), which has been in force since 1985, mandates that every country develop a SAR organization plan and cooperate with neighboring countries to coordinate emergency response efforts, regardless of where an accident occurs.

In 1987, the ILO Convention C164 on seafarers' health protection and medical care was introduced. It mandated that all member states ensure that seafarers' health protection and medical care are comparable to those available to workers onshore. The Convention emphasized the right of seafarers to access medical care without delay when in ports of call. It highlighted the importance of health prevention, promotion, and education for seafarers (ILO, 1987)(3). The Convention also included provisions for the ships' medical chest and medical guide. Importantly, it established a system of free radio/satellite-based medical advice, including specialist consultations, available at any time of day or night, organized by competent authorities. The requirement for an onboard physician was only mandatory for ships with more than 100 passengers and navigating for more than 3 days.

The EU Directive 29/92 also incorporated provisions for Telemedical Assistance at Sea (TMAS), enabling radio consultations with specially trained doctors (EUR-LEX, 2019)(4).

In 2000, the IMO Maritime Safety Committee (MSC) Circular 960 recommended an optimal arrangement for medical assistance at sea, which encompassed Rescue Coordinating Centers (RCCs), TMAS, means of intervention at sea, shore-based arrangements, and common operational

procedures. TMAS was deemed necessary to alleviate the isolation of both victims and captains responsible for treatment, minimize or avoid the need for evacuation when possible, and assist RCCs in making appropriate decisions (IMO, 2000)(5).

The International Convention on Standards on Training, Certification and Watchkeeping for Seafarers (STCW, 1984, amended in 1995 & 2010) requires that all seafarers have completed basic safety training, including first aid and response to emergencies, while a specified officer should be in charge to provide primary medical care. All seafarers should pass PEMEs (pre-employment medical examination) to ensure medical fitness before working on board (IMO, 1984)(6).

The Maritime Labor Convention (MLC, 2006, in force 2013) in title 4 includes provisions for medical care, welfare and social security protection of seafarers, medical care on board and ashore. Countries through which ships are passing should guarantee treatment and provide access to shore-based facilities to all seafarers, regardless of sex, race, religion. The same article also discusses shipowners' liabilities, social security coverage and protection, accident prevention and hygiene on board (ILO, 2006)(7). WHO, IMO and ILO also created an international medical guide for ships (IMGS), a medical first aid guide (MFAG), a medical first aid guide for use in accidents involving dangerous goods etc.

All those regulations and provisions have achieved a satisfactory framework of health protection for seafarers at the dawn of the 21st century. Despite its intrinsic limitations, telemedical assistance remains a valuable tool for management of medical cases and injuries on board, and modernization in technology can provide today, significant innovations to render its services more effective (Sagaro and Amenta, 2020)(8).

The COVID-19 pandemic

In 2019, an unanticipated pandemic appeared to endanger global health and international security. The COVID-19 pandemic, which started from China, spread rapidly to every corner of the planet, jeopardizing human health and international economy, law, security and human rights. Every aspect of human life was affected, and every occupation was disrupted. More than 625 million people have been infected worldwide, up to date, and more than 6,5 million people have died from the new coronavirus (Johns Hopkins University, no date)(34). More than this, fear of disease and economic insecurity have had a devastating psychological impact to human populations. Seafarers, by nature isolated at sea, were also affected in multiple ways, unable to disembark or even have access to medical care and were obliged to extend their contracts for a long time with severe psychological adverse effects (Shan, 2022)(9). TMAS centers were also forced to adapt to the new situation, trying to manage medical cases on board without support from shore facilities, while medical evacuations were often denied or postponed indefinitely. Shipping schedule cancellations and transport and trade disruptions with service suspensions during the initial phases of the pandemic hit the maritime industry which, nevertheless, managed to avoid possible collapse (Dirzka and Acciario, 2022)(10). Delayed crew repatriations and contract extensions were routine during the initial period as well as

deprivation of medical assistance (Hebbbar and Mukesh, 2020)(11). Despite calls from UN and the shipping industry to consider and respect the rights of seafarers in all jurisdictions as "key workers" of international trade, many countries didn't allow crew exchanges in their ports, keeping seafarers on board far beyond their initial contracts, against international law and MLC (Wilhelmsen, no date)(35), constituting a true humanitarian crisis (De Beukelaer, 2021)(12). On 26 May 2020, IMO, ILO, and ICAO (International Civil Aviation Organization) published a guidance for facilitating crew changes in ports and airports during the pandemic (IMO, 2020)(33). However, in June 2020, more than 150,000 seafarers were still awaiting their return home. The G20 summit in March 2020 also committed to facilitating international trade (Dolumbia-Henry, 2020)(13). In 2021, IMO published a framework regulating safe crew changes and travel during the pandemic (IMO, 2021)(14). During this year the situation slightly improved, however, referrals to specialist care ashore still face problems today, 2 years after the pandemic started.

Maritime health trade was put at risk during pandemic times. The requests for medical advice for flu-like symptoms significantly increased during the pandemic (Sagaro et al., 2020)(15). TMAS during the pandemic showed increased capacity to aid the crew in diagnosis, monitoring, protocols and operations during flu-like outbreaks on board as well as other medical issues (Sossai et al., 2020 and Dehours et al., 2021)(16, 17). The CDC published an interim guidance on managing suspected or confirmed cases of COVID-19 on board (CDC, 2022)(18). Similar guidelines were published by WHO (WHO, 2020)(19), the IMO (IMO, 2019)(20) and the ILO (ILO, 2020)(21). Studies showed that outbreaks on cargo vessels could be managed with effective quarantine measures and protocols (Codreanu et al., 2021)(22) to maintain a balance between uninterrupted trade and healthy crew, considering crewmen exchanges. It was proposed that ships should have rapid diagnostic tests and seafarers receive priority vaccination (Dengler et al., 2021 and Schlaich et al., 2021)(23, 24).

Research already demonstrated the high prevalence of depression, anxiety and psychiatric disorders in general, in seafarers during the COVID-19 pandemic (Baygi et al., 2021 Lucas et al., 2021 and Qin et al., 2021)(25,26, 27). Post-traumatic stress disorder and mental health issues were also related with extended durations of work on board ((Baygi et al., 2022 and Pauksztat, Andrei and Grech, 2022)(28, 29) and affected their work performance and well-being ((Hebbbar and Mukesh, 2020 and Sliško, 2020 and Pauksztat, Grech and Kitada, 2022)(11, 30, 31). Insomnia and feelings of lack of safety were also experienced by seafarers (Pesel et al., 2020 and The Mission to Seafarers, no date)(32).

Much has been discussed regarding the impact of the pandemic on the maritime industry and maritime health. However, there has been a lack of extensive research on the challenges faced in case management on board from the perspective of telemedical assistance services, considering the barriers imposed on disembarkation and referrals to specialists ashore. In this study, a substantial number of cases handled by an International Tele-Medical Assistance provider (Med Solutions International) during the two-year duration of the pandemic were analyzed. The focus was on the limited

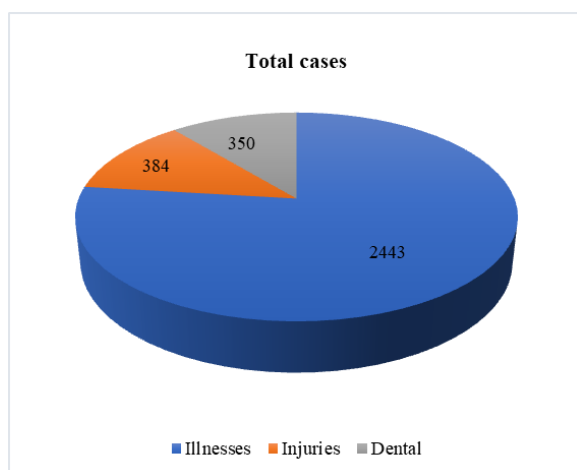
cases that eventually received medical examination ashore or were admitted to hospitals, the prolonged periods of monitoring for serious medical cases and injuries on board, and the significant number of cases that were repatriated for further investigation and treatment due to denied examination ashore. Some cases were monitored for several months, and adverse health outcomes were observed, which will be discussed in more detail.

MATERIAL and METHODS

Study population: The study focused on the analysis of cases reported to Med Solutions International, a telemedicine company specializing in serving the global maritime merchant industry, during the two-year period of the pandemic (2020-2021). Throughout this duration, the company received a significant number of assistance calls from merchant ships worldwide and managed numerous medical cases and injuries, including a notable number of cases with flu-like symptoms suspected to be related to COVID-19. The company encountered various challenges in coordinating medical examinations ashore and, more significantly, arranging medical evacuations, even for emergency situations, while handling difficult cases on board under demanding conditions. The study encompassed all reported cases to Med Solutions during the two-year period, encompassing medical cases, injuries, and dental cases, without any exceptions. The cases involved seafarers of diverse nationalities, shipping companies flying different flags, and ports situated in various countries across the globe.

Study design: A list of the entire cases handled during the 2 years in EXCEL was analyzed. The list contained the dates at which cases opened and closed, information on whether the cases were examined ashore and their outcomes (recovery, repatriation, hospitalization etc.). Cases were classified into medical illnesses, injuries, and dental cases (**Table 2**).

Table 2: Total TMAS cases 2020-2021



Medical cases were divided into cases with flu-like symptoms (potential or confirmed COVID-19 cases), cardiovascular cases, gastrointestinal cases, genital-urinary cases, skin conditions, eye conditions, psychological and musculoskeletal conditions, and other miscellaneous medical conditions. Injuries included orthopedic, eye injuries and burns. Poisoning cases were also classified as injuries. Orthopedic cases included injuries of the upper and lower extremities, injuries of the back, head, and miscellaneous other cases. In

all categories, the mean duration of monitoring on board and the percentage of cases eventually receiving medical examination ashore or hospital admission were calculated. The number of cases being monitored for more than one month and the number of cases repatriated for further management in their own country when management ashore was denied, were also calculated. Last but not least, some cases with significant adverse effects due to delayed referral are discussed, as well as the challenges of handling difficult cases on board for prolonged time, without the presence of medical professionals and with insufficient means and equipment.

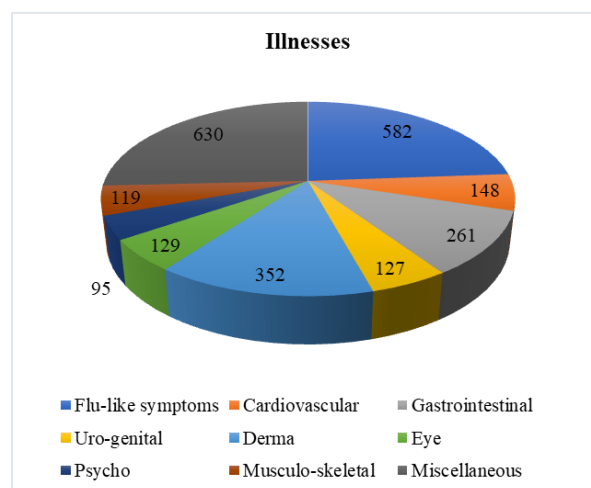
RESULTS

A total of 3,221 cases were reported during the years 2020-2021.

1. Illnesses

A total of 2443 illnesses cases were reported, corresponding to 75.8% of total cases. Those were further divided into 582 cases with flu-like symptoms (including COVID-19 cases), representing 24% of illnesses (18% of total), 148 cardiovascular cases (6% of illnesses, 4.5% of total), 261 gastrointestinal cases (10.6% of illnesses, 8% of total), 127 urogenital cases (5.2% of illnesses, 4% of total), 352 skin conditions (14.4% of illnesses, 10.9% of total), 129 eye conditions (5.2 of illnesses, 4% of total), 95 psychological conditions (3.8% of illnesses, 2.9% of total), 119 musculoskeletal conditions, mostly back pain and arthritis (4.8% of illnesses, 3.6% of total), plus miscellaneous other minor cases (**table 3**).

Table 3: Illnesses

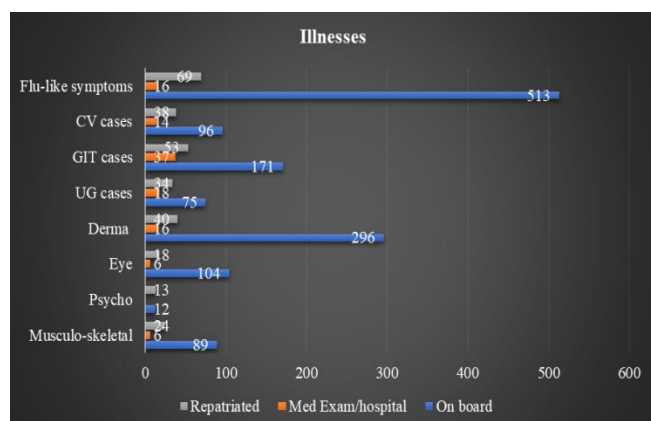


1.1. Most of 582 cases with flu-like symptoms (fever, sore throat, dyspnea) were handled on board. Mean time of monitoring on board was 10.9 days (in line with standard isolation period at the time and evolution of Covid-19 symptoms). Only 8 cases were monitored for over 1 month (one of those was eventually hospitalized). From total, 69 signed off, referred for examination ashore (11.8%) and 16 were admitted in hospital (table 4). We have no sufficient data on whether some seafarers who signed off were also admitted in the hospital after disembarkation. There was one urgent medical evacuation for a patient with low oxygen saturation and dyspnea after 9 days of monitoring on board. There were 2 deaths reported after the seafarers disembarked,

which occurred during their hospitalization ashore (0.3% of cases with flu-like symptoms).

1.2. Cases with symptoms of chest pain, shortness of breath, palpitations, elevated blood pressure and loss of consciousness were classified as cardiovascular. During this period there were 148 such cases. From those cases, only 14 were transferred ashore for examination (9.5%) and 6 were hospitalized (two after urgent medical evacuation). 38 seafarers were referred for medical examination after signing off (post-repatriation), (**Table 4**). The mean time of monitoring on board was 7.7 days. Of these, 11 cases were monitored for more than 1 month.

Table 4: Illnesses managed on board / examined ashore / repatriated



1.3. Two hundred sixty-one cases reported gastrointestinal symptoms (abdominal pain, nausea, vomiting, diarrhea). The mean time of monitoring on board was 12.6 days, however 20 cases were monitored for over 1 month. From the total 261 cases, 37 were examined ashore (14%) and 13 were admitted in hospital. 53 seafarers signed off and were repatriated (table 4). From 20 cases monitored for more than one month only 8 were finally examined. There were 14 cases of probable appendicitis of which 7 were hospitalized and the other 7 disembarked and were repatriated for treatment. There were also 2 cases of probable diverticulitis, 1 case of probable pancreatitis signed off for treatment and 1 case of acute abdomen (peritonitis) hospitalized.

1.4. Cases with symptoms from genital-urinary tract (urinary infections or kidney stones, symptoms from genitalia) were 127. From those cases, only 18 were examined by a doctor ashore (14.1%) and 3 were hospitalized (2.3%). Mean time of monitoring on board was 7.5 days. However, 14 cases were monitored on board for over 1 month and 6 cases over 2 months. 34 seafarers were repatriated for treatment in their country (**Table 4**).

1.5. 352 dermatological cases were reported during the 2 years (including various conditions from rashes, pimples, and skin infections, alopecia and acne). Only 16 cases (4.5%) were referred for medical examination ashore. All the rest were managed on board. Cases which could not be managed on board would usually sign off to get examined in the home country if permitted by port restrictions (40 cases were repatriated), (table 4). The mean time of monitoring on board was 10.2 days. 38 cases were monitored for over 1 month and 10 cases over 2 months.

1.6. Ophthalmological cases reported were 128 in total, including eye infections, irritations etc. From those, only 6 (4.6%) were examined ashore. 18 seafarers signed off or and were repatriated for further investigation and treatment (table 4). The mean time of monitoring on board was 16 days. However, 7 cases were handled for more than a month and 2 more than 2 months.

1.7. During the 2 years of the pandemic, there were reports of a wide range of psychological conditions. There were 25 cases with clear psychological illness, including 7 cases of acute psychotic episodes and 2 episodes of depression, while the remaining were cases of panic attacks, anxiety disorders and insomnia. The mean time of monitoring on board was 16.3 days. However, 10 cases were monitored on board for more than 1 month, and 3 of them for more than 2 months. All those cases were treated on board and repatriated for further treatment in their country (**Table 4**). There were also 70 more cases with non-specific symptoms attributed to anxiety (weakness, headaches, dizziness, numbness in extremities etc.).

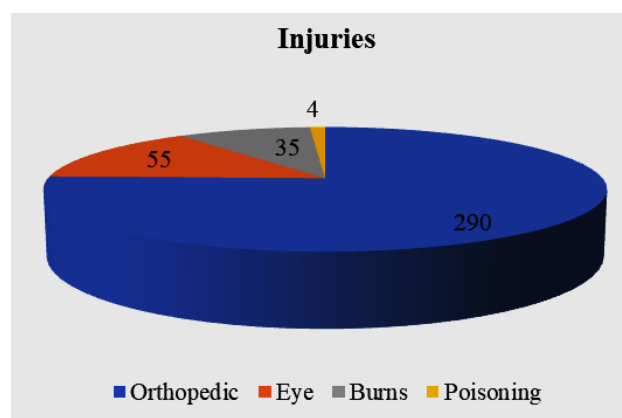
1.8. There were 119 cases with musculoskeletal symptoms, mostly back pain. Only 6 cases were examined ashore (5%) and 24 cases were repatriated for further treatment (table 4). Mean time of monitoring on board was 12.9 days. However, 6 cases were monitored on board for more than 1 month and 1 case for more than 2 months.

1.9. There were also other serious cases, including an episode of pulmonary embolism and a case of deep vein thrombosis which were urgently evacuated, 1 epileptic seizure, which was monitored on board for 9 days and eventually repatriated for further management, 5 strokes which were all hospitalized (1 of them disembarked after 45 days and another after 17 days). There were also 2 sudden deaths on board.

2. Injuries

384 injury cases were reported, corresponding to 11.7% of the total number of cases. From those, orthopedic injuries were 290 (75% of injuries, 8.8% of total), eye injuries were 55 (14.5% of injuries, 1.7% of total), and burns were 35 cases (9.2% of injuries, 1% of total). There were also 4 cases of poisoning (1% of injuries, 0.1% of total), (**Table 5**).

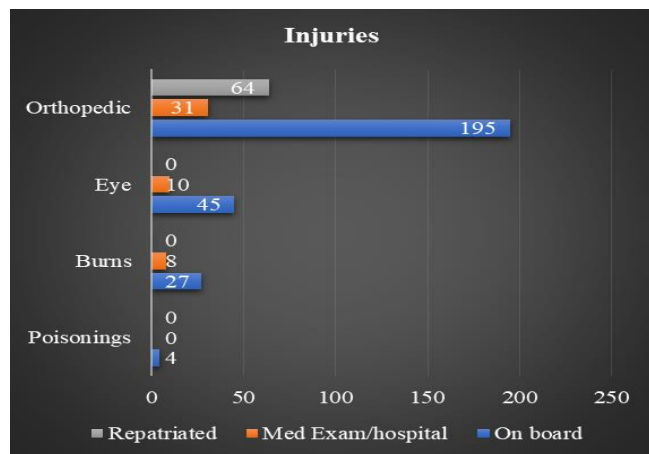
Table 5: Injuries



2.1. Orthopedic cases included lacerations, fractures, contusions, and musculoskeletal pain involving upper extremities (125 cases, 43.7% of orthopedic injuries), lower extremities (95 cases, 33% of orthopedic injuries), lower back

and chest injuries (25 cases, 8.7% of orthopedic cases), head injuries (11 cases, 3.7% of total orthopedic cases) and other miscellaneous cases, falls and minor injuries. Orthopedic injuries were treated on board for long time (mean duration 17.6 days) with only a small percentage examined ashore. From 125 injuries of upper extremities (hands, elbows, shoulders) only 17 were examined ashore (13.6%), from which 7 were admitted in hospital, 20 cases were monitored on board for more than one month, while 36 seafarers signed off with a recommendation for orthopedic exam post-repatriation. Regarding 95 lower extremities injuries (toes, ankles, knees, hips), only 11 cases were examined ashore (11.5%), and 2 were hospitalized for leg fractures, 16 cases were monitored for more than a month and 16 seafarers signed off with recommendation for med exam and definitive treatment post-repatriation. From 25 back and chest injuries, only 2 cases (8%) were examined ashore, and 10 seafarers signed off with recommendations for medical exams post-repatriation (Table 6).

Table 6: Injuries managed on board/examined ashore/repatriated



2.2. Almost all 55 eye injuries were caused by foreign bodies in the eyes (except for a few cases of chemical injuries). Only in 10 cases (18%) medical exam ashore was possible from which 4 cases were admitted to the hospital (table 6). All cases were monitored and treated on board for a mean duration of 16.3 days. In 5 more cases, monitoring on board exceeded one month, while 7 patients signed off with recommendations for medical exam post-repatriation.

2.3. Burns were caused by hot steam, water, oil, chemicals, or during the operation of the incinerator. Out of the 35 reported cases, only 8 were able to receive examinations ashore (23%). Among those, 3 cases required hospital admission. The remaining cases were managed on board, with an average monitoring duration of 16.2 days (Table 6).

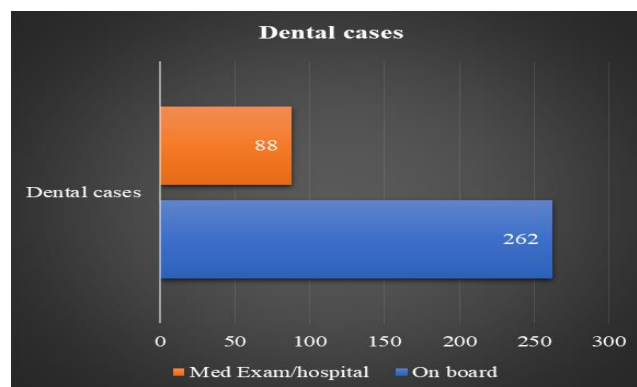
2.4. The 4 poisoning cases involved ingestion of thinner or inhalation of smoke, exposure to ozone, and toxic gases. All 4 cases were handled on board without referral ashore (mean duration of monitoring 5.7 days), (Table 6).

3. Dental cases

A total of 350 dental cases were reported, corresponding to 10.8% of total number of cases. From those 350 cases, only 88 received definitive treatment from a dentist ashore (25%), (Table 7). The rest of the cases were managed on board with

conservative means and recommendation for definitive dental treatment when possible. In most cases, this meant post-repatriation (where we cannot confirm whether it was performed). In addition, during 2020, 26 cases remained with symptoms and without dental exam for more than one month and 9 from those, more than 2 months. Only 6 of those were finally examined by a dentist. During 2021, there was an improvement in the situation, with only 5 cases ongoing without examination for more than a month, and just one case exceeding a duration of 2 months.

Table 7: Dental cases managed on board / examined ashore



DISCUSSION

1. Illnesses

1.1 Most of the cases with flu-like symptoms were highly likely to be COVID-19 infections. However, the diagnosis of COVID-19 could only be confirmed when rapid tests were available on board, after medical examination ashore, or if there was contact with a known COVID-positive patient. The majority of cases were uncomplicated and resulted in full recovery. The decision to disembark or hospitalize these cases was not solely based on medical needs (which were rare), but also influenced by port regulations, personal requests, and the fears of both the crew and shipping companies. As a precautionary measure, many crew members signed off for medical examinations, followed by repatriation. Furthermore, in many ports, any positive COVID-19 case was immediately admitted to the hospital, regardless of their clinical condition, until they tested negative. Handling multiple COVID-19 cases on board posed a challenge for the medical team. All cases were monitored based on symptoms and vital signs, including pulse oximetry (which was not always available), without the possibility of conducting physical examinations. Despite isolation precautions, many crew members on the ships were frequently exposed to the virus. There were occasional shortages of medications, and the provision of oxygen was insufficient for prolonged administration, with replenishment being impossible. Due to the ships often being located in remote areas, medical evacuations were only possible after prolonged negotiations and limited to life-threatening conditions. As a result, the vessels had to operate with a significant percentage of the crew isolated and off duty.

1.2. Regarding cardiovascular cases reported, it was common for many cardiovascular symptoms to contain an anxiety component. Chest pain, difficulty in breathing, numbness, and

palpitations in young seafarers without medical or cardiovascular history were usually attributed to anxiety or panic attacks. However, not all seafarers lacked risk factors for heart disease, and many were heavy smokers. Consequently, seafarers reporting suspicious symptoms, even if their risk profile was low, were often recommended to remain off duty until symptoms resolved or until medical examination. If the medical exam was postponed indefinitely, seafarers would remain off duty for a long time, compromising the normal function of the ship. Some seafarers signed off with recommendations for medical exam before repatriation. We lacked sufficient data to confirm whether they underwent examination ashore and what the results of those examinations were. If the reported symptoms were not suspicious, it is likely that they were examined in their home country, as this was the trend in ports, particularly during the pandemic. Few true heart disease incidents were reported during those 2 years. An acute coronary syndrome was evacuated within 48 hours and hospitalized. There was another case of stroke which was evacuated within 24 hours. One seafarer with atrial fibrillation, abdominal pain and unregulated diabetes was monitored on board for over 2 months (135 days). He was eventually examined and returned to the ship where he was monitored for a long time until he was repatriated.

1.3. Cases with gastrointestinal symptoms were challenging to manage because clinical examination of the abdomen was impossible through telemedicine. Most cases were episodes of gastritis or gastroenteritis, however there were cases with acute pain, suspicious for appendicitis or other abdominal inflammation. If the clinical condition was deteriorating and the pain was suspicious, the medical team tried to refer the seafarer ashore for further investigation. The cases of probable appendicitis were initially treated on board with antibiotics until medical examination ashore was coordinated. In some cases, medical evacuation was possible within 1-2 days. However, this was not always the case, and potentially life-threatening conditions remained on board, treated conservatively with antibiotics until clinical deterioration. Some seafarers had to sign off and be repatriated for investigation and treatment. A seafarer with acute appendicitis was monitored on board for 19 days before approval for disembarkation and hospitalization ashore. Another patient with biliary colic was not allowed to disembark and was monitored on board for 85 days before repatriation for further investigation. A patient with jaundice was allowed to go to hospital ashore after several days, and there he remained without testing, waiting for PCR tests for COVID. A seafarer with blood in stools was monitored for 53 days on board without the possibility of examination ashore and was eventually repatriated. Chronic abdominal pain from GERD, gastritis, and irritable bowel syndrome would never be allowed to go ashore for further investigation, so they were all handled on board.

1.4. Regarding patients with symptoms from uro-genital tract, there were seafarers with dramatic symptoms from kidney stones or urinary tract infections who remained on board with symptomatic treatment. They were all treated with painkillers without complications. Seafarers with genital infections (prostatitis and epididymitis) were managed on board. A seafarer with hematuria remained on board for 70 days until he was allowed to disembark and be repatriated for further

investigation. Another seafarer with similar symptoms was monitored for 32 days before repatriation. A third patient was treated on board for 12 days until hematuria resolved, and since examination ashore was not possible, the case closed with recommendations for further investigation when possible. A seafarer with swollen testicle and suspected testicular torsion was evacuated by helicopter within 2 days and subsequently hospitalized.

1.5. It would not be expected for seafarers with skin conditions to be allowed to disembark for medical examination ashore since it would never be considered life-threatening. This meant that all kinds of skin conditions, infections (bacterial, viral, fungal), rashes, abscesses and rare conditions reported should be managed with poor and insufficient medications. A seafarer with an allergic rash was monitored on board for 156 days. In some cases, skin infections (i.e. finger or toe infections) were reported late, with extensive tissue damage and suppuration requiring intravenous antibiotics and hospital admission, which were out of the question. One infected paronychia case was finally examined after 1 month and another one after 3 weeks. An infected finger from a knife cut was allowed to disembark after 11 days on board to receive IV antibiotics. In addition, various abscesses in diverse body parts, including perianal abscesses (pilonidal sinuses) were all treated with antibiotics on board without medical exam by a surgeon. The most tragic case involved a seafarer who had a neglected abscess in his nose resulting from an infected pimple. The condition eventually developed into sepsis, which could not be controlled with oral antibiotics. Despite repeated efforts to transfer him to a hospital ashore and diplomatic interventions, he passed away on board after 10 days due to sepsis.

1.6. Eye conditions would rarely be considered life-threatening, so almost all cases were handled on board, some of them for a long time, only with available eye drops, which were occasionally insufficient for complicated situations. Crewmembers with eye conditions were obliged to suffer eye irritation for long on board, compromising their duties. A seafarer with a corneal ulcer from rust was handled on board for 65 days before a medical examination was possible. A crewmember with corneal abrasion was treated on board for 54 days before medical examination. In another case, a seafarer with a retinal tear was monitored for 12 days and then signed off for further treatment in his country.

1.7. The pandemic created multiple reasons for anxiety and panic attacks (as already reported by various aforementioned studies) and the difficulties in referral ashore exacerbated psychological conditions. Family problems were also frequent for seafarers who were absent from home for a long time. Symptoms like atypical chest pain, weakness, dizziness, difficulty in breathing, numbness, and headaches were commonly reported as a result of anxiety or amplified by psychological stress. Simple anxiety and panic attacks were usually manageable on board with drugs (which were not always available), but there were also more serious psychotic episodes which were a true challenge to manage at port during the pandemic and repatriation was very complicated. In addition, diagnosis of a psychological condition should exclude all relevant pathological conditions, and this was not possible on board. A seafarer who experienced a psychotic episode remained on board for a total of 188 days without

being permitted to disembark, even with the involvement of his country's embassy. This situation not only endangered the seafarer's own well-being but also posed a risk to the safety of the ship. The management of such cases involved complex ethical issues and liabilities.

1.8. Musculoskeletal conditions like back and knee pain were almost all handled on board without clinical examination or x-ray imaging. Painkillers and rest were always recommended, and the seafarer would remain off duty for a long time. A seafarer with knee pain remained on board 56 days without examination and another with knee pain remaining 46 days. They were both repatriated for further treatment. A seafarer with lumbalgia was examined eventually, after 58 days on board. Another case with lower back pain was monitored and managed on board for 107 days without being able to get examined ashore. Cases which could not improve through painkillers and without medical examination were repatriated for treatment in their own country.

1.9. Regarding deaths that occurred on board, the TMAS provided instructions to the crew on how to handle the deceased seafarer's remains on board the ship. During the pandemic, vessels were not allowed to disembark remains in ports. In certain instances, remains were onboard for over 2 months until they were allowed to disembark in port and returned to their families.

2. Injuries

2.1. For most orthopedic injuries, medical examination ashore was not possible. The seafarers were monitored for a long time with analgesic treatment and immobilization of body parts, off duty and without definitive therapy or surgery. Fractures and sprains remained on board without placing casts. In most cases, repatriation was finally arranged to receive medical or surgical treatment back in their own country after long time on board. A seafarer with back pain was monitored on board for 98 days. A seafarer with an open wrist fracture was monitored on board for 84 days before exam was finally possible. Two seafarers with wrist injuries, one caused by a hammer and the other with a wrist fracture, were repatriated to their own country for further examination and treatment. Additionally, there were three cases of shoulder dislocation, which were initially treated on board. One of these cases remained with the dislocation for 44 days before arrangements were made for repatriation. A seafarer with a knee injury was monitored on board for 61 days before repatriation was arranged for further treatment. A case of toe fracture was handled entirely on board without imaging test or medical exam by an orthopedist. There were 41 cases of ankle sprains, from which only 5 were examined or proceeded to X-ray ashore (2 of them after 50 days on board). There were also cases of fractures or injuries of the meniscus and knee ligaments, which were not able to get examined and were repatriated to receive treatment at their own country after several days on board. In addition, a seafarer with a chest injury after a fall and loss of consciousness was finally examined ashore after 33 days on board and a seafarer with injury of the cervical spine was examined after 21 days. A patient with a head injury remained on board 10 days before it was possible to be transferred to a hospital ashore for admission. A patient with dislocated jaw remained on board for 2 days with various attempts to restore the dislocation

unsuccessful before he was transferred ashore. Finally, a patient who sustained multiple injuries after a fall was unable to be referred ashore for 17 days. During this period, the patient was continuously monitored on board the ship. Medical examination was finally coordinated after disembarkation. The only medical assistance provided for those seafarers during all those days was advice from the TMAS orthopedist by phone and pictures by email.

2.2. Seafarers with eye injuries would spend several days with eye irritation or pain, using eye drops and compromising their duties on board, while specialist consultation was possible only through telemedicine. Due to the lack of immediate access to medical care, the master of the ship received instructions from an ophthalmologist on how to remove foreign bodies from the eyes without the presence of a physician and the use of medical instruments. During the pandemic, most port authorities did not consider foreign bodies in the eye a life-threatening, even if there was a risk of loss of eyesight. In one case with perforation of the eye with a metal object, hospital admission was succeeded after special permission for medical examination ashore (P&I club interference) since the seafarer would lose his eye vision. In two other cases, hospital admission was possible after 54 days monitoring on board and in another case after 22 days monitoring on board. In another case, the foreign body was removed by the captain and the patient was monitored on board for 81 days without being able to get examined. Another seafarer who had a foreign body in the eye was examined after 29 days. The foreign body had been previously removed by the captain, and the examining doctor discovered a macular opacity in the eye, which was expected to resolve. In another case, rust in the eye with corneal inflammation was monitored for 100 days on board with minimal improvement, however, medical examination ashore was never achieved until the patient signed off. A seafarer with chemical injury of the eye (hydrochloric acid splashed) and blurry vision could not get examined ashore and was repatriated for further treatment. Another seafarer with a face and eye injury was referred ashore after 4 days on board, reporting total loss of vision before disembarkation.

2.3. All burn cases, regardless of their severity or location (including burns to the face, head, hands, and chemical burns), were managed on board using basic medications and creams. Seafarers with burns had to endure the pain and receive treatment based on the availability of drugs on the ship. They remained off duty for extended periods, risking long-term aesthetic deformities of their skin. In some cases, seafarers had to wait for 36 days or 21 days before being examined by a medical professional. The dermatologist on board was often faced with the challenge of treating extensive burns without access to specific medications.

2.4. All poisoning cases were handled on board with continuous monitoring of symptoms and vital signs during the acute phase without the presence of a health professional and without proper medical facilities for monitoring. Medical evacuation would not be considered necessary unless symptoms were critical.

3. Dental cases

Dental cases were quite common among seafarers, and it was essential to have definitive dental treatment to prevent

recurring issues. However, during the pandemic, dental examinations ashore were often denied unless it was considered an emergency, as toothaches were not deemed life-threatening. Consequently, seafarers had to rely on long-term administration of antibiotics and anti-inflammatory drugs to alleviate symptoms without receiving definitive dental therapy. Dental examinations were typically postponed indefinitely, usually until after repatriation. For instance, one seafarer had to endure toothache for 95 days before being examined, and even after the initial examination, the pain relapsed, requiring another dental exam after an additional 88 days (183 days in total). Another seafarer experienced symptoms for 141 days before the case was closed, with a referral for dental examination post-repatriation. Seafarers were compelled to remain on board for extended periods, enduring pain and discomfort, while receiving antibiotics and compromising their duties and quality of life. The availability of antibiotics on board was sometimes insufficient to support long-term treatment, and obtaining drugs from shore was occasionally problematic.

In the absence of imaging and lab testing capabilities onboard vessels, telemedicine relied heavily on clinical history for diagnosis, although confirmation was not always possible. Treatment was primarily symptomatic and based on factors such as clinical profile, reported symptoms, age, medical history, and risk factors. However, during the two-year period, ports frequently denied requests for specific testing to rule out severe conditions, leading to indefinite cases with symptomatic treatment and no definitive diagnosis. Seafarers often received treatment covering various minor or severe illnesses because definitive diagnoses could not be established.

Furthermore, cases that could potentially result in permanent disability, such as eye injuries, burns, and fall injuries, were not considered urgent as they did not immediately endanger the seafarer's life. As a result, permission for disembarkation was not granted. Additionally, in certain locations, even if a crew member was hemodynamically unstable, permission for disembarkation was either denied or delayed due to pandemic restrictions. Evacuation of severe cases typically occurred only after prolonged requests and negotiations. The medical team onboard faced uncertainty and fear regarding the loss of life, often lacking adequate resources. The ships' medical inventory was designed to handle first aid situations during ocean travel and was not equipped to manage serious conditions over an extended period without medically trained personnel. Moreover, the availability of drugs and equipment, such as oxygen, could not be replenished under the specific circumstances, and the lack of drugs emerged as another major issue as time passed. In essence, the indirect consequences of the Covid-19 pandemic often posed greater dangers than the virus itself.

CONCLUSION

The medical care of the seafarers was adversely affected by the COVID19 pandemic. The adverse effects were demonstrated at all levels and in every aspect of well-being. Illnesses, injuries, and dental cases did not receive proper care during the 2 years of the pandemic. Access to shoreside medical services was severely limited due to port regulations during the pandemic, therefore, seafarers were denied access

to basic diagnostic testing and treatment. Telemedical assistance provided an invaluable service during this period and in most instances, entirely replaced shoreside medical care, remaining the only source of medical consultation. Most illnesses and injuries were treated on board during the pandemic, even if hospital admission was required in many cases. Only a few cases considered life-threatening, were allowed to disembark, and get transferred to hospital. The crew in life-threatening conditions were evacuated only after lengthy approval procedures and delays. In some instances, this threatened the life and in certain cases led to their death. In many instances, life-threatening conditions were evacuated only after persistent efforts and with the interference of 3rd parties. Seafarers' human rights were blatantly violated throughout the pandemic as they did not receive medical care on the same level as land-based employees, due to port restrictions and regulations. Their human rights have been extensively recognized by International Institutions and protected by International Law. Significant ethical issues arise considering that international restrictions and border closures aim to protect populations' health, thus, recognizing the superiority of Public Health protection to individual health and well-being. However, denying access to healthcare to severely ill individuals who require medical treatment is unacceptable and unjustified, even without life-threatening conditions. International institutions and national authorities should acknowledge long-established International Maritime Law, consider their responsibilities, provide solutions and implement strategies to overcome barriers in order to ensure proper healthcare services to ill and injured seafarers, just like to every other patient ashore (table 8).

Limitations: A limitation of the study design is that delays in medical referrals ashore may also involve the time needed for navigating vessels to approach to ports. There were no available data for this parameter, however, during the pandemic, most ships were immobilized at anchorages close to ports, and even if they were navigating at high seas, medical evacuation was usually possible within a short time frame of a few days. The collection of data for a huge amount of cases was also problematic, and many details were missing (i.e. there was no information regarding seafarers repatriated for further investigation and treatment).

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