
# ABSTRACT BOOK

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# Aim & Scope

Population Medicine is an open-access double-blind peer-reviewed scientific journal that encompasses all aspects of population, preventive, and public health research including health care systems and health care delivery. Its broader goal is to address major and diverse health issues, to provide evidence-based information to professionals at all levels of the health care system, and to inform policymakers who are responsible for the formation of health policies that can lead to evidence-based actions.

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# EDITORIAL

## An overview of the European Scientific Association for Health and Hygiene in Maritime Transport 2024 Congress

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The Public Health Congress on Maritime Transport and Ports 2024: Innovations in Infectious Diseases Control and Occupational Health was held on 18–19 October 2024 in the historic city of Naples, Italy. The Congress was organized by the European Scientific Association for Health and Hygiene in Maritime Transport (EU SHIPSAN Association)[1], which established in 2018 in order to ensure the continuation and sustainability of the activities of the European Commssion's EU SHIPSAN ACT Joint Action, in collaboration with the Cruise Lines International Association (CLIA)[2] and the Association of Mediterranean Cruise Ports (MedCruise)[3].

The Congress was held under the auspices of the Greek Ministry of Maritime Affairs and Insular Policy and the National Public Health Organization (NPHO) of Greece and brought together representatives from governments, industry, and the scientific community to address emerging challenges and opportunities in safeguarding public health in the maritime transport sector. The conference provided a platform for sharing opinions, best practices, research findings, and innovative approaches related to infectious disease prevention and control, occupational health, maritime healthcare, environmental health and hygiene, and healthy ship design for strengthening public health actions in the framework of green maritime operations.

Across two days, nine round tables addressed a wide spectrum of issues regarding safeguarding health in the maritime transport sector, including:

- Maritime occupational medicine: known and emerging health risks and their management
- The Horizon Europe HEALTHY SAILING project[4]: innovations in training and early threat detection on large passenger vessels
- Diagnostics, vaccines, and the ship's medicine chest
- Dialogue forum for global collaboration in cruise ship health and hygiene
- Health and hygiene in inland navigation vessels
- Horizon Europe Healthy Ship for You (HS4U) project[5]: innovations in healthy ship design
- Respiratory infections on board ships: redefining airborne transmission and presenting the latest research findings
- Acute gastroenteritis in cruise ships: innovations and new evidence
- EU SHIPSAN inspection[6] and training activities

The congress was further enriched by interventions from the World Health Organization with regards to the amendments to the International Health Regulations and the implications for governments, port and ship operators, as well as the WHO Pandemic Agreement[7].

In addition to the above, 27 oral presentations addressed topics such as environmental health and hygiene, inspections, norovirus gastroenteritis, COVID-19, influenza and other infectious diseases, crew occupational health, preparedness and response to outbreaks, and cross-border health threats related to maritime transport[8]. Moreover, the congress also included a dedicated workshop on "Health and Hygiene in the Maritime Transport and Port Terminal Sectors: An Operators' Perspective" took place that included panel discussions with both port operators and large passenger vessel operators on public health and sustainability considerations.

Overall, the exchange of ideas and presentation of innovations exceeded expectations and provided a strong foundation for the next Congress in 2026, which is soon to be announced.

Looking forward to welcoming you to the next Public Health Congress on Maritime Transport and Ports in 2026

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## ORAL

### Perspectives of international cooperation in maritime medicine - the role of the International Maritime Health Foundation

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**Introduction**

The International Maritime Health Foundation (IMHF) was founded in 2018 by the Polish Society of Maritime, Tropical and Travel Medicine, the Norwegian Association for Maritime Medicine and the Norwegian Centre for Maritime and Diving Medicine. The organisation was established to create and support a sustainable base for the only international journal dedicated to the health of people working at sea - The International Maritime Health (IMH). Its goal is to act for the development of science, to increase and disseminate knowledge of maritime medicine and related fields, and to support and initiate scientific and research activities in the field of maritime medicine worldwide.

**Methods**

The achievements and impact of IMHF activities over the five-year period, the analysis of citations, the structure, development and projects of the IMHF are presented.

**Results**

Based on the Journal Citation Report (JCR) for the year 2022, IMH received an Impact Factor of 2.2, which represents significant progress for the journal. The JCR Journal Performance Data for the year 2022 shows that the journal is cited mostly by non-medical journals of the maritime industry, indicating its growing influence in the field.

**Conclusions**

IMH has become an important source of maritime knowledge for the shipping industry. There is a need for cooperation on an individual basis between experts in maritime medicine and industry. Universities, academies, organisations, associations, societies and companies that share the aims and objectives of the IMHF are invited to such cooperation.

**Funding**

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**Conflicts of interest**

I certify that I have no financial or non-financial, relationships, or personal, professional, or institutional affiliations that may create a potential bias or conflict of interest in relation to this manuscript.

**Ethics**

Ethical approval and informed consent were not required for this study.

**Popul. Med. 2025;7(Supplement 1):A1**

### Case study on water quality in ships from 2022 to 2024 at a strategic European port

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**Introduction**

During the ship's stay in port, an inspection may be required to verify the compliance with WHO standards for health and hygiene and to issue the Ship Sanitation Certificate. The inspections are based on Annex 3 of the International Health Regulations and the World Health Organization recommendations[1-3]. All ships must implement a Potable Water Quality Monitoring Plan[3], to ensure that the potable water supply system on the ship is operating safely, as well as to control the level of sanitation of the entire internal system. When requested, the Border Health Service of the Port of Leixões, through Environmental Health Team (EHT), collects water samples to test for physical-chemical and microbiological parameters.

**Methods**

This study aims to describe the results obtained from the water monitoring plan on ships, resulting from samples collected by the Port of Leixões Health Authority. From February 2022 to May 2024, our EHT analysed the presence of Legionella (pneumophila and non- pneumophila spp.), free chlorine concentration and pH, microorganisms at 36ºC and 22ºC, coliform bacteria, E. coli, Enterococci, C. perfringens, and the presence of heavy metals.

**Results**

From February 2022 to May 2024, 100 water samples were taken from 11 cargo ships. Of these, 63 were analyzed for Legionella pneumophila and non-pneumophila spp., detecting Legionella pneumophila at 14 points and Legionella spp. at 16. For free chlorine (n=95), 56 points showed values below 0.2 ppm. Among microbiological samples, 4 had microorganisms at 36ºC and microorganisms at 22ºC above recommended values, and 2 had coliforms above the parametric value. For chemical parameters (n=37), 7 had iron, 4 had lead, and 1 had cadmium above the parametric values.

**Conclusions**

Ships must maintain water quality monitoring to assess the risk of microbiological and chemical contaminants. It is essential that the water supplied to the ship is of high quality and that a water safety plan is implemented.

**Funding**

There was no funding for the submitted abstract.

**Conflicts of interest**

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**Ethics**

Ethical approval and informed consent were not required for this study.

**References**

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**Popul. Med. 2025;7(Supplement 1):A2**

### Port capacities and challenges in infectious disease preparedness and response in the Eastern Mediterranean Region (EMR)

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**Introduction**

Points of Entry (PoEs)—including ports, airports, and ground crossings—are vital for international travel and trade. The International Health Regulations (IHR, 2005) aim to prevent, protect against, control, and respond to the international spread of diseases while minimizing interference with travel and trade.

**Methods**

This study conducts a secondary analysis of data from the IHR monitoring and evaluation framework in the EMR utilizing publicly available WHO data[1] and country mission reports conducted during the COVID-19 pandemic.

**Results**

PoE capacities in the EMR are among the lowest globally, with significant variability across countries. The region designated 247 PoEs for IHR implementation: 90 airports, 104 ports, and 53 ground crossings. In 2023, the average PoE capacity in the EMR was 62%, down from 68% in 2022. Routine capacity averaged 64%, while public health emergency response capacity averaged 58%, and capacity for risk-based international travel measures averaged 65%. Ports had an average capacity of 68%, with 72% for routine capacities and 65% for emergency capacities. Additionally, 17 countries reported that they have authorized ports to issue ship certificates (120 ports). All designated ports reported having identified competent public health authorities. 76% of designated ports reported having Public Health Emergency Contingency Plans (PHECP), and 90% vector surveillance and control programs. COVID-19 pandemic exposed limited PoE preparedness, amongst others limitations in PHECP implementation, functional testing of plans and multi-sectoral coordination. COVID-19 also posed challenges for international shipping, interrupted supply chain and impacted the health of seafarers[2].

**Conclusions**

The maritime sector was heavily impacted during COVID-19, affecting global supply chains and seafarer health. There is a critical need for member states to equip ports with necessary resources and capacities for all-hazard preparedness, including infectious diseases. Investments are required to enhance coordination, and operational capacities for rapid response. Lessons learned emphasize the need for innovative, multisectoral coordination in preparedness and response at ports to address global health security needs.

**Acknowledgements**

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There was no funding for the submitted abstract.

**Conflicts of interest**

No conflicts of interest declared.

**Ethics**

The abstract doesn't involve human subject; data is publicly available and thus there was no need for obtaining ethical approval.

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**Popul. Med. 2025;7(Supplement 1):A3**

## Successful management on the field of cruise ships: Norovirus AGE: Experience and lessons learned

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**Introduction**

The successful management of a cruise ships norovirus outbreak is described to highlight best practices and operational points to improve in the future.

**Methods**

In November 2023 an outbreak of AGE was managed on a cruise ship operating in Mediterranean area. A collaboration between Health Port Authority, the company health departments and the onboard outbreak management team was established immediately. A continuous action of testing (biological specimens, environmental surfaces and waters) was conducted in different Mediterranean ports: norovirus was identified as the etiological agent. Epidemiological investigation was carried out (patient questionnaires, layout examinations) but couldn't identify any point source on board. A list of public health prescriptions has been agreed and implemented on board according to SHIPSAN guidelines[1] and other international reference documents[2]. A benchmark process with review of CDC database of AGE outbreaks cases[3] was conducted.

**Results**

After the onboard implementation of the measures the epidemic curve shows a dramatic resolution of the outbreak.

**Conclusions**

The results demonstrate

1) Effectiveness of SHIPSAN guidelines,

2) Team collaborative working between public health authorities, company health departments and board outbreak management team were key factors for successful outbreak management.

3) All crew collaborated in the implementation of public health measures. Critical issues to work on in the future are the availability and coordination of accredited laboratory testing capacities in different ports, the coordination between public health authorities, ways to check the passenger's compliance to isolation disposition, the physiological wellbeing of isolated persons and the need of periodical international training simulation on the field.

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**Conflicts of interest**

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**Ethics**
Ethical approval and informed consent were not required.
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## Reintroduction of *Aedes aegypti*, a current open challenge: Cross-border health measures at the Italian ports

Cristian Ferrao[1], Emanuela M. Frisicale[1], Federica Ferraro[1], Devis Antonelli[1], Lanfranco Iodice[2], Francesco Maraglino[1], Antonio Salzano[1], Collaborating group*, Francesco Vaia[1]
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**Introduction**
Recently, dengue incidence increased with a peak in cases in 2023, affecting over 80 countries[1]. Italy experienced first autochthonous dengue transmission in 2023 (82 confirmed cases, 295 imported cases[2]) with *Aedes albopictus* being the primary vector[1]. Due to climatic conditions changes, the establishment of the most competent vector, *Aedes aegypti*[3], can happen. To prevent it, the Italian Ministry of Health issued two Circulars in 2024 to enhance health surveillance at Italian borders and implement control measures for aircrafts, ships, and goods from at-risk countries[4].
**Methods**
Activities were carried out by the Cross-Border Health Authorities (USMAF-SASN)[4] and included verifying residual disinsection certificates (RDCs) for aircrafts/ships and inspecting measures taken by ships and goods. Ships coming from non-EU countries had to submit: 1. A list of the last 10 visited ports, or those visited in the last 28 days, 2. An RD certificate/declaration in which declaring measures were undertaken and 3. list of the ports at risk visited/transited from EU and 4. The maritime declaration of health. The update of pest control plans was also required to shipping companies. The delivery of RDCs by USMAF-SASN is recorded on the national health information system (NSIS), in order to monitor and evaluate further vigilance activities and harmonize USMAF-SASN data entry. From July 2024, a new shared reporting system (SRS) was launched and a checklist template on vessel control has been issued to facilitate the declaration of the Ship Command/Ship owning Companies in compliance with the Circulars.
**Results**
From 2005 to 2024, NSIS recorded 142 "ships control reports", mainly referring to RDCs delivered. SRS results are showed below. USMAF-SASN Lombardia, Piemonte, Valle d'Aosta is not shown as for the absence of seaports.
**Conclusions**
This study shows that USMAF-SASN at Italian borders carry out mainly documental control activities. A total of 204 disinsection residual certificates in the Q3 of 2024 were delivered and 86 inspections were carried out by USMAF-SASN personnel. This shows a commitment of Italian authorities in preventing vector spread along borders. A common approach across European borders would be beneficial.
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(Figure and table at the end of the document).
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**Popul. Med. 2025;7(Supplement 1):A5**

## Training needs for stakeholders dealing with infectious hazards in German ports – Results of a qualitative study

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**Introduction**
To prevent the spread of pathogens in the maritime sector, an effective approach to the prevention and management of outbreaks on board ships and in ports as points of entry is crucial. This sub-study examines what training is already being provided for stakeholders involved in outbreak events and where training

is still needed. The data are gained/are derived by/from the overarching study 'Healthy Ports, Strong Together (GESA)', which aims to harmonize and consolidate the necessary capacities for maritime health safety in German ports.

**Methods**

A total of 35 guided, semi-structured qualitative interviews were conducted with relevant stakeholders in Germany's top five major ports. These included port medical services, port authorities, terminal operators, pilots, agents, seamen's missions, federal and waterway police, fire and rescue services and other. Current practice and training needs were assessed. The interviews were transcribed and analyzed using a coding system with software MAXQDA.

**Results**

Reported training practices and formats largely vary depending on the initial function of stakeholders. There is an increased need for training in infectious disease emergencies, particularly among non-medical personnel. The main areas of identified needs are communication and interface work, operational procedures, background knowledge of infectious diseases and risk assessment, as well as hygiene and proper use of personal protective equipment.

**Conclusions**

Although full-scale exercises are considered helpful, their implementation is limited by high costs. Less resource-intensive exercises, such as table-top exercises, are suitable to training communications and procedures. Regular training is necessary to keep knowledge up to date and to achieve sustainable preparedness. Further, efficient ad-hoc training strategies are essential for dynamic and potentially new outbreak events of unknown origin. The GESA study aims to develop standardized training formats based on identified needs to support sustainable training practices in the area of infectious disease emergencies in German ports

**Acknowledgements**

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**Funding**

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**Conflicts of interest**

All authors declare to have no conflict of interest.

**Ethics**

Ethical approval was not required for this study (Ethics Committee of the Hamburg Medical Association, notification no. 2023-300340-WF). All interview participants provided informed consent.

**Popul. Med. 2025;7(Supplement 1):A6**

## Public health management of a recurrent norovirus outbreak on a cruise ship

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**Introduction**

In May 2024, UKHSA was notified about an ongoing gastro-intestinal (GI) outbreak on a cruise ship over several weeks. The proportion of passengers and crew affected was 5-8% but quickly went over 10%. Norovirus was detected at point of care testing. UKHSA convened an outbreak control team to contain the infection and respond to public enquiries.

**Methods**

Two OCT meetings were held to gather information, complete a risk assessment, and agree on measures. The OCT included UKHSA border health, international travel health, port health, public health and emergency preparedness, local infection prevention control, communications, harbour master, MCA, public health and medical officers from the cruise ship company.

**Results**

Actions after initial meeting:

- IPC measures at sea and in port:
  - Improved hand hygiene, signage, stop alcohol hand gel
  - Increased isolation of those affected to 48 hours after last symptom[1],
  - Extended firebreaks between cruises,
  - Improved cleaning agents, equipment, and Results
- Boarding ship to review measures, training and sanitation schedules
- Improved communication strategy to crew and passengers

Initial actions resulted in a drop to baseline levels of GI illness. Four weeks later, 7% of passengers and crew reported GI symptoms, with crew consistently being early cases.

A second OCT meeting advised:

- Cohort staff by duties on board including accommodation and eating arrangements
- Review crew isolation measures
- Reduce mixing of crew during firebreaks

Further measures were intended to create firebreaks at sea. A sustained drop to baseline levels of GI illness was reported after further measures were put in place.

**Conclusions**

The low infectious dose of Norovirus, combined with its environmental stability afford it multiple routes for transmission. Within the context of maritime outbreaks, which are principally on enclosed platforms, the role of vomit-oral transmission in persistence and recurrence of outbreaks shouldn't be underestimated.

**Acknowledgements**

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**Funding**

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**Conflicts of interest**

There is none.

**Ethics**

Ethical approval was not required for the submitted abstract.

**References**

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**Popul. Med. 2025;7(Supplement 1):A7**

## Reducing diagnostic delays is key for norovirus control on cruise ships

Alfredo De Bellis[1,2], Andrea Bizzotto[1,2], Lemonia Anagnostopoulou[3], Leonidas Kourentis[3], Valentina Marziano[1], Varvara Mouchtouri[3], Stefano Merler[1], Giorgio Guzzetta[1]
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**Introduction**

Acute gastroenteritis outbreaks caused by noroviruses are common public health incidents on cruise ships[1]. Understanding the main drivers of sustained outbreaks and the dynamics of transmission onboard is crucial for evaluating the effectiveness of preventive interventions such as the isolation of infected individuals and to provide real-time forecasts to support outbreak control.

**Methods**

We analyzed anonymized line-lists of cases diagnosed in 7 norovirus outbreaks on cruises, totaling 365 cases (range: 20-121). We probabilistically reconstructed likely transmission chains for the largest outbreak using Bayesian approaches[2,3] based on the time of symptoms and diagnosis of each case and on the time spent on- and off-board while infectious. We developed different statistical models, based on renewal equation approaches[4], to forecast future case counts in real-time. Our statistical models rely on observed case counts and consider delay distributions between symptoms and diagnosis/case isolation ("diagnostic delays"). The forecasting ability of the models was compared on data from the seven outbreaks.

**Results**

Reconstructed transmission chains suggest that 47-63% of secondary cases are caused by a 10% of infected individuals with longer diagnostic delays (mean 73 hours vs. 37 for the remaining 90%). The isolation of diagnosed individuals in their cabins immediately upon symptoms reduced their transmissibility by 94%. Integrating diagnostic delays and isolation effectiveness in the forecasts improved the accuracy compared to a baseline model based on the observed incidence of cases. Reducing diagnostic delays markedly improved both outbreak control and forecasting accuracy.

**Conclusions**

Diagnostic delays play a key role in norovirus outbreaks on cruise ships. Targeted information campaigns to passengers, encouraging immediate health assistance-seeking upon early gastrointestinal symptoms may promote a significantly improved control of outbreaks.

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**Conflicts of interest**

We declare no conflicts of interest.

**Ethics**

Approval committee: University of Thessaly Research Ethics Committee.

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**Popul. Med. 2025;7(Supplement 1):A8**

## A descriptive study of respiratory diseases among seafarers based on the contacts from ships to the Italian Telemedical Maritime Assistance Service Center between 2021 and 2023

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**Introduction**

More than 80% of the world's goods are shipped via maritime transportation networks, making seafarers indispensable in the movement of goods and commodities between countries. However, they face unique challenges and hardships compared to their counterparts on land due to their working conditions. This study aimed to assess the frequency of respiratory diseases among sailing seafarers between 2021 and 2023.

**Methods**

A retrospective descriptive study was carried out to analyze medical data on respiratory diseases in seafarers between 2021 and 2023 using the Centro Internazionale Radio Medico (C.I.R.M.) database. C.I.R.M. is the Italian Telemedical Maritime Assistance Service (TMAS) Center. In the C.I.R.M. database, diseases are classified according to the WHO International Classification of Diseases 10th revised version (ICD10). The diagnoses were retrieved from the database along with relevant variables.

**Results**

During the study period, 1045 contacts were made to the Italian TMAS due to respiratory diseases. Among these contacts, 37% were categorized as upper respiratory infections (URIs), 17.3% as chronic lower respiratory diseases (CLRDs), 16.2% as flu or influenza, and 12.7% as COVID-19. 2.2% of contacts had respiratory failure and 1.2% had chronic obstructive pulmonary disease (COPD). Asthma (53.6%) and the common cold (36.5%) were the most common reasons for consultation among CLRDs and URIs, respectively. The average age of seafarers at the time of contact was 40.5 (standard deviation of 11.9) years. The frequency of respiratory diseases was highest in the age group of 30 – 40-years sailors (42.6%). The occupational groups could be evaluated in 853 out of 1045 contacts. Most seafarers contacting for respiratory disorders were deck crew (30.4%), followed by deck officers (22%). We obtained information on the nationalities of 557 contacts. Most of the seafarers came from Asian and Pacific regions (73.2%), particularly Filipino (54.7%) and Indian (26%). Evaluation of the action taken information was available for 335 contacts. Accordingly, 215 (64.2%) patients were treated onboard, 23 (6.9%) were evacuated by a rescue boat,

one (0.3%) individual was evacuated by helicopter, and 11 (3.3%) cases required a vessel diversion. The vessel diversion was due to COVID-19 cases and evacuation by helicopter and a rescue boat were due to respiratory failure.

**Conclusions**

This study highlights the importance of addressing respiratory diseases in the maritime industry. By understanding the distribution of respiratory diseases among various occupational groups, targeted interventions can be developed to mitigate occupational risks.

**Ethics**

Ethical approval and informed consent were not required for this study.

**Funding**

This research received no funding.

**Conflicts of interest**

The authors declare no conflict of interest in this work.

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## Epidemiological analysis of occupational diseases among seafarers between 2022 and 2023

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**Introduction**

Seafarers face an increased risk of injuries, diseases, and fatalities than workers on land due to their working conditions. To mitigate these risks, it is important to identify the potential areas of incident and assess the probability of occupational medical events. This study aimed to determine the incidence of common occupational diseases among seafarers between 2022 and 2023.

**Methods**

A descriptive epidemiological study was conducted to analyze medical data using the Centro Internazionale Radio Medico (C.I.R.M.) database. This study focused on contacts (n=312) from container ships due to occupational diseases to the C.I.R.M., supplemented by data on the estimated total at-risk seafarer population on container ships (n=9075) over the study period. Incidence rates (IRs) for each worksite and rank were calculated by adjusting the total number of seafarers at risk proportionally to the number of seafarers in the database for whom rank, and worksite information were available. An IR ratio (IRR) and 95% confidence interval (CI) were determined to compare the disease rates among seafarers based on their rank and worksite.

**Results**

During the study period, 312 patients were assisted by the C.I.R.M. on container ships. Of these, respiratory infections (32%) were the most common reason for consultation, followed by musculoskeletal disorders (28.8%) and dermatological disorders (27.6%). However, 16.7% (52) of total patients were unknown in terms of rank and worksite. The mean age (standard deviation) of seafarers at the time of consultation was 39.8 (9.7) years. The estimated two-year incidence of total occupational diseases among seafarers was 3.4 per 100 person-years. Non-officers had a significantly higher incidence of total diseases than officers (IRR: 1.30; 95% CI: 1.01 to 1.73). Non-officers had a higher incidence of musculoskeletal disorders (IRR: 1.70; 95% CI: 1.10 to 2.96) and dermatological disorders (IRR: 1.85; 95% CI: 1.09 to 3.40) than officers. Furthermore, deck workers had a higher incidence of dermatological diseases (IRR: 2.26; 95% CI: 1.32 to 3.96) and musculoskeletal disorders (IRR: 1.73; 95% CI: 1.08 to 2.88) than engine room workers.

**Conclusions**

Non-officers and deck workers have a higher incidence of occupational diseases than officers and engine room workers. This highlights the importance of implementing rank and work-specific prevention measures to address these health disparities.

**Ethics**

Ethical approval and informed consent were not required for this study.

**Funding**

This research received no funding.

**Conflicts of interest**

The authors declare no conflict of interest in this work.

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## Controlling infectious diseases in Moroccan ports - Example of COVID- 19 response at the Tangier-Med Port

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**Introduction**

Since the revision of the International Health Regulations (IHR) in 2005, Morocco has taken several initiatives to strengthen surveillance and public health action at points of entry to prevent and control infectious diseases in accordance with these Regulations[1]. Particular interest is given to the port of Tangier Med, recognized by its geographical position and the fact that it is connected to more than 180 ports worldwide, with a processing capacity of 9 million containers, 7 million passengers, 700000 trucks and 1 million vehicles. In addition, the port of Tangier Med is ranked the third fastest port for containers in the world[2]. The various pandemics announced since (Influenza pandemic 2009) have provided opportunities to strengthen the capacities of points of entry in general, and the port of Tangier Med in particular. To this end, several preparedness and action measures have been taken within the framework of the national preparedness and response plan. These measures include: the formalization of collaboration agreements with partners, the establishment of plans to control vectors and reservoirs, the integration of the port into the national health surveillance and monitoring system, the implementation of a continuing training program, and regular updating of the emergency plan. Various international exercises have been conducted in Tangier Med port, including international rescue at sea, biological, chemical, and radioactivity risks with all partners and with Interpol, and several exercises for infectious diseases on board ships.

**Methods**

The COVID-19 pandemic has provided an opportunity to give a real "boost" to the strengthening of control and action capacities at the port of Tangier-Med. On this occasion, several innovative strategies have been adopted, such as mobile real-time PCR diagnostic laboratories that have been installed on all ships at the beginning the pandemic; this was applied not depending on the ship flag, but strategically for all ships carrying maritime transport

between Morocco and Europe[3].

In this context of the health crisis linked to COVID-19, in addition to the examination and management of suspected passengers and crews, Tangier Med's priority was to adopt all preventive measures to protect the health of its staff and all users of its infrastructure. Aware of its crucial role in the logistics chain on a national and international scale, Tangier Med has implemented a continuity plan to ensure port, logistics and industrial operations 24/7. A monitoring and control committee for the COVID-19 response system has also been set up in collaboration with the competent authorities, to ensure control and strengthening of the pandemic response, and regular assessment of the health situation through rigorous monitoring of cases, including among personnel working at the port[3,4].

Port activities at the Tangier Med port continued normally despite the context of the pandemic, in particular container traffic in import/export and transhipment, TIR truck flows in import/export, liquid and solid bulk traffic, in compliance with the health instructions in force. Verification of documents and the health status of all ships requesting access to the port (to authorize ship manoeuvres and docking) has always been applied rigorously.

**Results**

In this context, a total of 2206859 passengers were screened at the port of Tangier Med as part of the national response to COVID-19 between March 2020 and December 2022. Control at the port entrance and exit concerned the passengers of 7698 ships; of which 15378 were suspected of having the virus, 1218 of which were confirmed by real-time PCR examination[5].

Despite its negative aspects, COVID-19 has proven to be an opportunity to accelerate capacity building and provide a real "kick-start" to the upgrade of Tangier Med Port. On this occasion, special interest was given to the port not only by the Ministry of Health and Social Protection, but all members of the government. Additional investment in material and human resources was made, to ensure necessary resources for pandemic response. This is justified by the economic balance sheet of Tangier Med port, which has achieved a remarkable increase during the COVID-19 pandemic, by more than 19% compared to 20206.

**Conclusions**

Morocco's expressed desire to strengthen its monitoring and response capacities to health events, particularly those that may constitute public health emergencies of international concern, always considers the essential role of entry points in international security, continuing to adapt to different contexts and pandemic situations. Particular attention is given to the port of Tangier Med, regarding its leading role in maritime transport of passengers and goods. The port has fulfilled its responsibilities to ensure health security during the COVID-19 pandemic, by complying with international recommendations, national directives and procedures relating to preparedness and response to this serious public health problem.

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## Ship sanitation inspection and issuance of ship sanitation certificates in Taiwan from 2018 to 2022 under the International Health Regulations (IHR 2005): Impact of the COVID-19 pandemic

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**Introduction**

Taiwan conducts ship sanitation inspections and issues Ship Sanitation Certificates (SSCs) in accordance with the IHR 2005 to prevent the cross-border spread of diseases[1,2]. This study aims to analyze the issuance of SSCs in Taiwan from 2018 to 2022 and explore the impact of the COVID-19 pandemic on these operations.

**Material and Methods**

A retrospective study was conducted using data from ship sanitation inspections at 10 authorized international ports in Taiwan from 2018 to 2022. The study periods 2018-2019 and 2020-2022 were categorized as "pre-pandemic" and "during pandemic" respectively. Statistical analyses were performed using R, with p-values <0.05 considered significant.

**Results**

Among the 6540 cases, 4785 ships underwent sanitation inspections, with 96.57% receiving Ship Sanitation Control Exemption Certificates (SSCECs) and 3.43% receiving Ship Sanitation Control Certificates (SSCCs). Compared to the pre-pandemic period, the odds of SSCC issuance were lower during the pandemic, although the difference was not statistically significant. Non-Taiwanese ships, ships at least 12 years old, ships with gross tonnage below 10000 tons, oil tankers, general cargo ships, and multipurpose ships had higher odds of SSCC issuance (p<0.001). The mean number of inspection findings in the SSCCs was 4.1. However, the proportion of certificate "extensions" increased significantly during the pandemic, from 0.29% to 0.68% (p<0.001). The proportion of "inspections unable to be conducted" also rose, from 0.38% to 1.69% (p<0.001), mainly because ship owners tended to proceed to the next ports for inspections.

**Conclusions**

The COVID-19 pandemic disrupted global shipping and may have affected the issuance of ship sanitation certificates. Post-pandemic,

it is crucial to resume normal operations quickly and pay attention to ships with health risks to improve public health collaboration[3,4].

**Acknowledgements**
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**Funding**
None declared.

**Conflicts of interest**
All authors have no conflict of interest to declare.

**Ethics**
Ethical approval and informed consent were not required for this study.
(Tables at the end of the document).

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## SHIPSAN routine inspections between 2018 and 2024

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**Introduction**
The study's aim is to describe the routine inspections that were carried out by competent Public Health Authorities (PHAs) on board passenger ships (cruise ships, inland vessels or ferries) sailing in European countries between 2018 and 2024. Eligible for inspection were all vessels from any passenger ship company sailing in EU if they fell under the following description: "Passenger ship/ship: Any seagoing or inland passenger ship (with more than 12 passengers) on an international voyage, sailing within the EU waters, providing accommodation and/or food (other than "prepacked" food items that are prepared on a licensed premises ashore) to passengers, and/or potable water from the ship water distribution system to passengers." Inspections were conducted according to inspection protocol and the hygiene standards set out in European Manual for Hygiene Standards and Communicable Disease Surveillance on Passenger Ships (Edition 2nd, April 2016)[1] and particularly concerning medical facilities, communicable disease surveillance, food safety, potable water safety, recreational water safety, pest management, housekeeping and facilities, hazardous chemical agents, waste management and ballast water management. The General Assembly members of the EU HEALTHY GATEWAYS joint action agreed and assigned tasks required for continuation of passenger ship inspection activities and capacity-building after the joint action concluded (from 1st May 2022) to the European Scientific Association for Health and Hygiene in Maritime Transport (EU SHIPSAN Association).

**Methods**
Inspections took place after a 24/48-hour notice by competent port health authorities (PHAs). Inspection reports were entered in EU Common Ship Sanitation Database (former SHIPSAN ACT Information System (SIS) https://sis.shipsan.eu/). In order for the routine inspections to be carried out in European ports University of Thessaly or EU SHIPSAN Association administration contacted the partners of European countries in order for them to arrange the inspections via official routes (ie. ministries), issue circulars in their country and develop inspection schedule for each year. According to inspection protocol, within a period of 15 days from the inspection date, inspection reports were to be finalized and notification email to be sent to company/ship including grade. Within the period of 21 days from the date of notification email, Corrective Action Statements (CAS) were to be completed and submitted by company/ship. Since June 2019, the inspection results were graded (A, B, C, D). According to the consortium agreement of the EU HEALTHY GATEWAYS joint action, the competent authorities authorized University of Thessaly and EU SHIPSAN Association to publish the list of all ships inspected in the EU HEALTHY GATEWAYS web portal[2] and EU SHIPSAN Association website[3].

**Results**
From 2018 to the end of September 2024, a total of 327 inspection reports were submitted by PHAs in SIS along with 292 Corrective Action Statements (CAS) by shipping companies or officers of ships. Out of 327 inspections that took place, 322 were routine, 4 were follow-up inspections and 1 was a focused investigation. Table 1 presents the numbers of inspection reports, deficiencies, CAS, non-compliances with requirements of the EU legislation, non-followed recommended standards of the European Manual and Notations from 2018 to 2024. Table 2 presents inspection reports and CAS in SIS per country and port. Table 3 presents the 10 most frequent inspection findings. 260 inspection reports resulted in a grade and up to now, 260 grades have been published. Out of 260 published grades, 227 were "A" grades, and 33 were "B", "C" or "D" grades and in particular 5 D. During 2020 and 2021, due to the fact that cruise ship operations were suspended due to COVID-19 pandemic, and because priority was given to focused

inspection for COVID-19, only 11 inspections were conducted. Since the beginning of 2022 cruise lines resumed sailing gradually. During 2020, the inspections were carried out on board cruise ships with no passengers and only crew on board. The average number of passengers and crew of the inspected ships was 1698 and 668 respectively. Inspections were conducted in 38 ports by 76 inspectors, five SHIPSAN experts, 16 inspectors in training and 31 observers. In total, 279 inspectors completed the e-learning from 2018 to 2024. Between 2018 and September 2024, 37 audits by five experts carried out in EU MS ports. Fifteen consultations and clarifications in written form were provided to the shipping industry, upon request, in 2019, two in 2023 and two in 2024.

**Conclusions**

Aiming to improving the quality of routine inspections and bringing a consistent and proportionate approach to the inspection of all ship types, it is imperative to provide on-the-job, on-line and face-to-face training, issue yearly inspection schedules and operate information tools for recording/sharing of inspection results are significant. It is also of importance to update the European Manual and develop funding activities. Inspections represent an important chance to increase competency and knowledge all involved stakeholders.

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**Conflicts of interest**

The authors declare no conflicts of interest. The content represents the views of the author only and is his/her sole responsibility; it cannot be considered to reflect the views of the European Commission and/or the Consumers, Health, Agriculture and Food Executive Agency (CHAFEA) or any other body of the European Union. The European Commission and the Agency do not accept any responsibility for use that may be made of the information it contains.

**Ethics**

Ethical approval and informed consent were not required for this study.

**Additional text**

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** EU SHIPSAN Association partnership: Phoebe Markotsi

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**Popul. Med. 2025;7(Supplement 1):A13**

## Development of evidence-based vaccination guidelines for infectious disease prevention on large passenger ships

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**Introduction**

Infectious diseases might pose a significant risk to public health in maritime settings, particularly on large passenger ships, where close contact and shared spaces heighten the potential for outbreaks, if control measures are not in place[1]. Task 3.7.2, a part of the EU Healthy Sailing initiative, aims to develop evidence-based vaccination guidelines to prevent vaccine preventable diseases[2].

**Methods**

A comprehensive review of existing ship operational frameworks good practices, literature and guidelines from organizations including WHO, IMO, ECDC, and EMSA was conducted[3,4]. A questionnaire was sent to four cruise lines and one ferry line to gather information on current vaccination practices. The extracted data was categorized as follows:

1) Vaccine recommendations from WHO for travelers and occupational groups relevant to passenger ships

2) Vaccine recommendations for crew and passengers

3) Timing of the vaccination:

a) as a condition of employment (for crew)

b) before travelling at any destination (for passengers)

c) before travelling at certain destination (for passengers and crew)
d) as part of outbreak management
4) Prioritization scale 1-5
Expert opinions and input from target groups, including the cruise and ferry industries, have been gathered to ensure the guidelines' relevance and practicality. The task drew on outcomes from related Healthy Sailing tasks and lessons learned from previous outbreaks like COVID-19[5].

**Results**

Two of the five companies have shared guidelines, and data collection is ongoing. Vaccination strategies were categorized by ship and voyage type. The working group is developing a list of vaccine-preventable diseases for potential inclusion, with special focus on crew and passengers traveling to endemic regions, recommendations will be tailored to specific crew departments and positions.

**Conclusions**

The developed guidelines will offer an evidence-based framework for vaccination on large passenger ships, aligning with international standards to enhance maritime health safety. Pilot testing on operational vessels will assess their practicality, with feedback from operators and authorities incorporated into the final version.

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**Conflicts of interest**

None declared.

**Ethics**

The Healthy Sailing Project Study has received approval from the University of Thessaly Research Ethics Committee for implementing Healthy Sailing research protocols. Approval committee: University of Thessaly Research Ethics Committee. Full approval date: 19.09.2022. Approval number: 59 / 19.09.2022.

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## Acute gastroenteritis in large passenger vessels

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**Introduction**

Acute gastroenteritis (AG) is a commonly reported illness among ship travellers, with cruise ship literature focused largely on AG[1,2]. This systematic review aimed to understand risk factors and effectiveness of control measures for acute gastroenteritis on large passenger ships.

**Methods**

Conducted according to PRISMA 2020, peer-reviewed articles reporting infectious disease events linked to passenger ships and seaports worldwide were eligible. Gastroenteritis events were defined as: 1) norovirus described by authors as an outbreak; 2) salmonella/shigella/other pathogen with one or more cases in passengers or crew. Articles had to describe infection frequency with at least one case laboratory-confirmed. PubMed, Scopus and Cochrane Library were searched. Articles published after June 2019 (referring to norovirus) and between January 2000 – March 2023 (referring to any other pathogen) were included.

**Results**

The review identified 14 eligible publications[3-16]. We analyzed 14 events (11 single pathogen, three multi-pathogen) among 14 ships (12 cruise, one food banquet cruise, one dinner ferry) on 18 voyages (11 events on single voyages, three events on consecutive/multiple voyages)[3,5-10,12]. Foodborne transmission (or presumed) was identified in 10 events, with most events published before 2005[3,6-10,12]; risk factors included consuming food onboard (seven events), ashore (three events), harvesting practices and possible cross-contamination during rapid cooling. Waterborne transmission was reported in four events published before 2004[3,5]. Presumed outbreak sources including contaminated water bunkered in overseas ports (three events) and brief water treatment system failures (two events). Six events reported control measures; removing implicated food sources, buffet cessation, excluding symptomatic/infected crew from duty were reported as effective[6,12].

**Conclusions**

Foodborne and waterborne outbreaks in the literature have not been widely reported in recent years, likely due to rigorous hygiene standards implemented onboard over the last two decades. However, even with declines in reported outbreaks, food and water safety measures must be vigilantly maintained onboard large passenger ships. (Figures & tables at the end of this abstract book).

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Piloting a syndromic diagnostic testing system on board a cruise ship: Assessing system performance in a passenger ship environment

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**Introduction**

Infectious disease point-of-care (POC) testing on passenger ships traditionally targets few pathogens; with syndromic surveillance it can facilitate rapid diagnosis, treatment and outbreak management[1,2]. Syndromic diagnostic testing systems exist to rapidly identify multiple pathogens simultaneously[3]. This study aimed to assess one system's performance for detecting respiratory/gastrointestinal pathogens among cruise travellers, also considering suitability for passenger ships.

**Methods**

Clinical samples were collected from crew/passengers travelling onboard a cruise ship during July 2023 who displayed respiratory/gastrointestinal symptoms. Two nasal swabs were obtained from each patient. One nasal swab was analyzed onboard using the QIAstat-Dx-Analyzer (Respiratory SARS-CoV-2 panel detects 20+ viral/bacterial pathogens; Gastrointestinal 2 panel detects multiple viral/bacterial/parasitic pathogens)[4,5]. To validate results against a reference method, the other nasal swab was analyzed at the University of Thessaly's Laboratory of Hygiene

and Epidemiology using the VIASURE Respiratory Panel III RT-PCR Detection Kit, CE-IVD.

**Results**

During the study period, no travellers reported gastrointestinal symptoms while 25 reported respiratory symptoms. Fifty nasal samples (two per patient) were collected, with 14 travellers positive for respiratory pathogens via QIAstat-Dx Respiratory SARS-CoV-2 Panel. The reference method yielded the same results for positivity and pathogen type in 13/14 samples with comparable viral loads. In one sample QIAstat-Dx detected two pathogens (Corona OC43/HKU1) while the reference method confirmed only one pathogen (Corona OC43) with highest viral load. Sensitivity, specificity, positive and negative predictive values of the QIAstat-Dx Respiratory SARS-CoV-2 Panel were 100%.

**Conclusions**

Ship medical personnel considered the QIAstat-Dx-Analyzer compatible with the medical facility's workflow. Sample collection and results interpretation were considered simple. High sensitivity/specificity, ability to differentiate between multiple respiratory pathogens, short time to results and minimal training requirements are considered benefits of this type of system. Study limitations affecting generalizability include the small number of respiratory samples and lack of gastrointestinal samples collected for assessment.

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**Conflicts of interest**

There are no conflicts of interest to declare. The commercial company (QIAGEN/SB BioAnalytica) was in no way involved in sample collection, storage or transport. During the study period, the commercial company had no access to the clinical samples.

**Ethics**

The HEALTHY SAILING project has received approval from the University of Thessaly Research Ethics Board (Protocol Nr. 59 / 19.09.2022). Under this framework, the study protocol was submitted to the University of Thessaly Research Ethics Board. Ethical considerations were in accordance with the cruise line's policy for clinical specimen collection from passengers and crew members for health and safety purposes. Information on the study was made available and written consent was obtained from study participants for examination of specimens at the University of Thessaly's Laboratory of Hygiene and Epidemiology, through information letters and consent forms.

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## Mapping the literature for the passenger shipping industry

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**Introduction**

Infectious disease risks related to passenger ship travel are documented among cruise, ferry, river cruise and expedition ships[1-5]. Studies examining risk factors and success of control measures inform evidence-based guidelines and practices. However, emerging infections generate new evidence. COVID-19 emphasized the need for updated guidelines and practices. This scoping review maps literature currently informing passenger ship infection prevention and control strategies.

**Methods**

The scoping review was conducted in accordance with PRISMA-ScR. PubMed, Scopus and grey literature were searched for scientific articles, legislation, guidelines and policies on infection prevention and control related to passenger ships (cruise, ferry, river cruise, expedition) and seaports between 1990-2023. Publications were categorised by: infectious disease, maritime setting, population, geographic region and measures.

**Results**

The review identified 620 publications, primarily scientific articles (58%) and guidelines (28%). The majority of technical guidelines (68%) were at regional or national level, with fewer

guidance documents available at international level. Technical guidance documents originated from various sources, including 48 publications from the World Health Organization, followed by 33 documents from previous European joint actions (HEALTHY GATEWAYS, SHIPSAN ACT). Infectious disease prevention and control in cruise ships was addressed approximately four times more than any other passenger ship type. From all eligible publications, seaports were addressed by approximately 30% of publications, while seaport communities were only referenced by approximately 5% of publications.

**Conclusions**

Most literature focused on cruise ships, indicating a more robust evidence-base in this setting. Comparatively less scientific literature focused on other ship types or seaports. A generic approach is needed for preparedness planning in the maritime sector, addressing both known and unknown infectious disease events. Further research should create context-specific guidelines for all types of infection prevention and control in ferries, river cruise, expedition ships and seaports.

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Respiratory infections in large passenger vessels

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**Introduction**

Respiratory tract infections are commonly documented on all passenger ship types, and attack rates in past outbreaks have affected as much as one-third of the onboard population[1-4]. This systematic review aimed to understand risk factors, transmission dynamics and effectiveness of control measures for respiratory infections on large passenger ships.

**Methods**

Conducted according to PRISMA 2020, peer-reviewed articles reporting human infectious disease events linked to passenger ships and seaports worldwide were eligible. Respiratory events were defined as: COVID-19 or other respiratory disease (excluding Legionnaire's disease) described as a case, cluster or outbreak. Articles had to describe infection frequency with at least one case laboratory-confirmed. PubMed, Scopus and Cochrane Library were searched from January 2000 – March 2023.

**Results**

The review identified 96 eligible publications. We analyzed 32 COVID-19 events among 32 ships (27 cruise, 2 river cruise, 2 expedition, 1 ferry) on 43 voyages (25 single voyage, 5 events on consecutive voyages) linked to 794 hospitalizations and 56 deaths[5-41]. Presumed outbreak sources included: ill/incubating crew embarking and infected travelers continuing in subsequent voyages. A total of 31 studies reported control measures. We analyzed 13 influenza events (5 single voyage, 4 events on consecutive voyages) linked to 100 hospitalizations and 2 deaths[2,42-53]. Presumed outbreak sources were most commonly infected incubating/ill traveler embarking; 5 events reported person-to-person transmission and 10 events reported control measures.

**Conclusions**

Presumed outbreak sources highlight the importance of continuing control measures after an outbreak voyage, emphasizing surveillance of travellers continuing on subsequent voyages. Strength of evidence for risk factors varies, but demonstrates the need for strict compliance with individual isolation, supported by behavioural interventions. Defining effectiveness of individual measures is challenging; a multi-layered approach for measure implementation is recommended.

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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**Popul. Med. 2025;7(Supplement 1):A18**

## Development of an artificial intelligence water safety plan tool for large passenger ships

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**Introduction**

As part of their compliance with European and global standards, passenger ships implement water safety measures[1,2]. The European Manual incorporates World Health Organisation (WHO) methods for creating Water Safety Plans (WSPs) in passenger

ships[1]. Development of WSPs in large passenger ships requires a systematic approach, resources and expertise. The purpose of the Healthy Sailing AI-WSP tool is to assist with adherence to a systematic approach, ensuring that no step is missed and that development is specific to each ship.

**Methods**

A situation analysis to identify the legal framework and existing mathematical models and electronic systems was conducted. In order to establish the inputs of the tool (i.e. list of possible hazardous events, prespecified risk assessment values) several WHO documents were used as well as the experience from the implementation of WSPs on cruise ships. Previous work form SHIPSAN projects was also exploided[3].

**Results**

The prototype guides the users through the steps of WSP development and assists in the risk assessment by providing lists of possible hazardous events and prespecified risk assessment values. The tool facilitates creation of a WSP team, documentation and description of the water systems and identification and prioritization of hazardous events associated with each water system component, assigning likelihood values and automatically calculating risk scores. It provides functionalities for users to add control measures for each hazardous event identified and supplement each control measure with operational monitoring, including operational limits, assignment of responsible personnel and instructions for monitoring.

**Conclusions**

To our knowledge this is the first WSP software tool that is tailored to passenger ships. An intervention study will be conducted on board cruise ships in order to evaluate the effectiveness of the tool.

**Funding**

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**Conflicts of interest**

The authors declare no conflicts of interest.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Factors affecting the microbiological and chemical quality of potable water on non-passenger ships

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**Introduction**

Ships implement international standards to ensure the safety of potable water on board[1,2]. Ships on international voyages are inspected to obtain a Ship Sanitation Certificate (SSC) under the International Health Regulations (IHR)[3]. During these inspections, potable water samples may be collected and analyzed for microbiological and chemical parameters. This study aims to analyze such results to identify factors contributing to positive microbiological and chemical results in water samples.

**Methods**

Results on microbiological and chemical analyses of potable water samples from non-passenger ships between 2010 and 2018 were provided by the Belgian port health authority. The dataset included sample characteristics and laboratory results, while ship characteristics were sourced from an online database[4]. Deficiencies identified during SSC inspections were obtained from EU Common Ship Sanitation Database[4,5]. Chi square test (and fisher test for values below 5%) was used in order to identify possible risk factors. Logistic regression was used for the multivariable analysis. Statistical analysis was performed using R Software.

**Results**

Between 2010 and 2018, a total of 5538 potable water samples were collected during 3497 SSC inspections aboard 2066 ships. General cargo ships had a higher risk of positive microbiological samples compared to other ship types. However, multivariable analysis did not identify statistically significant associations between ship type and microbiological contamination. Ships with at least one deficiency related to potable water safety had three times higher risk of positive samples compared to those with no deficiencies (RR = 3.68, p-value < 0.001). For chemical parameters, the risk of contamination was over four times higher in ships older than 12 years.

**Conclusions**

Recommendations for public health authorities include:

• Prioritizing microbiological sampling of potable water on ships where at least one relevant deficiency, particularly deficiency 9.18.8 (coloured water), has been identified.

• Prioritizing chemical sampling of potable water for ships older than 12 years.

**Acknowledgements**

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**Conflicts of interest**

The authors declare no conflicts of interest.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Syndromic surveillance for the passenger shipping sector

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**Introduction**

Cruise ship mainly conduct syndromic surveillance for gastrointestinal illness (GI) and Influenza Like Illness (ILI). The COVID-19 and other pandemics demonstrated the need a more inclusive systematic approach in syndromic surveillance for known and unknown diseases. Healthy sailing under task 4.1 developed a new syndromic surveillance system for large passenger ships.

**Methods**

A search was conducted in PubMed and grey literature in order to identify existing syndromic surveillance practices followed on ships and other settings (e.g. mass gathering events, touristic venues, migrants' campuses, etc.)[1-7]. The HEALTHY SAILING epi-team consisting of epidemiologists from three different institutions decided on the surveillance objectives, and then defined the syndromes, case definitions, indicators and the thresholds, considering literature review results and expert opinion. A set of standardised recording forms were created and the system was pilot tested by analysis of historical data and by acquiring feedback of the actual forms from ship doctors.

**Results**

The new surveillance system consists of three syndrome categories: respiratory illness (including ILI, Acute Respiratory Illness-ARI and pneumonia), gastrointestinal Illness (including bloody diarrhoea and acute gastroenteritis) and other syndromes (including additional eight syndromes). A medical log, a surveillance log and 11 additional forms for recording the measures applied to patients and to the environment were developed.

Results from pilot testing revealed the following:

- need for standardisation of what is considered "unusual" for each individual,
- training on the use of ICD coding system,
- clear recording of infectious acute and chronic gastroenteritis cases,
- doctors' notes in the medical logs should be more detailed,
- syndromic surveillance should be supplemented by laboratory testing

**Conclusions**

Incorporation of the new syndromic surveillance system into the HEALTHY SAILING E-SS prototype and implementation by large passenger ships is expected to improve case detection and enable early warnings for outbreaks[8].

**Funding**

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**Conflicts of interest**

The authors declare no conflicts of interest.

**Ethics**

Ethical approval and informed consent were not required for this study. Healthy Sailing has received approval from the UTH ethics committee.

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**Popul. Med. 2025;7(Supplement 1):A21**

## Challenges in cleaning and disinfection on board large passenger vessels

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**Introduction**

Cruise ships are settings where diverse populations interact, with risk of developing infections of various etiologies. The most frequent causes of infection are respiratory and gastrointestinal pathogens[1]. Viral gastroenteritis is caused mainly by norovirus, which is resistant to disinfectant and has the ability of persisting in the environment for several weeks[2]. Plenty of evidence has accumulated on the role of contaminated environmental surfaces in the transmission of pathogens. Cleaning and disinfection for both porous and nonporous environmental surfaces constitute a significant factor in preventing transmission of infectious disease[3-6].

**Methods**

We conducted ship site visits to observe the implementation of cleaning and disinfection practices in a real-world setting. The company's existing protocols, Standard Operating Procedures (SOPs), and training materials were obtained and reviewed in order to gain useful insights. Focus groups were conducted among cruise ship crew, officers and managers to understand in-depth the daily routine cleaning and disinfection procedures, barriers, challenges and good practices.

**Results**

The following challenges were identified: consistency in delivering training, difficulties describing in detail certain parts of SOPs, defining indicators for measuring outcomes of monitoring environmental surface cleaning and disinfection as part of an audit system, difficulties in standardising chemical products' mixing instructions especially in automatic dispensers, measuring contact time with a timer.

**Conclusions**

Challenges could be addressed by the following recommended measures: provision of detailed SOPs describing all steps in cleaning and disinfection process, production of new training materials and if possible incorporating videos, defining quantitative and qualitative indicators to monitor the success of disinfection, equip staff with timers. A toolkit for systematic monitoring of surface cleaning and disinfection will be produced by HEALTHY SAILING project in an attempt to address these challenges.

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**Conflicts of interest**

None declared.

**Ethics**

A formal ethics approval received from the University of Thessaly Research Ethics Committee for implementing Healthy Sailing research protocols. The information requested for the ethics statement is following: Approval committee: University of Thessaly Research Ethics Committee; Full approval date: 19.09.2022; Approval number: 59 / 19.09.2022.

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## Exploitation of the open source European Union digital passenger locator form (EUdPLF) for maritime transport

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**Introduction**

Passenger Locator Forms is an essential tool for implementing contact tracing in international travel. Digital passenger locator forms (dPLF) allows for rapid data collection and exchange between stakeholders, improving international contact tracing. In early 2020 the European Commission (EC) tasked the EU HEALTHY GATEWAYS joint action[1] with developing a web application and database for collecting dPLFs for air, maritime and ground transport. In May 2024, the EUdPLF was transformed into an open source software (OSS) for deployment by Member States (MS)[2].

**Methods**

From 2020 to May 2024, a working group with nine MS, agencies and transport associations (EASA, EMSA, ECDC, IATA, ERA, CLIA EUROPE) was formed overseeing development. Key activities during operation included developing a minimum mandatory dataset, implementing data protection and security measures and interconnecting EUdPLF with the EC exchange platform. A new working group oversaw the OSS transformation involving the contractor, DG SANTE, DG DIGIT, and ECDC.

**Results**

Five countries onboarded EUdPLF: four (MT, IT, SI, FR) during live operation (14 March 2021 - 31 May 2023) collecting 39731603 PLF from 51418147 passengers in all transport modes and one (DE) during stand-by mode of operation (June 2023-February 2024). The tool facilitated dPLF data collection from ferry and cruise passengers in three countries. The OS EUdPLF will be upload on the code.europa.eu. enabling MS to deploy national databases. EC has ensured interlinkage of national EUdPLF tools to Early Warning and Response System for automatic dPLF data exchange.

**Conclusions**

Digitalizing PLF data significantly enhances efficiency and speed, with potential applications extending beyond contact tracing to integration with transport operator check-ins and vaccination databases. The deployment of national EUdPLF databases is essential for preparedness across all transport modes, particularly in the maritime sector, necessitating further agreement among EUMS to avoid administrative burdens and double data entry.

**Acknowledgements**

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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**Popul. Med. 2025;7(Supplement 1):A23**

## Updated EU legislation for the European manual for hygiene standards and communicable diseases surveillance on passenger ships

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**Introduction**

To improve the quality and consistency of ship inspections, the “European manual for hygiene standards and communicable diseases surveillance on passenger ships” (Manual)[1] was developed through the EU SHIPSAN and EU SHIPSAN TRAINET projects[2,3]. The Manual comprises 10 chapters, 523 items (including 138 legal requirements) and guidelines for diseases prevention and control. Between 2011 and 2014, pilot inspections tested the Manual’s standards during EU SHIPSAN TRAINET and EU SHIPSAN ACT joint action (ja)[3,4]. It was translated into 5 languages and used for conducting routine inspections since 2015 in 56 ports in 17 countries. EU SHIPSAN Association was tasked by Healthy Gateways JA to undertake the second revision to incorporate changes in legislation and lessons learned from COVID-19 into routine operations[5].

**Methods**

Working groups were formulated and a workshop was organised. Terms of reference outlining tasks, responsibilities, and timelines were prepared. Revision of the legal acts referenced was conducted using the EURO-lex database. Feedback from the passenger industry and public health authorities, along with research from the Healthy Sailing Horizon project, will be incorporated[6].

Additionally, standards from WHO, CDC VSP manual and other programmes operating worldwide will be reviewed for alignment where feasible[7].

**Results**

Five working groups were established, comprising members from MS and industry representatives. A total of 40 stakeholders (29 from 14 countries and SHIPSAN members, 11 from industry) participated in the workshop. From 2015 until 2024, 126 comments were collected including rephrasing and grammatical suggestions. The review identified 10 new, 25 amended (from Part A 46 referenced), and 12 repealed legal acts.

**Conclusions**

The revised Manual will include evidence-based standards and the latest legislative and scientific developments. The improved version should be adapted by all MS for inspections of passenger ships. A legal base should be developed at a European level for the implementation of the hygiene inspections against the Manual standards.

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**Funding**

EU SHIPSAN Scientific Association

**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Shipsan training activities – enhancing capacity building of ship crew and public health authorities

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**Introduction**

The "European Scientific Association for Health and Hygiene in Maritime Transport" (EU SHIPSAN ASSOCIATION) was established in 2018 to sustain activities of EU SHIPSAN ACT joint action (2012-2017) and future actions. A key focus has been training for public health authorities and the maritime industry. This study presents the results of these training activities.

**Methods**

Training courses combined on the job training, audits, face-to-face learning, self-paced online learning and live streaming and were structured using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation)[1]. Learning objectives were tailored to the specific knowledge, skills, and attitudes required by each target audience. Training syllabus and materials were adapted from materials developed from EU SHIPSAN TRAINET project (2008-2011) and EU SHIPSAN ACT joint action (2012-2016). An evaluation strategy was implemented using Kirkpatrick's model of four levels of evaluation[2] to asses perceived impact.

**Results**

From 2017 until 2024 EU SHIPSAN association organised nine courses for the maritime industry, training 318 crew members in health, hygiene, public health operations, housekeeping and food safety. Additionally, two courses trained 114 port health officers (PHO) on hygiene inspections according to the European Manual[3]. Since 2017, a total of 362 PHOs received training via the e-learning platform on conducting inspections. Evaluation results showed that 95% of crew members found course content clear, 89% were satisfied with the knowledge gained, and 97% would recommend the course. All PHOs indicated they would apply the new skills, with 96% recommending the training. Notable improvements were observed in pre- and post-course assessments for industry participants.

**Conclusions**

Training provided by EU SHIPSAN association enhanced the competencies of PHOs and passenger shipping industry crew in implementing hygiene standards and conducting inspections. Future evaluations will assess the long-term impact on task performance following the training. Accreditation of the EU SHIPSAN association as a training provider is ongoing.

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

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**Popul. Med. 2025;7(Supplement 1):A25**

## Analysis of data from international health regulations ship sanitation certificates in the EU common ship sanitation database

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**Introduction**

The worldwide movement of people and goods via ships plays a role in the international transmission of diseases. Ship Sanitation Certificates (SSCs) are issued to facilitate the application of corrective actions if a public health risk exists on board. The SSCs in the EU Common Ship Sanitation Database (previous title EU SHIPSAN Information System SIS) was implemented according to the World Health Organization (WHO) "Handbook for Inspection of Ships and Issuance of SSC"[1]. Once the inspection is completed, either a Ship Sanitation Control Certificate (SSCC) or a Ship Sanitation Control Exemption Certificate (SSCEC) is provided. The study aims to present data from SSC inspections carried out in accordance with the International Health Regulations 2005[2] and recorded in the EU Common Ship Sanitation Database.

**Methods**

SSCs issued through the EU Common Ship Sanitation Database (https://sis.shipsan.eu/) by inspectors working at European port health authorities where inspection data were recorded and analysed.

**Results**

From July 2011 to September 2024, 677 SSC inspectors, assigned at 117 ports in 18 countries, inspected more than 17000 ships. The total number of inspections was 49947, 46033 SSCECs and 969 SSCCs issued, 1136 extensions to existing SSCs were granted and 632 inspections were conducted without issuing an SSC. 429253 areas were inspected and 44917 inspection findings were reported. The most frequent inspection finding was "No water quality analysis report available, last analysis report shows contamination or not all required parameters have been analysed"(10.53%). Other key findings were "Soiled stores"(4.78%), "Absence or inadequate sharps or biomedical collectors"(4.62%) and "Foods found spoiled or unpackaged. Containers or packaging have no source or suspicious source identifications" (4.39%).

**Conclusions**

A global information system, or interconnected national or regional information systems conducting data exchange, could facilitate to better implement SSCs using common standards and procedures. An international information system—or a network of interconnected national or regional systems exchanging data could enhance the implementation of SSCs by promoting the use of unified standards and procedures.

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**Conflicts of interest**

The authors declare no conflict of interest. The content represents the views of the author only and is his/her sole responsibility; it cannot be considered to reflect the views of the European Commission and/or the Consumers, Health, Agriculture and Food Executive Agency (CHAFEA) or any other body of the European Union. The European Commission and the Agency do not accept any responsibility for use that may be made of the information it contains.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Specificities of medical operations in expedition vessels

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**Introduction**

A guideline for specificities/needs of medical operations in expedition vessels is being developed in the European project Healthy Sailing[1], a research/innovation action aiming to prevent, mitigate and manage infections in large passenger ships.

**Methods**

The new guideline is based on the: ILO/IMO Regulations Maritime Labor Convention 2006, WHO Handbook for inspection of ships and issuance of ship sanitation certificate[2], EU SHIPSAN Manual[3], previous guidelines[4,5] and international reference documents for ashore hospitals[6]. The development proceeded in light of our experience gained in the authorization of medical facilities of new Italian cruise ships/ferries[7].

**Results**

The guideline layout includes 1) medical services 2) health services plan; 3) health staff (consistency, qualifications, training and skills); 4) layout/physical design; 5) equipment and laboratory testing capability; 6) telemedical assistance; 7) medicines 8) preparedness and readiness (contingency plan and reserve emergency facility); 9) public health; 10) quality system, clinical risk management; 11) customer satisfaction and complaints management; 12) prevention and occupational medicine for crew; 13) medico legal practice; 14) medical SPA and dialysis); 15) use of environmental resources; 16) authorization process, periodic audits, grade.

The guideline will be pilot tested on board over six months in collaboration with ship companies.

**Conclusions**

Innovative points of this guideline include: A) global view of the medical facilities (three pillars model): which must provide quality medical care, effective actions to prevent the spread of communicable diseases and occupational/preventive medicine for crew. B) transition from a static planning of requirements to a flexible model according to "what if scenarios" C) complementary services; D) authorization process proceeding in a collaborative way from the design phase through shipyard until sea operations; E) quality and clinical risk management system.

This draft will be continually reviewed, updated, and expanded with the contribution of all stakeholders. Readers are encouraged to provide feedback and contribute material for further updates.

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**Conflicts of interest**

The authors declare no conflicts of interest. The content represents the views of the authors only and is their sole responsibility; it cannot be considered to reflect the views of Italian Ministry of Health or any other body of Italian Government.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## E-POSTER

## Monitoring of IAQ at mass-gathering cruise ship to assess ventilation performance and disease transmission risk

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**Introduction**

The COVID-19 pandemic has demonstrated a noticeable deficiency in the comprehensive understanding of airborne infectious disease transmission risk specific to the human transportation sector, particularly the ship-board environments. Large passenger ships can be characterised as enclosed and crowded indoor spaces with frequent interactions between international travellers, providing the perfect conditions for the transmission of disease[1-3].

**Methods**

This paper presents the results of an indoor air quality (IAQ) monitoring study at nine different ship environments with low-cost CO2 sensors, including mass gathering locations and cabins, onboard a passenger cruise ship voyaging across the UK and EU. CO2 concentrations, temperature and relative humidity (RH) were simultaneously monitored to investigate the thermal characteristics and effectiveness of ventilation performances aboard. To optimise the comparability of measurements, monitors underwent co-locations with factory-calibrated instruments and subsequent correction factors were applied[4]. ACH and VR was calculated using the decay method, by evaluating the CO2 concentration when occupants vacated the venue until it reached background level (occupancy estimated based on seating plan). In addition, the risk of airborne infectious disease was estimated by employing a well-mixed Wells-Riley model.

**Results**

Results show a slightly higher RH of 68.2 ± 5.3% aboard compared to ASHRAE and ISO recommended targets, with temperature recorded at 22.3 ± 1.4°C. Generally, good IAQ (<1000 ppm) was measured with CO2 mainly varying between 400-1200 ppm. The estimated air change rates (ACH) and ventilation rates (VR) implied sufficient ventilation was provided in most locations, and the theatre (VR: 86 L s-1 person-1) and cabins (VR: >20 L s-1 person-1) were highly over-ventilated. Dinning areas have recorded high CO2 concentrations (>2000 ppm) potentially due to its high footfall and limited ACH, indicate a potential risk of infection and should be prioritised for improvement.

**Conclusions**

The IAQ and probability of infection indicated that there is an opportunity for energy saving. This study sets the stage for further exploration and provides practical recommendations for the optimisation of ventilation operations in passenger ships.

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**Conflicts of interest**

The authors declare that there are no known competing financia interests or personal relationships that could have appeared to influence the work reported in this paper.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## Intervention plan for mitigating Legionella risk in a cargo ship's potable water system

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**Introduction**

Legionella pneumophila is frequently detected on various types of ships, particularly general cargo vessels. These environments are susceptible to Legionella proliferation due to diverse water sources, storage and distribution systems, variations in water temperature, and insufficient residual disinfectant levels. The World Health Organization[1] recommends controlling and preventing Legionella on ships, and the Portuguese Manual of International Sanitary Procedures[2] advises biannual water analysis for Legionella.

**Methods**

This study describes the intervention by the Leixões Port Health Authority (LPHA) and the follow-up until 2024 on a cargo ship at the designated port of Leixões after the detection of Legionella spp. in 2022.

**Results**

In February 2022, the LPHA inspected the ship to issue its Ship

Sanitation Certificate, collecting water samples at two points for analysis. Legionella spp. and Legionella pneumophila (≥ 1 CFU/L) were detected at one sampling point. The LPHA recommended thermal shock, disinfection procedures and the creation of a water safety plan, as the ship did not previously have one. Follow-up testing in March revealed three samples with positive results for Legionella pneumophila (50 CFU/L, 130 CFU/L, and 200 CFU/L), leading to chlorination treatment of its two water tanks and other LPHA-recommended procedures. From April to June 2022, bimonthly control analyses were conducted at 12 points, all 12 samples returning negative for Legionella spp. From April 2022 to May 2024, 13 additional tests were performed, with all 13 samples negative for Legionella spp. Preventive actions were implemented, including the addition and control of disinfectant and sanitation plans in the water supply network.

**Conclusions**

Regular water analysis on ships is crucial for preventing the spread of Legionella bacteria. Thermal shocks and chlorination are effective methods to eliminate Legionella spp. Establishing a reliable relationship between the ship's crew and the LPHA enhances public health safety.

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**Conflicts of interest**

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**Ethics**

Ethical approval and informed consent were not required for this study.

**References**

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## The role of entomological surveillance in mitigating vector risks and monitoring points of entry

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**Introduction**

The critical role of entomological surveillance in addressing the challenges posed by climate change to vector-borne diseases (VBDs) cannot be overstated[1-3]. Mosquito species, both native (e.g., *Culex pipiens*)[4] and invasive (e.g., *Aedes albopictus*)[5,6], serve as significant vectors for various pathogens, necessitating robust monitoring frameworks.

**Methods**

In response to the growing threat of VBDs, an integrated surveillance approach has been implemented, encompassing traditional monitoring as well as heightened surveillance at key points of entry, such as ports and airports. Since 2021, over 57 BG-Sentinel 2 (BGS2) adult mosquito traps and more than 110 ovitraps have been continuously operational in the Attica region of Greece, inspected weekly throughout the year. Furthermore, since 2023, additional BGS2 traps have been strategically placed at major points of entry to reinforce monitoring efforts in these critical locations.

**Results**

Over the course of three years of monitoring mosquito populations using an extensive network of oviposition and adult traps across the Attica region, we identified 22 different mosquito species. This comprehensive dataset provided valuable insights into the seasonal abundance and activity of these species, including notable changes such as the increased winter activity of *Aedes albopictus*. All identified species corresponded with historical records for the region, suggesting the continued presence of established mosquito populations. Significantly, no new invasive mosquito species were found to have established populations at the designated points of entry during the monitoring period.

**Conclusions**

This proactive monitoring aims to detect and respond to new vector introductions early, thereby preventing the establishment and spread of invasive species. The findings from both regional and point-of-entry surveillance sites underscore the impact of climate change on vector behavior and the subsequent risks of VBDs detection, highlighting the necessity for a year-round, integrated mosquito management strategy[6-7].

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**Conflicts of interest**

The authors declare no conflicts of interest.

**Ethics**

Ethical approval and informed consent were not required for this study.

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## How the positioning of handrub dispensers affects passengers' hand hygiene behavior

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**Introduction**

The COVID-19 pandemic underscored the importance of infection control on cruise ships. Hand hygiene is exceptionally effective for preventing the of infection transmission. Alcohol-based handrub makes hand hygiene feasible at any location. Adherence to hand hygiene practices is often unsatisfactory, even in healthcare[1]. Cruise ship passengers exhibit low compliance with hand hygiene, as they prioritize relaxation[2]. This study aims to determine how to improve passengers' compliance with hand hygiene.

**Methods**

The study was conducted onboard the Celestyal Olympia. Hand hygiene compliance (how many times people clean hands/opportunities when they should) was measured by direct observation.

**Results**

Compliance varied significantly; positioning of dispensers had the most substantial impact. During disembarkation, compliance was 26.4% when the dispensers were placed where people were waiting in line, compared to 0.7% when the dispensers were placed after the checkpoint, where passengers hurried to board the tender boat. During embarkation, compliance was 3.3% when the dispensers were positioned close to the desk where passengers had to show their boarding cards. When placed farther, compliance increased to 33.0%. At the restaurant, receptionist asked everyone to rub their hands, resulted 79.2% compliance. In the buffet, where the equipment was left unattended, compliance dropped to 7.5%.

**Conclusions**

Several criteria were identified for better dispenser placement. Dispensers should be visible from a distance, allowing people time to process their presence. Should be placed along walking paths, as people are unlikely to take extra steps to reach them. People should not be in a hurry when they approach the dispenser. Their hands should be free; when they need to present their ship cards or tickets, they cannot use the dispensers. People should be reminded to use the dispensers. The study was conducted on a single cruise ship, that limits the generalizability of findings. Direct observation may introduce observer bias.

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**Conflicts of interest**

None declared.

**Ethics**

The Research Ethics Committee of the University of Thessaly (Greece) approved the research project with the decision number is 59 / 19.09.2022. The project was also submitted to the Norwegian Medical Research Ethics Committee (REK), which determined that the project falls outside the scope of the Health Research Act (it should not consider as a clinical study) and does not require ethical approval (decision reference number 562942).

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**Popul. Med. 2025;7(Supplement 1):A31**

## Extension of a specific simplified SHIPSAN program to commercial yachting sectors: An operational proposal

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**Introduction**

Mediterranean Sea is a popular destination for sailing. A large proportion of the world's mega-yachts (around 70%) sail in the Mediterranean year-round, with seasonal transfer from Caribbean and Indian Ocean[1]. About 2200 yachts over 30 meters in length crossed Mediterranean in the summer 2021 and there will be an increase of 5% per annum of superyacht worldwide[1]. According to this data[1], it's evident how more and more guest and crews sail in international itinerary and in the future will be an important impact of yachting on maritime public health actions finalized to avoid the spread of infectious diseases.

**Methods**

A simplified check list for SSEC inspections specific for commercial yacht has been adopted and used since 2022[2]. From September 2023 we have integrated this very useful tool with some optional requirements derived by simplifying some points of the European Manual4.

**Results**

Commercial yachts in many cases had a very good hygienic management system that stood out during on-board inspections for the SSEC3. Many others need to improve in a collaborative way with public health authorities.

**Conclusions**

The hygienic surveillance of commercial yachts is relevant to avoid and prevent the spread of infectious diseases at international points of entry. Extension of the SHIPSAN program4 to the yachting sector would be desirable in the future also, in order to minimize the risk posed by all those situations that cannot be detected by SSEC inspections (For all departments many points required from shipsan are only recommended for SSEC inspections). SHIPSAN's existing international guidelines4 mainly refer to large passenger ships with a board/company organization and facilities very different from a yacht, so the aim of this work is to stimulate the drawing of a specific simplified version for yachting to be included in the revised third edition of the European Manual4.

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**Conflicts of interest**

The authors declare no conflicts of interest. The content represents the views of the authors only and is their sole responsibility; it cannot be considered to reflect the views of Italian Ministry of Health or any other body of Italian Government.

**Ethics**

Ethical approval and informed consent were not required for this study.

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**Popul. Med. 2025;7(Supplement 1):A32**

## Water safety plan for passenger ships (cruise, ferry ships and commercial yachting sectors) an inspection assessment checklist

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**Introduction**

WHO (World Health Organization) Handbook for SSEC (Ship Sanitation Exemption certificate) inspections[1] and the Shipsan Manual[2] required that passenger shipping operators should apply hazard analysis principles and implement a Water Safety Plan (WSP) in order to ensure the safety and quality of potable water that is provided to passengers and crew. The risk analysis is required also from EU Directive 2020/2184, on the quality of water for human consumption that also introduce new biological/chemical parameters to check.

**Methods**

Liguria Health Port Authority, according to the abovementioned documents and Italian National Institute of Health guideline[4], has drafted a check list for Water Safety Plan Assessment specific for passenger ships (cruise and ferry) with a simplified version dedicated to commercial yachts. The list includes: A) WSP team established (including training) B) System assessment C) Operational monitoring D) Management plan.

**Results**

The pilot phase of WSP check list implementations has shown that in many cases (especially on yachts) there is not a ship WSP but only laboratory check reports of water quality. We have reported incomplete plans (especially in areas regarding hazard analysis and team establishment/training). Finally, we have also found reports of laboratory not accredited UNI Cei EN ISO/IEC 17025.

**Conclusions**

The complete implementation of water safety plans on passenger ships (cruise and ferry) and on commercial yachts is a key factor very important to prevent biological, chemical, physic and radiological risks. To reach this goal in maritime sector it is necessary to develop A) Training and practical tools for inspectors (like the check list presented here) B) Program of collaboration and training with WSP ship team and ship public health officers C) Sharing of best practices about WSP D) Introduction on board practice and in the revision of Shipsan Manual of the indication to check the new parameters laid down from community legislation.

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**Conflicts of interest**

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**Ethics**

Ethical approval and informed consent were not required for this study.

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## Integrated E-Surveillance System (E-SS) for health threats for passengers and crew members

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**Introduction**

HEALTHY SAILING is a research and innovation action that aims to improve the quality of passenger shipping services, facilitate recovery from the COVID-19 pandemic and make passenger shipping safer, more resilient, competitive and efficient.

Traditional detection methods of infectious diseases on cruise ships miss asymptomatic infections and unreported symptoms. This approach has significant limitations, as it lacks systematic syndromic surveillance to detect trends of known or emerging diseases, except for gastroenteritis and recently COVID-19. However, even COVID-19 surveillance faces challenges due to the high percentage of asymptomatic cases.

Our integrated E-SS is a health data platform element that addresses these challenges, providing a robust solution for early health threat detection.

**Methods**

A complete tool was developed, consisting of a relational database, API layer, web frontend and supporting data input and output scripts, to provide functionality for:

• Secure communication with heterogeneous data sources.
• Data recording through provided electronic.
• A dashboard with visualizations such as epidemic curves, epidemiological indicators, and charts, capable of providing generated reports to authorities.
• An API for delivering analytic outputs to complementary tools.

**Results**

The E-SS was validated with synthetic data, consisting of a fictional cruise ship with 1400 crew and passengers, supplemented with anonymized historical data of an actual gastrointestinal disease outbreak.

The complete dataset was inserted in distinct stages, simulating the progression of the outbreak over the 7 day cruise and the corresponding reporting actions of the fictional medical crew on the E-SS.

The system was capable to provide reliable recording and real-time reporting, as well as analytic outputs to complementary tools to facilitate early detection and mitigation.

**Conclusions**

The utilization of a modern, responsive and secure web-based tool to record medical cases, collect data, and perform syndromic surveillance, can improve current practices regarding on board cruise ships by providing a real-time overview of the situation, as well as prompt sharing of the information to the appropriate parties, prompting further action depending on the situation.

The E-SS is a solution for medical logging, syndromic surveillance, report generation and data sharing, that can be shown to facilitate improvements in outbreak response, mitigation and ultimately outcomes.

The development is ongoing, and planned tests by ship medical personnel will provide valuable feedback to improve all aspects of the tool, in anticipation of validating its effectiveness in a real environment.

**Funding**

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## Quality of water intended for human consumption onboard ships. An observational study based on institutional monitoring activity

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**Introduction**

The Territorial Unit of Porto Torres, USMAF-SASN Campania Sardinia, Italian Ministry of Health Office (UTPT) has monitored water intended for human consumption (WIHC) onboard ships docking at North Sardinian ports since 2006. Our aim is to analyze water quality emerging from the ship's distribution system in compliance with Italian DI2023/18[1] and European DEU2020/2184[2]. Legionella, monitored by specific national guidelines[3-6], is a parameter for risk management of internal distribution systems in DI2023/18.

**Methods**

Non-compliances with DI2023/18 and DEU2020/2184, from ordinances/prescriptions related to water samples collected by UTPT inspectors, were reported in an Excel table (ship's name, sampling dates and locations, type of non-compliances,

prescriptions/notes) and analyzed with Excel®software.

**Results**

In 2013-2017, the 13.4% of the 521 Legionella samples are non-compliant (mean value 65974 UFC/l; parametric Italian/European value <1000 UFC/l[1-5]). The UTPT ordinances/prescriptions always include risk analysis on water distribution system and measures to decrease the microbiological load, according to the Italian guidelines[3-5]. In the same period, 11.6% of the 112 WIHC samples has a trihalomethanes-total (THMs) non-compliance when considered the Italian parametric value 30 µg/l[1,7], 0% if considered European 100 µg/l[2,8]. One non-compliant sample has Coliform bacteria (0.9%).

**Conclusions**

As THMs concentration in ships depends also on extra-chlorination by internal automatic disinfection system of bunkered disinfected water, Italian ships are forced, since 2001[1,7], to find the balance between low THMs concentration (30 µg/l)[1,7] (and accurate control of extra-chlorination) and the need of water microbial growth control. The Italian proactive approach to waterborne risks, since 2005[4], helps shipowners and Institutions (UTPT) to reach the balance, providing more instruments to work with. DEU2020/2184 encourages Member States to strive for THMs concentration lower than 100 µg/l[2,8] although the risk assessment of supply/domestic distribution systems shall be compulsorily only by 2029. It could be easier/advisable to reach these goals together. (Figures & tables at the end of this abstract book).

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**Conflicts of interest**

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**Ethics**

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**References**

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**Popul. Med. 2025;7(Supplement 1):A35**

## Multisectoral collaboration in development of health protection guidelines for cruise shipping in Irish waters: Furing and post COVID-19

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**Introduction**

The COVID-19 pandemic significantly impacted the cruise shipping industry with operations ceasing by mandate in Ireland from 24 March 2020. As shipping return was under consideration in late 2021, we developed comprehensive multi-stakeholder

health protection guidance to manage maritime public health emergencies effectively, ensuring compliance with International Health Regulations[1] and emphasising the role of Port Health in safeguarding the health of passengers, crew members, and the broader community.

**Methods**

Guidance development evolved through a series of consultations and collaborations. Ongoing international intelligence gathering and collaboration by the HSE Port Health Network including with Public Health Agency, Northern Ireland, UK Port Health Association and EU Healthy Gateways[2] were integral to the process. Development of the guidance document involved considerable input from the Department of Transport (document host), Health Service Executive (HSE) Port Health Network, the port authorities, Cruise Ireland, and other relevant stakeholders. Meetings with representatives from the Harbourmaster Association, cruise line representatives, Department of Health and other key stakeholders were essential.

**Results**

The first version of the cruise protocol was published in March 2022, with subsequent updates in April 2023[3] which widened the guidance to be non-COVID specific. The guidelines emphasise tailored disease mitigation plans, adherence to Flag State requirements, and compliance with international conventions. They highlight the necessity for coordinated outbreak management plans between ship and port authorities, and interoperability with the HSE seaport guidance[4]. Key components include comprehensive risk assessment, sanitation measures, and detailed contingency plans for health emergencies.

**Conclusions**

Since the WHO declared the COVID-19 pandemic over in May 2023, the document revision ensures it remains a valuable tool for general infectious disease prevention and control, providing agreed interoperable guidance for health protection and preparedness for future public health emergencies in Irish waters.

**Acknowledgements**

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**Conflicts of interest**

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**Ethics**

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**Popul. Med. 2025;7(Supplement 1):A36**

## Brazilian cruise ships program season 2023/2024

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**Introduction**

The Brazilian Health Regulatory Agency supervises cruise ships and created the national health surveillance program for cruise ships in 2009 to promote transparency and dialogue with the industry. The action's objective is to control sanitary risk and thus protect travelers, the environment and the population on land[1,2]. The last Brazilian cruise season (10/04/23 to 30/04/2024) had 46 vessels, 46 ports and around 950 anchorages[2,3]. There's always an expectation of improvements in the vessels' sanitation security compared to last seasons, especially in the pandemic period.

**Methods**

The Program involves a vessels' guide[1,4], an information system for risk management[3], a national inspector's team, that produce a risk classification of cruise ships. In the last season, 17 vessels were inspected according to standard scripts, which includes health surveillance items[3]. The Inspections record contain required items. When they aren't implemented, especially "critical controls", they impact negatively ships classification, which has 4 standards A, B, C or D.[2,3]

**Results**

Figure 1 shows a total of 85 requirements established in the risk manager system for each one of the 17 cruise ships, totaling 1649[3]. In general terms, 95% of these requirements were complied with. In absolute terms, the most deficient items were food, cleaning and hygiene and climatization[2,3]. In relative terms, climatization and pest control. The items with the highest occurrence of "critical controls" were outbreak prevention and food. The scores corresponding to the requirements mentioned in figure 1 result in the vessels' classification[2,3].

**Conclusions**

This program has been successful in creating safe vessels, protecting the health of the population. It is a guideline for the sector, with a positive impact on economic activity, as it adds value and validates the services offered. This classification influences the market, directing demand towards healthy ships[3].

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**Conflicts of interest**

Please use the ICMJE form as your guide, to declare any potential conflict for your study. For more information, you may find the Disclosure of Interest at https://www.icmje.org/disclosure-of-interest/.

**Ethics**

Ethical approval and informed consent were not required for this

study.
(Tables at the end of the document).

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**Popul. Med. 2025;7(Supplement 1):A37**

## *Aedes aegypti* surveillance under the International Health Regulations - experience in a Portuguese island

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**Introduction**

*Aedes aegypti* was first identified on Madeira Island in 2005, persisting since then[1]. This mosquito transmits various haemorrhagic diseases and caused a dengue outbreak in 2012-2013[1,2]. The island has two seaports that may serve as points of entry or dissemination of these diseases, potentially leading to a new outbreak or international disease spread. We aimed to assess *Ae. aegypti* presence at the island's seaports during 2023.

**Methods**

Data was collected from 52 entomological surveillance reports produced by the Regional Health Department throughout 2023. This data is publicly available on the Institute of Health Administration's website. Ovitraps captured *Ae. aegypti* eggs, larvae, and pupae, and BG-Sentinel 2 traps captured adult mosquitos. Positivity refers to the proportion of times an ovitrap recorded eggs during a defined period, usually a week.

**Results**

Throughout 2023, there were 204 active ovitraps at the island (9 at Funchal's seaport, 8 at Caniçal's seaport) and 24 BG traps (2 at the airport, 2 at Funchal's port and 1 at Caniçal's port). Weekly reports revealed a median of 2243 (0-14448) eggs and 14 (0-234) mosquitos in all traps. Positivity was higher in the second semester. On average, ovitrap's positivity at Caniçal's port (avg 2.8%; 0-47%) were lower than the positivity of the island (avg 14.8%). Funchal's port had a higher positivity than the island (avg 15.9%; 0-67%). The average weekly positivity rate per ovitrap rose by 15% and 5% at Caniçal's port and Funchal's port, respectively, compared to 2012-2022.

**Conclusions**

Ovitrap positivity rate increased in 2023, indicating an increased likelihood of *Ae. aegypti* mosquitos nearby. The detection of immature stages triggers actions to prospect the surrounding area for identification and elimination of breeding grounds, as well as the placement of salt in water accumulation areas for mosquito control. This is particularly important at high-traffic areas such as seaports and airports.

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**Conflicts of interest**

The authors have no conflicts of interest to declare.

**Ethics**

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**Popul. Med. 2025;7(Supplement 1):A38**

## Enhancing maritime health through machine learning: Prediction models for infectious diseases and occupational health in seafarers

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**Introduction**

Seafarers face unique health challenges due to exposure to infectious diseases and occupational hazards, compounded by their extended time at sea[1]. The maritime industry's critical role in global trade necessitates enhanced health monitoring and disease prevention methods[1,2]. This study aims to apply supervised Machine Learning (ML) models[3] to predict the incidence of infectious diseases and improve occupational health among seafarers, based on health records and voyage data.

**Methods**

We utilized health records and voyage details from the International Radio Medical Centre (C.I.R.M.) in Rome. Supervised ML models were trained on these data sets to predict disease incidence and provide actionable insights for prevention. We compared the performance of four different ML models used to predict the incidence of infectious diseases among seafarers: Random Forest, Support Vector Machine (SVM), Convolutional Neural Network (CNN), and Gradient Boosting.

**Results**

Among the models, CNN showed the highest overall performance with an accuracy of 91%, a precision of 92%, and the highest AUC-ROC of 0.94, indicating that it is the most effective at predicting disease incidence. Random Forest also performed well, with slightly lower but competitive scores across all metrics. These

results highlight the potential of machine learning in disease prediction, with the Neural Network model emerging as the most robust.

**Conclusions**

These ML models demonstrated a significant ability to forecast disease outbreaks among seafarers, allowing for timely intervention[4]. These predictive models hold the potential to integrate seamlessly into maritime health protocols, reducing disease incidence and enhancing overall seafarer well-being. The use of ML models for disease prediction in the maritime industry can revolutionize public health strategies. By integrating these models into existing health protocols, we can reduce infectious disease outbreaks and occupational health issues in seafarers.

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**Conflicts of interest**

None.

**Ethics**

Ethical approval and informed consent were not required for this study.

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**Popul. Med. 2025;7(Supplement 1):A39**

## Medical emergency disembarkation in Autonomous Region of Madeira in 2024

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**Introduction**

In recent decades, increased cross-border movement of people has raised the risk of diseases spreading between countries. The Autonomous Region of Madeira receives thousands of tourists annually, with one of its main entry points being through its ports. In Maritime Health, epidemiological surveillance is a key tool for Public Health Teams to implement intervention strategies[1]. This study aims to characterize medical emergency disembarkation cases at the ports of the Autonomous Madeira Region.

**Methods**

We analyzed all medical emergency disembarkation cases between January 1 and August 15, 2024, at the ports of the Autonomous Region of Madeira (Funchal, Caniçal, and Porto Santo). Data were obtained from email messages sent to the Maritime Health team and organized in a management database. Categorical variables were described by absolute and relative frequencies, and continuous variables by median and interquartile range. A "medical disembarkation" occurs when a passenger or crew member leaves the vessel for medical reasons and does not return.

**Results**

During the study period, 147 vessels docked at the three ports, with 434 ship calls, including cruise, cargo, and military ships. In total, 53 people disembarked (46 passengers and 7 crew members). The majority were male (64%), with a median age of 76 years (P25-P75: 60-84). The majority were British (41%) and German (26%). Most disembarkations were from cruise ships, with the three main reasons being cardiovascular (28%), respiratory (21%), and orthopedic diseases (19%). The majority (64%) were transported to private services. One typhoid fever case required significant Maritime Health intervention due to the non-medical staff's lack of awareness of the disease and its transmission.

**Conclusions**

Organizing epidemiological data is crucial for addressing needs in Maritime Health. Coordination with the private sector remains a challenge for monitoring disembarked patients since access to clinical data is limited due to the disconnection between informatic systems.

**Funding**

There was no funding for the submitted abstract.

**Conflicts of interest**

There is no conflict of interests.

**Ethics**

Ethical approval and informed consent were not required for this study.

**References**

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**Popul. Med. 2025;7(Supplement 1):A40**

## Machine Learning for Early Diagnosis and Health Management of Seafarers Using Physiological Data and Wearable Sensors

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**Introduction**

Due to long sea voyages, harsh environmental conditions, and limited medical access, seafarers face unique health challenges[1]. Effective treatment and improved health outcomes can only be achieved through early diagnosis, despite the remote medical advice provided by Telemedical Maritime Assistance Services (TMAS)[2,3]. Proactive health predictions and enhanced healthcare for maritime workers can be achieved using Machine Learning (ML)[4]. The objective of this study is to investigate the application of machine learning techniques in the early diagnosis of diseases among seafarers by utilizing data from wearable devices,

environmental sensors, and health records. The goal is to provide timely medical interventions and improve the health outcomes of seafarers.

**Methods**

The study utilized physiological data from wearable sensors (e.g., heart rate, sleep patterns) along with anonymized health records. Three supervised ML models were adopted namely logistic regression, decision trees, and neural networks. To improve model accuracy and reduce overfitting, feature selection and data preprocessing techniques were employed. Cross-validation was applied to evaluate model performance.

**Results**

The ML models accurately predicted the onset of common diseases among seafarers, including cardiovascular and respiratory diseases, as well as mental health conditions. Traditional statistical methods were used as a benchmark for comparison. Neural networks outperformed the other models with 89.6% accuracy, showing the highest accuracy in diagnosing diseases.

**Conclusions**

ML has significant potential to transform healthcare in the maritime industry. By enabling early diagnosis and proactive health management, ML models can ensure timely medical intervention and improve the safety and well-being of seafarers. The integration of advanced data analytics into maritime health practices is recommended for sustainable health protection in the maritime sector.

**Acknowledgements**

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**Funding**

There was no funding for the submitted abstract

**Conflicts of interest**

None

**Ethics**

Ethical approval and informed consent were not required for this study

**References**

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**Popul. Med. 2025;7(Supplement 1):A41**

## Reintegration and Stress Management: The Role of Therapy for Employees Returning from Illness or Injury

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**Introduction**

Reintegration of employees into their mainstream jobs following an illness or injury is associated with unique difficulties, which are more pronounced in high-stress sectors like maritime and industrial settings. There is a therapeutic breakthrough at this time to ease these stresses and aid in the process of rehabilitation.

**Methods**

In this study, employees' experiences were examined using a mixed-methods research design focusing on the reintegration phase. Stress in the participants was quantified using the Perceived Stress Scale, with qualitative data collected from ten professional occupational therapists through semi-structured interviews. The sample comprised 100 participants, of whom 50 were seafarers and 50 were industrial workers. An analysis of reintegration issues was conducted across the sectors.

**Results**

The research results revealed that work-related reintegration strategies, including stress management treatments such as cognitive-behavioral modification programs, aid in the quicker adjustment of employees to occupational demands. Participants' anxiety levels were reduced, and their self-perception of job performance improved after the interventions.

**Conclusions**

Employers have realized the importance of a combined approach when dealing with stress to aid in effectively managing employees about to resume work after an illness or injury. Aside from focusing on individual health, these therapy programs also benefit the productivity and health of the work environment.

**Acknowledgements**

We acknowledge the people who helped with the study but are not its authors.

**Funding**

There was no funding for the submitted abstract.

**Conflicts of interest**

None declared.

**Ethics**

Ethical approval was deemed unnecessary for this study, as it involved anonymized data collection and did not include any sensitive information or direct interventions with participants.

**Popul. Med. 2025;7(Supplement 1):A42**

## Health Activities in the context of the Operation Crossing the Strait (OCS). Spain, 2023

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**Introduction**

The OCS is an activity carried out to facilitate the transit of people residing in Europe who travel on summer vacations to their countries of origin in North Africa. Foreign Health (FH) ensures that the facilities of the ports/ ships involved have adequate

hygienic and sanitary conditions, and respond to health events that could pose a risk to public health.

**Methods**

Descriptive study based on the data from a survey applied in the nine FH ports assigned to the OCS. Basic calculations of frequencies and percentages were carried out for univariate analysis.

**Results**

3.2 million passengers were registered. Thirty-three ships took part, making 11084 calls at nine ports. All the ships were inspected before the beginning of the operation. Thirty-nine Ship Sanitation Certificate SSC were reviewed and 15 Sanitation Control Exemption Certificate (SSCEC)/Ship Sanitation Control Certificate (SSCC) were issued (Figure 1).

**Conclusions**

The OCS is an event that mobilises a significant number of travellers every year, who converge in the maritime ports of southern Spain. This concentration of people/vehicles during the summer season poses a significant risk to public health in the absence of prevention, control and timely response measures to the problems identified.

**Acknowledgements**

We would like to thank all the staff of the Foreign Health Units: Algeciras, Alicante, Almeria, Ceuta, Malaga, Melilla, Motril, Tarifa y Valencia, involved in the OCS for all the collaboration provided for developing and preparing their local reports that have allowed the development of this work.

**Funding**

We have not received external funding for this study.

**Conflicts of interest**

We not declare any potential conflict of interest for this study.

**Ethics**

Approval from the ethics committee was not required for this study. (Figures at the end of the document).

**Popul. Med. 2025;7(Supplement 1):A43**

## Knowledge, attitudes and practices of seafarers on the potential health hazards related to the maintenance of scrubbers: a scoping review

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**Introduction**

Exhaust Gas Cleaning Systems, also known as scrubbers, are today widely used to allow for use of High Sulphur Heavy Fuel Oil and still comply with the regulations limiting sulphur content in marine fuels. Since 2018, roughly 5000 ships have installed scrubbers. The technology requests updated skills for safe handling of chemicals and compliance with the new regulations. The aim of this study was to review the seafarers' knowledge, attitudes and practices related to the operation and maintenance of scrubbers

**Methods**

Scopus, Web of Science, Google scholar and grey bibliography were searched for this scoping review from 2018 to 2024. The records were uploaded to EndNote and Rayyan to conclude the selection process.

**Results**

From the 67 identified articles 4 met the eligibility criteria referring to 954 participants. The articles dealt with practices related to environmental compliance, decarbonization, health and safety procedures. Summarised from the included studies the results showed in connection to knowledge that only 27% of the seafarers read and understand the Material Safety Data Sheet (MSDS) when a new cargo is loaded[1]. Values and beliefs in relation to safety climate showed that seafarers have lower perceptions of safety (Mdn = 3.00) than onboard service staff (Mdn = 3.11), p=0.01[2]. Personal Protective Equipment (PPE) during cargo operation was practiced by only half of seafarers (53%) and by only (16%) during tank cleaning[3]. The lack of knowledge (34%) as well as the lack of relevant competencies (32%) about the new technologies were considered as barriers to adopt energy efficiency measures on board[4].

**Conclusions**

Scrubbers pose an additional burden on crews that need to get new skills on the maintenance and handling. Training in new technologies helps seafarers performing their duties effectively. Compliance with environmental regulations create additional stress and workload with adverse effects on ship safety. International organisations should take into considerations the impact of regulations on seafarers' health and wellbeing.

**Funding**

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**Conflicts of interest**

There is no conflicts of interest.

**Ethics**

No ethics approval is necessary for the abstract.

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**Popul. Med. 2025;7(Supplement 1):A44**

## Respond to a public health event at a port

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**Introduction**

The scope of the poster is to present the respond to a public health event at the port of Thessaloniki in 2019. The goal was to prevent the spread of a vectorborne disease, malaria.

The Port Health Authority (PHA) received information from the Port Police Authority (PPA) of Thessaloniki, that a cargo ship due to arrive at the port of Thessaloniki, during its voyage from the Ivory Coast disembarked on 23rd of July 2019 in Almeria, Spain a crew member who fell ill with malaria due to Plasmodium falciparum[1-3].

The Almería port health authority recommended the Captain to perform disinsection on the ship. Carrying out of disinsection should be checked in the next port of call-Thessaloniki.

**Methods**

We used two methods in order to prevent disease spread: 1. Performed disinsection on board: Indoor residual spraying (IRS) in closed areas of the 4 decks: cabins, galleys, storage, bridge) and outdoor residual spraying (ORS) in open spaces of the ship and in the port area closed to the ship. 2. screening of the 21 crew members active surveillance for malaria cases (temperature checking, questions about current or recent illness - malaria case criteria).

**Results**

The PHA took actions in chronological order: 1. before the ship anchored the port: Sent information material to the ship agent (mosquito control measures -approved biocides etc.-, personal protection measures against mosquito bites) to inform crew members. 2. Immediately after its berth: a Doctor, a Public Health Inspector and employees of the mosquito control company in the Region of Central Macedonia (RCM) boarded the ship to perform: screening of the crew (no findings were obtained), disinsection on board, before the officers debarked the ship, they recommended the crew to immediate report of relevant symptoms and take all necessary measures to avoid exposure to mosquito bites[4].

**Conclusions**

The early warning - notification of the PPA of Thessaloniki about the disembarked crew member in Spain led the PHA to take actions in order to prevent a disease spread. The detailed information about the case and the advice given by the Port Authority in Spain was available through the Eu Healthy Gateways members, who were in direct email and phone contact with them[5].

The use of the electronic communication platform SIS is important for recording health risk events.

**Acknowledgements**

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**Funding**

There was no funding for the submitted abstract.

**Conflicts of interest**

I declare that I have no conflicts of interest related to this study.

**Ethics**

Ethical approval and informed consent were not required for this submitted abstract.

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**Popul. Med. 2025;7(Supplement 1):A45**

## Vector-borne diseases in large passenger vessels

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**Introduction**

Vectors onboard passenger ships can impact travellers' health, while ships can facilitate vector spread across borders. This systematic review aimed to understand risk factors, transmission dynamics and effectiveness of measures for vector-borne infection on passenger ships.

**Methods**

Conducted according to PRISMA 2020, peer-reviewed articles reporting infectious disease events in human travellers linked to passenger ships and seaports worldwide were eligible. Vector-borne events were defined as: malaria/zika/other described as a case, cluster or outbreak. Articles had to describe infection frequency with at least one case laboratory-confirmed. PubMed, Scopus and Cochrane Library were searched from January 2000 – March 2023.

**Results**

We identified a case report, cross-sectional study and randomized trial describing Israeli spotted fever (ISF), malaria and other tick-borne illnesses (TBIs) (Lyme disease, Babesiosis, Ehrlichiosis), respectively[1-3]. Two publications related to ferry travel with African and North American itineraries[2,3], and one to Mediterranean cruise travel[1]. The presumed risk factor in one study was time ashore during cruise excursions, with an ISF case likely infected spending time in Libya[1]. Another study reported spending time on mainland Equatorial Guinea as a risk factor for malaria, with prevalence higher among ferry passengers travelling from mainland to island[2]. Strength of evidence was low for both studies. A TBI educational intervention among ferry passengers was reported as a somewhat successful prevention measure, with estimated TBI risk among longer-term visitors in the intervention group 43% that of the control group[3].

**Conclusions**

There was no published evidence that vector-borne infection may be acquired onboard passenger ships; however, there was evidence infection could be acquired during ashore activities before/during travel. Results indicate the role that ferry transport in particular can play in importation of vector-borne pathogens to geographic areas. Based on voyage profiles, risk communication and educational interventions promoting prevention behaviors could be delivered before embarkation or during the journey.

**Acknowledgements**

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**Conflicts of interest**

None declared.

**Ethics**

Ethical approval and informed consent were not required for this study.

**References**

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**Popul. Med. 2025;7(Supplement 1):A46**

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**A5 figure & table**

Figure 1. New shared reporting system Q3 2024 results per USMAF-SASN. USMAF-SASN Lombardia, Piemonte, Valle d'Aosta is not shown as for the absence of seaports.

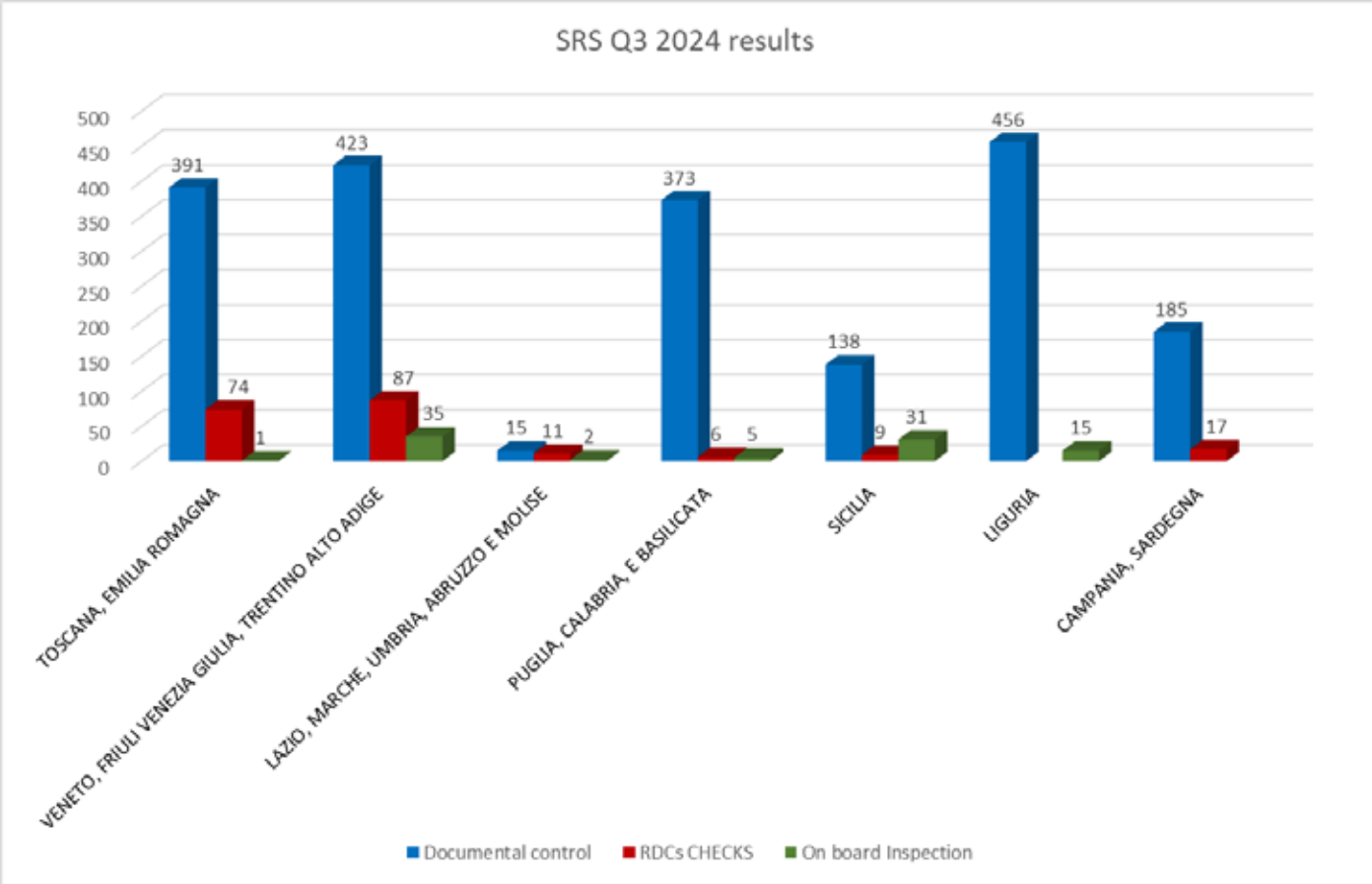


Table1: New shared reporting system Q3 2024 results per USMAF-SASN.

| Cross-Border Health Authorities (USMAF-SASN) | Documental control | RDCs Check | On board Inspections |
|---|---|---|---|
| TOSCANA, EMILIA ROMAGNA | 391 | 74 | 1 |
| VENETO, FRIULI VENEZIA GIULIA, TRENTINO ALTO ADIGE | 423 | 87 | 35 |
| LAZIO, MARCHE, UMBRIA, ABRUZZO E MOLISE | 15 | 11 | 2 |
| PUGLIA, CALABRIA, E BASILICATA | 373 | 6 | 5 |
| SICILIA | 138 | 9 | 31 |
| LIGURIA | 456 | 0 | 15 |
| CAMPANIA, SARDEGNA | 185 | 17 | 0 |

**A12 tables**

Table 1. Summary of ship sanitation inspections and issuance of Ship Sanitation Certificates.

| Stages | Ship Arrivals | Inspection with a SSCEC(%) | Inspection with a SSCC(%) | Frequency of Inspections (%) | Frequency of Extensions (%) | Frequency of Inspections Unable to be Conducted (%) |
|---|---|---|---|---|---|---|
| **Pre-pandemic (Avg.)** | **47,075** | **1,022 (96.50)** | **37 (3.50)** | **1,059 (2.25)** | **137 (0.29)** | **181 (0.38)** |
| 2018 | 47,043 | 1,055 (96.79) | 35 (3.21) | 1,090 (2.32) | 140 (0.30) | 197 (0.42) |
| 2019 | 47,106 | 988 (96.20) | 39 (3.80) | 1,027 (2.18) | 134 (0.28) | 165 (0.35) |
| **During pandemic (Avg.)** | **34,757** | **859 (96.63)** | **30 (3.37)** | **889 (2.56)** | **237 (0.68)** | **589 (1.69)** |
| 2020 | 37,354 | 976 (95.87) | 42 (4.13) | 1,018 (2.73) | 191 (0.51) | 366 (0.98) |
| 2021 | 34,572 | 876 (96.90) | 28 (3.10) | 904 (2.61) | 247 (0.71) | 598 (1.73) |
| 2022 | 32,346 | 726 (97.32) | 20 (2.68) | 746 (2.31) | 273 (0.84) | 802 (2.48) |
| **Total** | **198,421** | **4,621 (96.57)** | **164 (3.43)** | **4,785 (2.41)** | **985 (0.50)** | **2,128 (1.07)** |

Table 2. Logistic regression analysis of factors in relation to Ship Sanitation Control Certificates.

| | SSCC (%) n=164 | SSCEC (%) n=4,621 | *OR* | *95% CI* | *p-value* |
|---|---|---|---|---|---|
| **Period** | | | | | |
| Pre-Pandemic | 74 (3.50) | 2,043 (96.50) | Ref | - | - |
| During Pandemic | 90 (3.37) | 2,578 (96.63) | 0.96 | 0.71-1.32 | 0.82 |
| **Ship flag** | | | | | |
| Taiwanese | 10 (1.01) | 981 (98.99) | Ref | - | - |
| Non-Taiwanese | 154 (4.06) | 3,640 (95.94) | 4.15 | 2.30-8.44 | *p* <0.001 |
| **Ship Age** | | | | | |
| <12 | 19 (0.90) | 2,103 (99.10) | Ref | - | - |
| ≧12 | 145 (5.44) | 2,518 (94.56) | 6.37 | 4.04-10.65 | *p* <0.001 |
| **Gross Tonnage** | | | | | |
| <10000 | 144 (6.62) | 2,031 (93.38) | 9.18 | 5.88-15.16 | *p* <0.001 |
| ≧10000 | 20 (0.77) | 2,590 (99.23) | Ref | - | - |
| **Ship type** | | | | | |
| Oil Tanker | 75 (13.99) | 461 (86.01) | 17.64 | 9.48-36.62 | *p* <0.001 |
| General Cargo Ship | 38 (4.49) | 808 (95.51) | 5.1 | 2.63-10.87 | *p* <0.001 |
| Multi-Purpose Ship | 11 (10.19) | 97 (89.81) | 12.29 | 5.06-30.21 | *p* <0.001 |
| Bulk Carrier | 10 (0.91) | 1,084 (99.09) | Ref | - | - |
| Others[1] | 30 (1.36) | 2,171 (98.64) | 1.5 | 0.76-3.24 | 0.27 |
| **Evidence Findings** | | | | | |
| 0 | 0 (0.00) | 4,500 (100.00) | - | - | - |
| 1-3 | 79 (41.58) | 111 (58.42) | - | - | - |
| ≧4 | 85 (89.47) | 10 (10.53) | - | - | - |

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**A13 tables**

Table 1. Number of inspection reports, deficiencies, CAS, non-compliances with requirements of the EU legislation, non-followed recommended standards of the European Manual and Notations between 2018 and 2024.

| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 01/01/2024 to 30/09/2024 | Total |
|---|---|---|---|---|---|---|---|---|
| Inspection reports | 41 | 86 | 10 | 1 | 52 | 85 | 43 | 327 |
| Deficiencies | 440 | 909 | 167 | 2 | 446 | 595 | 358 | 2.917 |
| Corrective Action Statements | 44 | 64 | 22 | 0 | 46 | 80 | 36 | 292 |
| Non-compliances with requirements of the EU legislation | 130 | 289 | 90 | - | 158 | 191 | 135 | 993 |
| Non-followed recommended standards of the European Manual | 300 | 569 | 67 | 2 | 270 | 348 | 213 | 1.769 |
| Notations | 10 | 51 | 10 | - | 18 | 56 | 10 | 155 |

Table 2. Inspection reports and Corrective Action Statements in EU Common Ship Sanitation Database (former SHIPSAN ACT Information System (SIS) https://sis.shipsan.eu/.) per country and port between 2018 and 30th September 2024.

| Country | Port | Inspection reports | CAS |
|---|---|---|---|
| Belgium | Zeebrugge | 6 | 7 |
| | Antwerpen | 1 | 1 |
| Croatia | Opatija | 1 | 1 |
| | Split | 1 | 2 |
| Cyprus | Limassol | 21 | 20 |
| Estonia | Tallinn | 1 | 1 |
| | Vanasadam | 4 | 3 |
| Germany | Hamburg | 19 | 19 |
| Greece | Heraklion (Iraklion) | 9 | 5 |
| | Kavala | 10 | 10 |
| | Piraeus (Pireefs) | 58 | 56 |
| | Thessaloniki | 9 | 8 |
| | Agios Nikolaos, Kriti | 1 | 1 |
| | Rhodes | 3 | 2 |
| Ireland | Cork | 3 | 2 |
| | Dublin | 9 | 9 |
| | Dún Laoghaire | 1 | 1 |
| Italy | Bari | 5 | 5 |
| | Catania | 1 | 1 |
| | Giardini Naxos | 3 | 3 |
| | Livorno | 15 | 15 |
| | Messina | 1 | 1 |
| | Napoli | 2 | 2 |
| | Palermo | 4 | 4 |
| | Savona | 4 | 4 |
| | Vado Ligure | 1 | |
| | Venice | 6 | 5 |
| | Trieste | 10 | 10 |
| Lithuania | Klaipeda | 12 | 11 |
| Netherlands | Amsterdam | 5 | 5 |
| | Rotterdam | 6 | 3 |
| | Velsen (IJmuiden) | 4 | 4 |
| Monaco | Monaco | 2 | 1 |
| Malta | Valletta | 8 | 8 |
| Slovakia | Bratislava | 22 | 9 |
| Slovenia | Koper | 10 | 10 |
| Spain | Algeciras | 3 | 1 |
| | Alicante | 8 | 8 |
| | Barcelona | 2 | 2 |
| | Bilbao | 1 | |
| | Ceuta | | 1 |
| | Gijon | 2 | 2 |
| | Las Palmas de Gran Canaria | 9 | 8 |
| | Palma de Mallorca | 5 | 4 |
| | Santander | 5 | 4 |
| | Valencia | 12 | 10 |
| | Vigo | 2 | 3 |
| Total | | 327 | 292 |

Table 3: Top 10 inspection findings concerning inspections between 2018 and 30th September 2024.

| Item number | Description of item | Frequency | % of total* |
|---|---|---|---|
| 3.6.1 | Cleaning of utensils and equipment | 80 | 2.7 |
| 3.4.13 | Labelling of foodstuffs | 75 | 2.5 |
| 3.5.5.1 | Condition of equipment | 71 | 2.4 |
| 4.46 | Hot water distribution system temperature | 60 | 2 |
| 3.3.10 | Cleaning and disinfection | 52 | 1.7 |
| 3.4.13.3 | Traceability | 51 | 1.7 |
| 4.56 | Monitoring of temperature | 49 | 1.6 |
| 3.4.24.2 | Information to consumers | 43 | 1.4 |
| 3.4.10 | Protection against contamination | 42 | 1.4 |
| 6.1 | Pests | 41 | 1.4 |

* (%) of total items cited in inspections

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**A37 table**

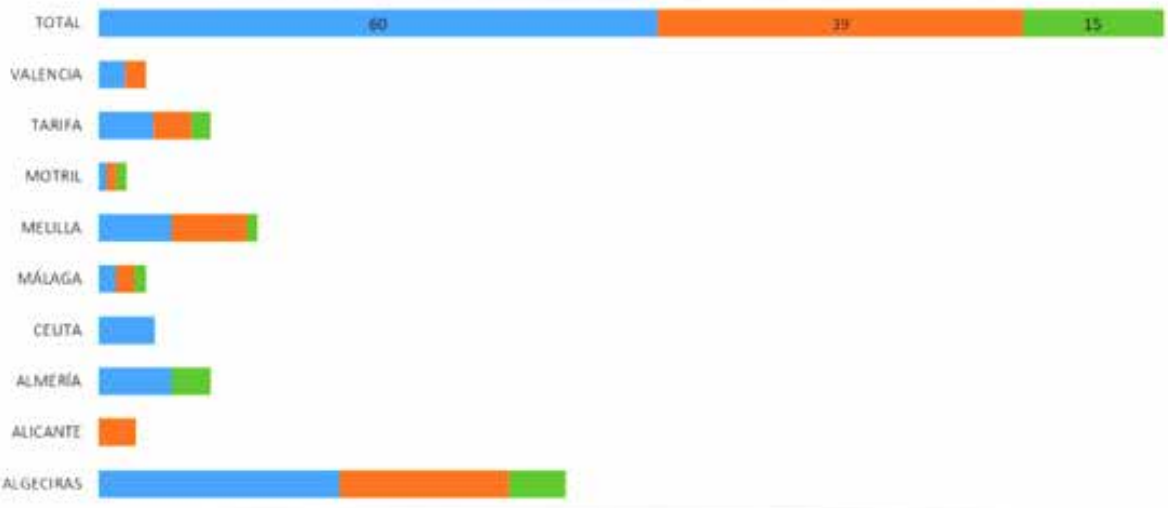
Table 1 - Cruise Ship Inspection 2023/2024

| Items | Not Implemented | Critical Controls | Total of Items | % Not Implemented |
|---|---|---|---|---|
| Food | 43 | 3 | 663 | 6% |
| Climatization | 10 | 0 | 85 | 12% |
| Cleaning and hygiene | 9 | 2 | 153 | 6% |
| Outbreaks prevention | 7 | 5 | 153 | 5% |
| Waste management | 5 | 0 | 119 | 4% |
| Hospital | 3 | 0 | 119 | 3% |
| Pest control | 2 | 2 | 17 | 12% |
| Recreational waters | 1 | 0 | 68 | 1% |
| Potable water | 1 | 0 | 119 | 1% |
| Sewage | 0 | 0 | 153 | 0% |
| TOTAL | 81 | 12 | 1649 | 5% |

Source: Risk Manger system 08/19/2024
* Total of items = 17 ships X number of recommended items

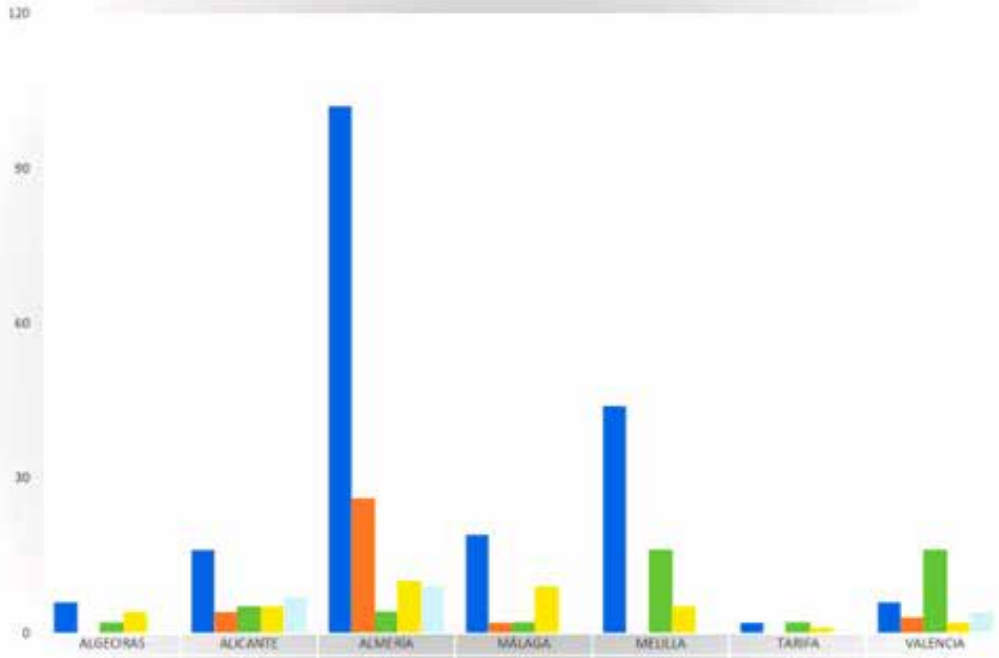
**A43 figures**

**Figure 1. Distribution of inspected vessels, SSC reviewed and SSCEC/SSCC issued Operation Crossing the Strait. Spain, 2023.**




| | ALGECIRAS | ALICANTE | ALMERÍA | CEUTA | MÁLAGA | MELILLA | MOTRIL | TARIFA | VALENCIA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| Vessels inspected | 26 | 0 | 8 | 6 | 2 | 8 | 1 | 6 | 3 | 60 |
| SSC reviewed | 18 | 4 | 0 | 0 | 2 | 8 | 1 | 4 | 2 | 39 |
| SSCEC/SSCC issued | 6 | 0 | 4 | 0 | 1 | 1 | 1 | 2 | 0 | 15 |

**Figure 2. Distribution of hygiene-sanitary inspection points in ports inspected by Foreign Health Units Operation Crossing the Strait. Spain, 2023.**




| | ALGECIRAS | ALICANTE | ALMERÍA | MÁLAGA | MELILLA | TARIFA | VALENCIA | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Port facilities | 6 | 16 | 102 | 19 | 44 | 2 | 6 | 195 |
| Public drinking fountains | 0 | 4 | 26 | 2 | 0 | 0 | 3 | 35 |
| Showers and fixed public toilets | 2 | 5 | 4 | 2 | 16 | 2 | 16 | 47 |
| Mobile public toilets | 4 | 5 | 10 | 8 | 5 | 1 | 2 | 36 |
| Water storage/distribution points | 0 | 7 | 9 | 0 | 0 | 0 | 4 | 20 |