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## **Ship sanitation: controlling and preventing of risk factors of disease transmission in the port of Kendari**

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### **Keywords**

*ship sanitation;  
presence of rat;  
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### **Abstract**

*The spread of infectious diseases globally has been a threat to public health and national economies for many centuries. One of the undeniable sectors that contributed to the spread of disease is maritime transport. This research aimed to examine ship sanitation for controlling and preventing the potential risk of disease transmission. This study used an observational survey method, with a sample of 24 ships anchored in the port of Kendari by using an accidental sampling technique. The instrument used in this research is the ship sanitation inspection form. The variables examined in the ship sanitation inspection include kitchen, food preparation room (pantry), warehouse, hold (cargo), room (officers, passengers, and deck), drinking water, liquid waste, ballast water, medical waste, medical facilities, and engine room. Data analysis in this study was carried out descriptively, presented in the form of frequency, percentage, and graph. This research revealed that there were amount 10 ships (41.7%) with high-risk sanitation categories or have inadequate sanitation. The main determinants contributing to accelerating the global transmission of various infectious diseases on the ship are the sign and presence of vectors. Outbreaks associated with the presence of vectors on board are usually related to inadequate control and sanitation, along with insufficient attention to preventing contamination. Therefore, the crewmember onboard needs to increase their knowledge through various ship sanitation training, develop sanitation programs and integrate sustainable monitoring and evaluation programs of vectors to improve sanitation to prevent risk factors for disease transmission.*

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### **Introduction**

The ship is one type of transportation developing so rapidly and offers economical and efficient long-distance transportation (1–4). The shipping industry is an integral component of global trade (5–7). More than 99,741 commercial vessels worldwide carry every type of cargo and are registered in more than 150 countries manned by more than 1 million seafarers in almost every country (8,9). The number of world seaborne trade through the cargo ship industry also increased of 4.8% in the last few decades (10–12).

The shipping industry also supports tourism and recreation by increasing passenger size and capacity (13–15). Data shows that there has been an increase in the total number of inland ferry ports in Indonesia, namely in 2013 as many as 217 and 2019 to 294 operating in Indonesia. This shows that there has been an increase of 77 ports over the last six years in Indonesia (16). Along with the increase in the number of ports and the development of transportation technology, travel times between regions/countries have become easier, trade and the number of passengers have increased, which can lead to various potential dangers of spreading cross-border diseases and other public health hazards such as chemicals, related to food safety, zoonoses, vector-borne diseases, infectious diseases (17–20).

Historically, ships played an important role in the global transmission of infectious diseases (21,22). In the 14th century, the port denied access to a ship suspected of carrying the bubonic plague as an effort to control the transmission of diseases caused by rat fleas to humans via ships (23,24). Furthermore, in the 19th century, the spread of cholera and other vector-borne disease pandemics was estimated to have been facilitated by ship, and more than 100 outbreaks of ship-related infectious diseases were recorded between 1970 and 2003 (25,26). Furthermore, the outbreak of acute gastroenteritis has also become the centre of attention of various parties on cruise ships (27–29). It was noted that from 2002 to 2009, there was an increase in norovirus disease outbreaks on cruise ships and lands such as tourist destinations and lodging (30,31). 84 people out of 2,318 passengers underwent an examination with symptoms of acute gastroenteritis to the ship's health service during the trip. Then, the outbreak continued on the next voyage, with 192 passengers and 23 crew members experiencing acute gastroenteritis (32).

The high cases of infectious diseases and vector-borne diseases due to inadequate ship sanitation impact the health, maritime, economy and tourism sectors (33). Therefore, in 1967, the World Health Organization (WHO), under the International Health Regulation (IHR), first issued a ship sanitation guide that aims to monitor and control six serious infectious diseases, namely cholera, plague, relapsing fever, smallpox, typhus, and yellow fever; taking ship sanitation measures to maintain the health of passengers and crew and to prevent risk factors for the spread of infection from one country to another (9,34). In addition, the ship's sanitation inspection is also carried out to prevent the possibility of further infection and disease transmission being carried on the ship to the mainland.

The Port Health Office (KKP) is a technical implementing unit within the Ministry of Health. It is responsible to the Director-General of Disease Control and Environmental Health at the Ministry of Health in inspecting ship sanitation in Indonesia. As regulated in Article 2, which states that every ship that enters/conducts a voyage in Indonesian waters, is required to have a Ship Sanitation certificate consisting of a Ship Sanitation Control Exemption Certificate (SSCEC), which is given to ships that are declared free of sanitation measures and Ship Sanitation Control Certificate (SSCC) is awarded to the ship following the recommendations in the sanitary inspection (35).

Sanitation inspection of ships at ports is a routine agenda carried out by the KKP in various provinces throughout Indonesia to prevent various risk factors for disease transmission. Kendari City Port is one of the ports that serve various domestic and international shipping through passenger, cargo, and container ships. Based on the results of observations on several ships that docked at the port of Kendari City, it shows that the goods on the deck of the ship are not neatly arranged, and garbage, especially food scraps in the kitchen, are scattered, which can provide an opportunity for disease-carrying vectors such as cockroaches and rats to breed, and at risk of transmitting disease. Referring to these problems, it is imperative to identify the sanitation of ships anchored at the Kendari city port to minimize the ship's risk to public health.

## Methods

This is a descriptive quantitative research using an observational survey approach. A total of 24 ships were sampled in this study, taken by non-probability sampling using the accidental sampling technique. This sampling technique is used to carry out ship sanitation based on ships anchored at the port of Kendari City during the research period. Data collection was carried out using an observation form to inspect ship sanitation from the Port Health Office (KKP) Class II Kendari.

Determination of ship sanitation categories based on the results of inspections on each ship. High-risk if there are signs of vectors, rodents, or other disease-carrying animals that impact human health. As for the low-risk category, there are no signs of vector life, disease-carrying animals, or other risks that impact human health (35). Furthermore, data from ship sanitation inspections were analyzed descriptively using SPSS 26. This descriptive analysis was conducted to obtain a description of the characteristics of each inspected ship. Quantitative data variables are presented in the form of frequency, percentage, and graphs related to the results of ship sanitation inspections.

## Results

A total of 24 ships have been subjected to sanitary inspection in this study. The characteristics of ships anchored at the port of Kendari city, there are 9 cargo ships, 5 passenger ships, 2 Roll on-Roll off (RO-RO) ships/ferries, and 8 container ships (Table 1).

Table 1. Characteristics of ship types

The type of ship	n = 24
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	<b>n</b>	<b>%</b>
Cargo	9	38
Passenger	5	21
RO-RO/Ferries	2	8
Container	8	33

The results of the sanitation inspection showed that in the galley, approximately 79.17% do not have a trash can equipped with a cover, in the food preparation section, shows that 41.67% is not clean, which is indicated by the presence of leftover food in the preparation food preparation place. The warehouse is clean, has good air circulation and adequate lighting. Room (officers, passengers, and deck) basically 70.84% do not have ventilation, so the air circulation in the room is not good. Drinking water on board meets the requirements. The liquid waste disposal facilities are qualified, but based on the ship's sanitation inspection results, it shows that overall, the ship has not processed liquid waste. Medical equipment, medicine, and Standard Operating Procedures (SOP) for health emergencies/outbreaks are available. The engine room is clean, has good air circulation and lighting (Table 2)

Table 2. The result of ship sanitation inspection

Variable	<b>n = 24</b>			
	Yes		No	
	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>
<b>Galley</b>				
Clean	13	54.16	11	45.84
There is a trash can with a lid	5	20.83	19	79.17
Good air circulation	10	41.67	14	58.33
Lighting adequate	24	100	0	0
<b>Food preparation room</b>				
Clean	14	58.33	10	41.67
There is a trash can with a lid	6	25	18	75
Good air circulation	24	100	0	0
Lighting adequate	24	100	0	0
Good food storage	24	100	0	0
<b>Warehouse</b>				
Clean	24	100	0	0
Good air circulation	24	100	0	0
Lighting adequate	24	100	0	0
<b>Room (officers, passengers, and deck)</b>				
Clean	13	54.16	11	45.83
Good air circulation	7	29.16	17	70.84
Lighting adequate	24	100	0	0
Free of insect and mice	14	58.33	10	41.67
<b>Drinking water</b>				
Drinking water available	24	100	0	0
Qualified drinking water	24	100	0	0
Drains and water collection equipment and storage area are clean	24	100	0	0
<b>Liquid waste</b>				
Qualified liquid waste disposal facilities	24	100	0	0
Carried out liquid waste treatment	0	0	24	100
<b>Medical facilities</b>				
Medical equipment and medicine are available	24	100	0	0
Standard Operating Procedures (SOP) for health emergencies/outbreaks are available	24	100	0	0
<b>Engine room</b>				
Clean	24	100	0	0
Good air circulation	24	100	0	0
Lighting adequate	24	100	0	0

The results of the evaluation sanitation inspection on 24 ships anchored at the port area of Kendari city showed that there were 14 ships with low-risk sanitation and 10 ships with high-risk sanitation (table 3).

Table 3. Ship's sanitation inspection evaluation at the port of the city of Kendari

Ship sanitation category	n = 24	
	N	%
Low risk	14	58.3
High risk	10	41.7

Subsequently, the ship sanitation category based on the type of the ship in the port area of Kendari city in Figure 1 indicates that ships with a low-risk sanitation category are 1 cargo ship, 3 passenger ships, 2 RO-RO ships, and 8 container ships. In addition, ship sanitation with high risk was founded on 8 cargo ships and 2 on passenger ships.

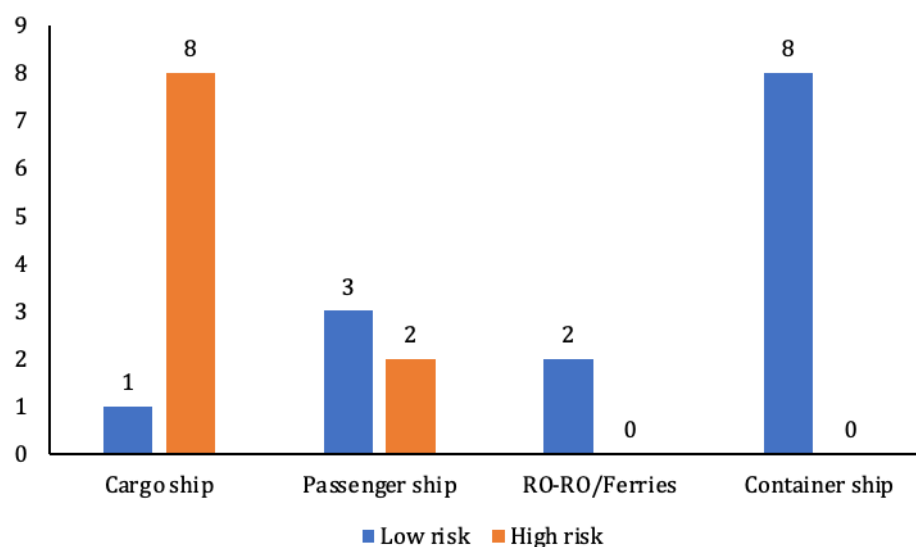


Figure 1. Ship sanitation category based on the type in the port area of Kendari city

## Discussion

A ship is a transportation or water vehicle with a certain shape and type (36). Sanitation inspection of ships is important in efforts to prevent the spread of disease (37). Moreover, ship sanitation is also an effort to overcome or identify various environmental risk factors that can cause various diseases (38). The results of this study are in line with other researchers who show that there is still ship sanitation that does not meet the requirements or with a high sanitation risk to the risk of disease occurrence and transmission (39–42). The ship captain is responsible for the ship's safety from the source of illness and reports in the form of a Maritime Declaration of Health (MDH) to the port health authority every time it enters the territory of a country (9). Sanitation inspection of ships includes kitchen, food preparation room (pantry), warehouse, hold (cargo), room (officers, passengers, and deck), drinking water, liquid waste, ballast water, medical waste, medical facilities, and engine room (35).

### The galley

Sanitation inspection of ships, especially the galley, is essential because kitchens with inadequate sanitation can be one part of the risk factors for disease transmission (43). Based on the study results, the kitchens on several passenger ships and cargo ships with high-risk sanitation are still not clean. There are no closed trash cans, food scraps are scattered on the kitchen floor, and there are signs of vector life (rats) which can facilitate disease transmission. Other researchers also expressed this by showing that a galley with poor sanitation invited rats as vectors of disease transmission (44). Controlling disease vectors such as insects and rodents such as mosquitoes, rats, cockroaches, flies, fleas, and rat fleas is essential to maintain health on board ships because they can transmit diseases (9,45,46).

### Food preparation area

Ships with low-risk sanitation in the food preparation area are clean, air circulation and lighting are good, the food storage area on the ship is clean, food is stored on shelves, food storage materials are good, and there are also no signs of vector life. Other studies also revealed that the sanitation of the food

preparation space on ships that meet the requirements looks clean, there are closed trash cans, food utensils are also clean, lighting is adequate, and there are no signs of disease vector life (47).

### **Warehouse**

The study revealed that the warehouse looked clean, had good air circulation and lighting, no insects (cockroaches), and no signs of vector life (rats) on all ships. This is different from the results of other studies, which state that there are still ships whose warehouses do not meet the requirements with the results of a sanitation assessment which shows that the goods in the warehouse or hold are not neatly arranged, there are no trash bins and ventilation, inadequate lighting, and the presence of insects in the ship's warehouse (43,48).

### **Room (officers, passengers, and deck)**

Ships, when sailing not only carrying ship crews, passengers, luggage and cargo, but can also carry various unwanted disease vectors such as flies, cockroaches, mosquitoes, and other vectors that can be carried through food supplies, cargo, luggage, vehicles, or can be carried by humans and animals as ectoparasites (49). The results showed that the crew and passenger rooms on cargo ships with high-risk sanitation did not have ventilation, so the air circulation was not smooth. Furthermore, the ship's deck looks unclean, and the goods are not neatly arranged. There are cockroaches and the presence of vectors. Unlike the case on ships with low-risk sanitation, it shows that the officer and crew rooms and passengers are clean, have adequate ventilation and air conditioning (AC) so that air circulation in the room is smooth, lighting is adequate, and there are no insects or signs of vector presence. Then, the bathrooms and toilets on the ship are clean, odorless, and the faucets work well.

### **Drinking water**

Providing safe drinking water on board is important because contamination can occur directly throughout the supply chain management (50). Interventions to improve water quality onboard ships can significantly benefit health and water storage/supply and must be controlled to protect health (51). The results showed that the drinking water available on the ship is physically clear, colourless, and odourless. In addition, the volume of drinking water supply is also sufficient for the needs of the crew. This is in line with the research conducted by Mulić and Tomić (52), which proved that the drinking water on board is managed according to hygienic and health standards that are applied throughout the supply chain, from source to the point of consumption.

### **Liquid waste**

Implementing unsafe ship waste management and disposal can easily lead to adverse health consequences. Humans can be directly exposed, both on ships and in ports, from contact with waste that is not managed safely. Exposure from waste can also occur by transferring disease-causing organisms to the environment or hazardous substances due to unsafe disposal. However, waste management can be carried out to be environmentally friendly and disposed of properly to prevent hazardous material, leading to various risk factors for health problems (53–55). Observation results indicate that there are facilities for liquid waste disposal on all ships whose channels are closed, do not leak, and are channelled to a special place.

### **Medical facilities**

Medical equipment is the main facility onboard. Some ships with long voyages are equipped with trained health personnel and very sophisticated equipment to provide health care and services (56). In addition, to overcome the problems caused by infectious diseases in transit, it is essential to provide information, vaccinations, medical supplies, and resources to prevent disease on board (57,58). The study showed that there are tools and materials used for medical examinations and trained personnel for first aid. There are medicines in all ships, special examination rooms, handwashing facilities, and have Standard Operating Procedures (SOP) for health emergencies/outbreaks.

### **Engine room**

The engine room is one of the vital compartments on a ship because there is important equipment with different features and functions to move and carry the ship's operational capabilities. A good ship's engine room has a ventilation system to provide fresh air or regulate the air circulation system and remove unwanted heat from the main engine, auxiliary generators, and other heat sources (59). The results of observations in the ship's engine room did not see dirt and garbage, there were no insects or signs of vector life, good air exchange, which was indicated by the presence of an exhauster and good

lighting on all ships. This is in line with other researchers who stated that the ship's engine room looks clean, garbage is not scattered, and there are no signs of disease vector life (60).

Ships have an important role as a means of transportation in human life. However, on the other hand, ships can also become a medium for disease transmission if the sanitation is poor. This present study proves that various risk factors on ships with high sanitation risks can impact health. It is imperative to make various efforts to maintain and improve sanitation in the ship's environment.

## Conclusion

This study provides insight into the inspection and sanitary conditions of ships anchored at Kendari port. The findings of this study revealed that there are ships with high sanitation risk as indicated by the presence of vectors, insect signs, unclean kitchens, and food scraps on board that can contribute to the transmission of various risk factors for infectious and vector-borne diseases to passengers along with the ship's crew. Concerning this, a response from the Port Health office is needed to advise all ship crews about the importance of maintaining ship sanitation and its impact on health by applicable regulations. Furthermore, ship crews also need to increase their knowledge through various training such as the Vessel Sanitation Program (VSP), develop sanitation programs, and integrate sustainable vector monitoring and evaluation programs to improve sanitation because good sanitation can reduce the possibility of various risk factors for disease on board.

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