



RELATIONSHIP BETWEEN SANITATION CONDITION AND VECTOR'S EXISTENCE ON VESSELS AT THE WORKING AREAS OF PORT HEALTH OFFICE (KKP) CLASS II SEMARANG IN 2019

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Abstract

Semarang Port Health Office (KKP Kelas II Semarang) is included in 25 strategic commercial ports in Indonesia. Data from the KKP shows that there was a 1,3% increase in vessels with high health risks in 2019 with compartments most at risk for vector breeding ground are the galley room and pantry room. The purpose of this study was to determine the relationship between sanitary conditions and vector's presence in each compartment of the ship. This research was an analytical method with a cross-sectional design and uses secondary data from KKP Class II Semarang in 2019. The research's samples were ships with high health risk including Semarang and Tegal's

Port in 2019 with a total of 34 ships. The independent variables in this study were the sanitary conditions of the galley, pantry, warehouse, crew's bedrooms, officer's bedroom, and ship's deck. The dependent variable is the presence of vectors on the ship. The results with chi-square test showed that there was a relationship between galley sanitation (p-value = 0.031), pantry sanitation (p-value = 0.002), warehouse sanitation (p-value = 0.025), crew's bedroom (p-value = 0.021), and officer's bedroom (p-value = 0.043) with vector's presence on the ship. Meanwhile, the sanitary condition of the ship's deck was not related to the vector's presence in the compartment of the ship (p-value = 0.3870). So, it can be concluded that the sanitary conditions of the galley, pantry, warehouse, bedroom for crew and officers are related to the presence of vectors on the ship.

Keywords: *KKP Class II Semarang, Port, Sanitation, Ship, Vector*

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Introduction

Marine ships carry passengers and their cargo, ship engines, and compartments, and also carry the risk of carrying disease-transmitting organisms such as rats, cockroaches, flies, mosquitoes that can enter the ship through food supplies, cargo, or can be carried in the human body. and animals as ectoparasites. In a study conducted by Mouchtouri et al in the United States, 85.7% of flies and 52.3% of cockroaches were found on 21 ferries. (Mouchtouri et al., 2008). Vectors on ships can carry various types of disease pathogens and breeds on board. Most of the vectors can cause quarantine disease (a disease that must be monitored by state health workers because it has the potential to cause an outbreak such as PES (*plague*), cholera, yellow fever, and so on (Kementerian Kesehatan Republik Indonesia, 2007).

To prevent quarantine diseases in an area, it is mandatory to control the presence of these vectors in inter-regional transportation, especially cross-country transportation (WHO, 2012). The spread of yellow fever originating from Africa, which is carried by mosquito vectors to other countries, is known to occur via ship trips, proving that the presence of vectors on ships has an impact on the spread of the disease in a country (WHO, 2007). Moreover, poor sanitation conditions such as poor lighting, dirty, humid, bad air circulation will increase the potential for vector presence on ships, as well as the potential for vector animals to breed in the ship's compartment (Putri et al., 2017).

One of the efforts to prevent the spread of disease is through transportation, WHO (*World Health Organization*) published IHR (*International Health Regulation*) document which explains the importance of ship inspection consisting of sanitation inspection activities, first aid kits, a list of vaccinations carried out under the supervision of the Port Health Office (KKP). The existence of vectors on board is one of the factors that can affect public health risks on board. Research by Norhayati in 2017 related to ship's sanitation at ports, 45% of ships did not meet the requirements for good ship sanitation, 35% of ships were positive for the presence of rats in ships, and there was a relationship between sanitary conditions and the presence of vectors on ships (Norhayati et al., 2017).

Semarang Class II Port Health Office is the main port health office in Central Java, which has ports that are included in 25 strategic commercial ports in Indonesia (Minister of Health of the Republic of Indonesia, 2011) (Statistik, 2018). The Port health office is responsible for the supervision and control of vessels with high health risks. Disease vector control requires collaboration with the captain and crew so that vector control can run continuously, so the crew needs to know the important factors that affect vector control for each compartment, namely the sanitary conditions of each compartment of the ship, especially if the ship is declared a high health risk. However, not all compartments on a high-health risk vessel have poor sanitary conditions and not all compartments have signs or presence of vectors. That's because not all risk factors for the existence of vectors are present in all compartments of the ship.

One of the ship compartments that has the greatest potential for vector reproduction, especially rats and cockroaches, is the galley room and the pantry (Norhayati et al., 2017). Research by Burhannudin Thohir at the Banten Port Health Office shows that there is a relationship between galley sanitation, warehouse sanitation, room sanitation for crew members with the presence of vectors on ships, while passenger space is declared free of signs or vectors (Thohir et al., 2018). This proves that not all ship compartments are a risk factor for



the existence of vectors on the ship. Complies with international guidelines, *Handbook for Inspection of Ships and Issuance of Ship Sanitation Certificates* from WHO, The existence of different conditions and risk factors for the presence of vectors in each compartment makes the kinds of prevention and vector control for each compartment different (WHO, 2011). Thus, knowing the sanitary conditions of the ship compartments which are a risk factor for the existence of vectors is needed to provide recommendations for the appropriate control and prevention of infectious diseases in each compartment of the ship with high health risks.

Methods

This research was observational research with analytical methods. This study uses a cross-sectional design and using secondary data obtained from Semarang Port Health Office. Secondary data obtained were in the form of the results of the sanitation inspection of each compartment of the ship which was declared to have a high risk of or does not meet the requirements for the sanitation inspection, as well as the results of the inspection for the presence of vectors and in each compartment. The population of this research is all ships berthed at the port which is included in the KKP Kelas II Semarang's working area which was included in the high-health risk vessels in January-December 2019. Based on KKP Class II Semarang Annual Report 2019, of the 2,780 vessels that were subjected to ship sanitation inspection measures, 34 ships (29 ships from the Port of Tanjung Emas in Semarang and 5 from the Port of Tegal) were declared to be at high health risk. Meanwhile, the sample of this study is the entire population.

The independent variables in this study are the sanitary conditions of the galley, pantry room, warehouse, bedroom for crew members, and the bedroom for officers. While the dependent variable is the existence of vectors in each compartment of the ship. Data analysis used univariate analysis and bivariate analysis. The univariate analysis in this study is the type of ship, ship's flag, the sanitary conditions of the galley for each ship, the sanitary conditions of the pantry room, the sanitary conditions of the warehouse, the sanitary conditions of the crew's bedroom, and the sanitary conditions of the officers' bedrooms on each ship. Meanwhile, the bivariate analysis used the *chi-square* test statistical test with a significance of 95%. ($\alpha = 0,05$).

Results

The following table is a table of the frequency distribution of sanitary conditions and the presence of ship vectors with high health risks in the KKP Semarang Class II working area in 2019.

Table 1. Frequency Distribution of Ship Types, Ship Origin, Sanitary Conditions, and Vector Presence on High Health Risk Vessels in the KKP Class II Semarang Work Area in 2019

Characteristics	Frequency	Percentage (%)
Type of Ship		
Survey ship	2	5,9
Motor vessels	24	70,6
Tugboat	3	8,8
Motor tanker	5	14,7
Ship's flag		
Domestic ship	34	100,0
Foreign ship	0	0,0



Characteristics	Frequency	Percentage (%)
Galley Sanitary Conditions		
Not qualified	30	88,2
Qualified	4	11,8
Pantry Room Sanitary Conditions		
Not qualified	25	73,5
Qualified	9	26,5
Warehouse Sanitary Conditions		
Not qualified	19	55,9
Qualified	15	44,1
Crew's Bedroom Sanitary Conditions		
Not qualified	21	61,8
Qualified	13	38,2
Officer's Bedroom Sanitary Conditions		
Not qualified	16	47,1
Qualified	18	52,9
The Existence of Vectors in the Galley		
There is a sign / the presence of vector	31	91,2
There is no sign / the presence of vector	3	8,8
The Existence of Vectors in the Pantry		
There is a sign / the presence of vector	28	82,4
There is no sign / the presence of vector	6	17,6
The Existence of Vectors in the Warehouse		
There is a sign / the presence of vector	25	73,5
There is no sign / the presence of vector	9	26,5
The Existence of Vectors in Crew's Bedroom		
There is a sign / the presence of vector	28	82,4
There is no sign / the presence of vector	6	17,6
The Existence of Vectors in Officer's Bedroom		
There is a sign / the presence of vector	26	76,5
There is no sign / the presence of vector	8	23,5

Based on the data in table 1, the types of vessels with the highest health risk were motor vessels, with total of 24 ships (70.6%). Meanwhile, the types of vessels with high health risk were survey ships with a total of 2 ships (5.9%). All vessels with high health risks come from domestic with a total of 100%.

The sanitary conditions of each compartment that did not meet the requirements the most were the galley rooms, which were 30 out of 34 rooms (88.2%). Meanwhile, the sanitary condition of each compartment that met the most requirements was the officer room, which was 18 out of 34 ships (52.9%). Then, the compartment with the most signs and presence of vectors was the galley room with 91.2%, and the compartment with the least signs and vector presence was the warehouse room with 82.4%.

The following table is an analysis table of the relationship between sanitation conditions and the existence of vectors on the ship with high health risks in the KKP Class II Semarang work area in 2019.



Table 2. Analysis of the Relationship between Independent Variables and the Existence of Vectors on Ships with High Health Risks in the KKP Class II Semarang's Work Area in 2019

Variables	Keberadaan Vektor				Total		<i>p-value</i>
	Exist		Not exist		f	%	
	f	%	f	%			
Galley Sanitary Conditions							
Not qualified	29	96,7	1	3,3	30	100	0,031*
Qualified	2	50,0	2	50,0	4	100	
Pantry Room Sanitary Conditions							
Not qualified	24	96,0	1	4,0	25	100	0,002*
Qualified	4	44,4	5	55,6	9	100	
Warehouse Sanitary Conditions							
Not qualified	17	89,5	2	10,5	19	100	0,025*
Qualified	8	53,3	7	46,7	15	100	
Crew's Bedroom Sanitary Conditions							
Not qualified	20	95,2	1	4,8	21	100	0,021*
Qualified	8	61,5	5	38,5	13	100	
Officer's Bedroom Sanitary Conditions							
Not qualified	15	93,8	1	6,3	16	100	0,043*
Qualified	11	61,1	7	38,9	18	100	

Note:

* = significant

Discussion

The Relationship between Galley Sanitation and the Existence of Vectors on Ship with High Health Risk

Based on table 2, there were 29 out of 30 (96.7%) galley's sanitation condition that did not meet the requirements found for signs or the presence of vectors. Meanwhile, among galley's conditions that met the requirements, there were 2 out of 4 (50%) galley sanitation conditions that met the requirements but there were signs or vector's presence. Signs of the presence of the vector were bitten marks, footprints, smells, or feces from rats, cockroaches, and flies. Based on the results of the *chi-square* test, it got $p\text{-value} = 0.031$ ($p\text{-value} < 0.05$), so that there is a relationship between the galley's sanitary conditions with the presence of vectors in the galley on ship with high health risk in KKP Class II Semarang working area in 2019.

Most high health risk ship's galley does not meet the cleanliness requirements of the room, as evidenced by the presence of leftover vegetables scattered on the floor and less clean and untidy cooking utensils. Based on the observations of officers, cockroach vectors were found in open trash cans and corners of the room and a mouse vector was found roaming under the galley's table. Based on research by Noorhayati, galley's sanitation has a very large indication of the presence of vectors (Norhayati et al., 2017). Cockroaches and rats are often found in the kitchen area where there are many sources of food in the place (Service, 2012). Unclean kitchen conditions and poor waste management can lead to vector breeding in the



galley, especially for the rat, cockroaches, and flies because vectors tend to like a slum and humid habitats. (Harahap, 2016; WHO, 2011). Besides, poorly paid attention to food processing hygiene can increase the risk of excreta contamination and bacterial infection that is carried by vectors on food ingredients and cooking utensils in the kitchen. (Service, 2012; WHO, 2007). This study is in line with research conducted by Olievia, N using the *chi-square* test, the *p-value* was 0,000 (*p-value* < 0,05) with a strong relationship between the *p-value* was 0,766, then there is a relationship between galley's sanitary conditions and the presence of cockroach vectors on the ship with the large percentage of cockroaches found in the galley (Olievia et al., 2018).

The Relationship between Pantry Sanitation and the Existence of Vectors on Ship with High Health Risk

The pantry room is a place to prepare food before serving, so there are many sources of food and cooking food. Based on table 2, there were 24 out of 25 (96%) pantry's sanitation condition that did not meet the requirements found for signs or the presence of vectors. Meanwhile, among galley's conditions that met the requirements, there were 4 out of 9 (44,4%) pantry sanitation conditions that meet the requirements but there are signs or vector's presence. Based on the results of the *chi-square* test, it got *p-value* = 0.002 (*p-value* < 0.05), so that there is a relationship between the pantry's sanitary conditions with the presence of vectors in the pantry on ship with high health risk in KKP Class II Semarang working area in 2019.

Based on the results of observations by officers, the air circulation in the room is not too good so that the room tends to be humid and the trash can is not closed. Rooms with bad humidity and uncovered trash cans can support vector reproduction in the pantry room (Purnama, 2017). Also, there are lots of shelves and gaps between containers that are damp and dark, that condition supports vector's breeds in that place (Permenkes RI No. 50, 2017) The vector in the pantry room can contaminate food through fecal-oral contamination or through contact with hands that already contaminated with bacteria so that it has the potential to spread infectious diseases (Mutiarani, 2017). So, the ship's crew must pay attention to how to serve food and store food in the pantry. Foodstuffs must be placed in a tightly closed container, then the trash can must always be closed. Besides, food racks and utensils in the food raft room must be cleaned regularly before and after use to avoid bacterial contamination of cutlery. Chemical vector control by spraying must pay attention to a safe distance from the pantry room because chemicals contained in pesticides can contaminate food (WHO, 2007). This research is in line with research conducted by Arumsari, G using the *chi-square* test obtained *p-value* = 0,00 (*p-value* < 0,05). The pantry room is the second ship compartment that has a risk factor for the presence of a second rat after the kitchen (Arumsari et al., 2018). This statement is reinforced by research by Ampri, A which states that 36.67% of the pantry room is not yet free from the vector's existence (Harahap, 2016).

The Relationship between Warehouse Sanitation and the Existence of Vectors on Ship with High Health Risk

The warehouse room is a storage space for food supplies and for storing other logistical needs on the ship. Based on table 2, there were 17 out of 19 (96,7%) warehouse's sanitation condition that did not meet the requirements, found for signs or the presence of vectors. Meanwhile, among warehouse conditions that met the requirements, there are 8 out of 15 (53,3%) warehouse sanitation conditions that met the requirements but there were signs or



vector's presence. Based on the results of the *chi-square* test, it got $p\text{-value} = 0.025$ ($p\text{-value} < 0.05$), so that there is a relationship between the warehouse's sanitary conditions with the presence of vectors in the warehouse on ship with high health risk in KKP Class II Semarang working area in 2019.

As a storage area, lots of cardboard boxes, and other portable equipment in the warehouse that has the potential to become a hiding place for vectors, especially rats and cockroaches (WHO, 2007). The warehouse is a vector hiding place, especially for rats and cockroaches (B. Yuliadi et al., 2016). Based on observations by officers, several rats and cockroaches were found in the ship's warehouse. The existence of vectors in the food storage warehouse on the ship risks carrying infectious germs and contaminating foodstuffs and other supplies in the warehouse (Assagaff, 2019). Therefore, crew members must minimize the breeding of rats in the warehouse by reducing the presence of cardboard, another portable equipment that can become a hiding place for vectors. It is recommended that food items in the warehouse be stored in metal and protected containers (WHO, 2007). The crew members are advised to routinely clean the warehouse periodically and routinely carry out disinfection and disinsection in the warehouse, by securing foodstuffs in the warehouse first. This study is in line with research conducted by Thohir, B using the *chi-square* test, with $p\text{-value} = 0.028$ ($p\text{-value} < 0.05$) (Thohir et al., 2018). Furthermore, research conducted by Assagaff, F in 2019 also mentioned the findings of 3 types of rats in market warehouses with poor sanitation. (Assagaff, 2019).

The Relationship between Crew's Bedroom Sanitation and the Existence of Vectors on Ship with High Health Risk

Based on table 2, there were 20 out of 21 (95,2%) crews bedroom's sanitation condition that did not meet the requirements found for signs or the presence of vectors. Meanwhile, among crews bedroom's conditions that met the requirements, there were 8 out of 13 (38,5%) crews bedroom's sanitation conditions that met the requirements but there were signs or vector's presence. Based on the results of the *chi-square* test, it got $p\text{-value} = 0.021$ ($p\text{-value} < 0.05$), so that there is a relationship between the crew's bedroom sanitary conditions with the presence of vectors in the crew's bedroom on ship with high health risk in KKP Class II Semarang working area in 2019.

The air exchange component does not meet the requirements because of the small ventilation so that the air circulation in the room is not good, especially in a standard size room, the room is inhabited by 5 to 10 crews so that poor air circulation can have a bad impact on the health of the crew members (Citraswari et al., 2015). Also, the large number of residents in the room makes a lot of items and clothes hangers in one bedroom. It can trigger vector breeding, especially cockroaches and mosquitoes (Nirwan et al., 2010). The presence of cockroaches and mosquitoes in the bedroom has the potential to transmit infectious diseases to occupants of the room (WHO, 2007). For this reason, it is advisable to install wire screens on the windows or ventilation holes to prevent mosquitoes from entering the room. It is also recommended for the crew to spray natural permethrin and pyrethrin on the inside and outside of clothes and socks to protect themselves from mosquito bites. (WHO, 2007). The crew is expected to regularly clean the bedroom every day, it is better if dirty items and clothes are stored in a locker or a separate place from the bedroom, the footwear is placed outside the room and neatly arranged, to minimize the presence of vectors in the bedroom. This study is in line with research



conducted by Thohir, B using the *chi-square* test with $p\text{-value} = 0,001$ ($p\text{-value} < 0,05$) (Thohir et al., 2018). Also, research by Nirwan, A shows that there is a relationship between the sanitary conditions of the ship and the behavior of crew members in preventing mosquito vector manifestation with the presence of *Aedes Aegypti* mosquitoes, especially in the crew's bedrooms. (Nirwan et al., 2010).

The Relationship between Officer's Bedroom Sanitation and the Existence of Vectors on Ship with High Health Risk

Based on table 2, there were 15 out of 16 (93,8%) officers bedroom's sanitation condition that did not meet the requirements found for signs or the presence of vectors. Meanwhile, among officer's bedroom conditions that met the requirements, there were 11 out of 18 (50%) officer's bedroom sanitation conditions that met the requirements but there were signs or vector's presence. Based on the results of the *chi-square* test, it got $p\text{-value} = 0.043$ ($p\text{-value} < 0.05$), so that there is a relationship between the officer's bedroom sanitary conditions with the presence of vectors in the officers bedroom on ship with high health risk in KKP Class II Semarang working area in 2019.

In contrast to the crew's bedroom, officer's bedrooms are usually located under the rudder engine room (bridge room). For this reason, the officer's bedroom must be free from vector because it has the potential to enter the bridge space which can interfere with the operating system in the ship. So, it is necessary to make mechanical and chemical prevention efforts such as covering the bedroom window with gauze to prevent mosquitoes, eliminating piles of dirty items and clothes in the bedroom, and carrying out routine disinfection and disinsection to minimize the risk of vectors breeding in officers' bedrooms. (WHO, 2011) The results of this study are in line with research conducted by Thohir, B using the *chi-square* test with $p\text{-value} = 0,001$ ($p\text{-value} < 0,05$) (Thohir et al., 2018).

Potential Public Health Risks from the Presence of Vectors on Ships

Rats found in the ship compartment came from the closest residential areas, so the rats species found on the ship were *Rattus tanezumi* and *Rattus norvegicus* (Priyotomo, 2015). Rats are found mostly in galley and warehouse areas (Norhayati et al., 2017; WHO, 2012). Rats have the potential to carry fleas and ectoparasites which can cause various diseases such as *plague*, typhoid fever, leptospirosis, etc. (Purnama, 2017). Rats can transmit the disease through direct (bite) and indirect (interaction with ectoparasites and endoparasites) contact or through cross-contamination (B. Yuliadi et al., 2016). Poor environmental sanitation factors play a role in the flea index and the density of rats on the ship (Priyotomo, 2015). Rat control programs that can be pursued onboard include installing rat guards and carrying out routine maintenance on rat guards, and eliminating potential breeding spots for rats. (WHO, 2012).

Cockroach vectors that are often found on ships are *Blatella germanica* species found in nearly all compartments of a high-health risk ship (Harahap, 2016). Because cockroaches like damp, dark, and dirty places, cockroaches can transmit disease through various bacteria carried by cockroaches, including *Streptococcus*, *Salmonella*, *Entamoeba histolytica*, *Escherichia coli*, which can cause dysentery, cholera, and various other diseases (Permenkes RI No. 50, 2017; Service, 2012) Apart from cockroaches, flies are also a vector that is often found on ships. The flies that are commonly found on ships are the type of house fly (*Musca domestica*) (WHO, 2007). This type of fly can transmit diarrhea, dysentery, typhoid, and



cholera because these flies land from slums, feces to food sources, and carry bacteria such as *Salmonella*, *Shigella* and *Escherichia coli*, and can contaminate food (Purnama, 2017; Service, 2012). If not controlled, flies can breed on the ship and endanger the health of the crew and passengers, and can spread disease to other areas through the ship and port. (WHO, 2011). Then, mosquito vectors are more commonly found in the bedroom. The condition of the bedroom is dark and there is a clothes hanger to become a mosquito resting place (Puteri et al., 2018).

Knowing the various dangers that can be caused by the presence of vectors on ships, health port officers are advised to provide guidance to ship crew leaders to prepare and implement SOPs for sanitation and vector control on ships. It would be even better if a ship could compile an integrated vector control plan in the ship according to *Handbook for Inspection of Ships and Issuance of Ship Sanitation Certificates* from WHO (WHO, 2012).

Conclusion and Recommendation

Based on the results of statistical analysis using *chi-square*, there are a relationship between galley sanitation conditions ($p\text{-value} = 0,031$), pantry sanitation conditions ($p\text{-value} = 0,002$), warehouse sanitation conditions ($p\text{-value} = 0,025$), crew's bedroom sanitation conditions ($p\text{-value} = 0.021$) and officer's bedroom sanitation conditions ($p\text{-value} = 0,043$) with the existence of vectors on a ship with high health risk at a port that is included in Semarang Port Health Office Class II working area.

It advisable that officers from the Port Health Office Class II Semarang provide periodic guidance to ship crew leaders to pay more attention to ship sanitation and vector control on ships. Also, ship crew leaders need to make SOP of ship sanitation and vector eradication on ships with strict sanctions if there is a violation of the SOPs that have been made. In addition to increasing awareness to comply with SOPs, ship leaders and crew should also pay attention to personal hygiene to create good ship sanitation and minimize the spread of infectious diseases through ship transportation.



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