

Original Research Article

Factors Related to the Existence of Rats on Passenger Ship

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Abstract: The development of sea transportation has led to an increase in the intensity of ship use both for people, goods, and ship departure schedules. The volume of ship departure and arrival has an important role in the transmission of various kinds of insect pests that can potentially cause disease to the crew (ABK) and passengers, both between regions or across countries. The purpose of this study was to determine the factors associated with the presence of rats on passenger ships that dock at the Port of Kendari City. This type of research is analytic cross sectional design research. The population in this study is the local passenger ship that docked at the Port in the city of Kendari as many as 44 ships. The sample size of 40 ships was selected using simple random sampling technique. Measurement of temperature and humidity using a hygrometer while lighting using a lux meter. Data on sanitation conditions was collected using a marine sanitation checklist sheet. The collected data is then analyzed using the chi square test and the phi coefficient. The results showed that there was a relationship between temperature, humidity and lighting with the presence of rats on the ship, where the value of $p < \alpha = 0.05$ was obtained. Periodic maintenance and cleaning efforts are needed for lighting and room maintenance facilities so that the temperature, humidity and lighting in the room always meet the requirements and can reduce the potential for rat activity on the ship.

Keywords: Temperature Sanitation, Humidity, Lighting, Rats.

INTRODUCTION

Ships can be used to transport infected people, reservoirs, and insect vectors of disease [1]. The development of sea transportation has led to an increase in the intensity of ship use both for people, goods, and ship departure schedules. The volume of ship departure and arrival has an important role in the transmission of various kinds of insect pests that can potentially cause disease to the crew and passengers, both inter-regional or cross-country [2]. The state of the port as the recipient and manager of goods from all over the world is one of the causes due to insect infestation on ships [3].

Passenger ships or cargo ships and all types of ships must implement ship sanitation. The sanitation inspection of the ship includes, among others, kitchens, hatches, goods, crews (ABK), clean water, garbage, engine room, medical facilities and other parts that need to be examined. Vessel sanitation checks are carried out based on points already contained in the vessel sanitation form that must be adapted to the parts of the ship [4].

Vectors and animals carrying diseases can cause problems in human life both directly and indirectly [5]. In the field of transportation such as ships, vectors and disease-carrying animals is absolutely undesirable, because the means of transportation are required to be free of vectors and disease-carrying animals in accordance with the 1962 Marine Quarantine Act and article 52 of the IHR (International Health Regulation). As for the port area based on Article 16 of the IHR, the Port Health Office must strive to ensure that the port area is free from rat infestation and conduct ratproofing (rats inspection) of buildings in the port area. In addition to suppressing the rat population, eradication of rats at the port is important in order to increase awareness of the possibility of bubonic plague in local mice.

Rats are rodents (rodentia) that are harmful to humans [6]. The relationship between rats and humans is often parasitic [7]. In the field of rat health can be a reservoir (reservoir) for several pathogens that cause disease in humans, both animals, livestock and pets [8]. Types of diseases carried by mice include bubonic plague, leptospirosis (a disease caused by the bacteria *Leptospira interrogans*), murine typhus (this disease is also called endemic typhus), scrub typhus (caused by *Orientia tsutsugamushi*, transmitted by

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the bite of larval mites that live on rodents), leishmaniasis (a disease caused by the protozoan parasite belonging to the genus *Leishmania* and transmitted by bites of the genus *Lutzomyia* and *Phlebotomus*), salmonellosis (a group of bacteria that causes typhus and also causes food to become toxic), the disease can be transmitted directly to humans directly by saliva, urine and feces or through ectoparasite bites in the body of rats [9]. Compared to ectoparasites (a type of parasite that lives in its host (other host animal), ectoparasites fleas have an important role in the health sector because they act as vectors of diseases such as bubonic plague [10].

PES is a zoonotic disease, especially in mice and other rodents that can be transmitted to humans [11]. The bubonic plague in Indonesia was infected at the port of Tanjung Perak in Surabaya in 1910. The distribution was allegedly via rice vessels that "carried" mice infected with bubonic plague. In some countries this disease is still a problem and needs to be watched out for transmission so that it is still categorized as a quarantine disease contained in the International Health Regulation (IHR) [12]. The spread of bubonic plague in Indonesia cannot be separated from the role of the port as the entrance of the flow of transport, passengers and goods. All have the potential to be a gateway for transmutation of disease transmission that has an impact on public health due to quarantine, new infectious diseases and old re-emerging disease. The potential spread of the disease is the impact of rapid progress in the field of information technology and transportation, free trade, and the rapid mobility of the population between countries and regions [13].

One of the activities carried out to prevent and control vectors of infectious diseases entering and leaving the port is through ship sanitation assessment [14]. Measures to control risk factors for vessels that are at high risk for health problems, including fumigation and disinfection. Meanwhile, vessels that are inspected are at low risk of health problems. The ships are issued by the Ship Sanitation Control Certificate Exemption Certificate / SSCEC. According to Permenkes RI RI number 40 of 2015 states that sanitation checks are carried out on all rooms and media on the ship which includes kitchens, food raft rooms, warehouses, hatches, sleeping rooms, clean water, liquid waste, medical waste and solid waste, water reserves, medical facilities, swimming pools, and other areas that are examined. If the hatch is loaded, the cargo must be inspected. Ship sanitation infection to obtain sanitation certificate is carried out regularly every six (6) months.

Observation of the presence of rats is carried out in order to determine the level of presence of rats in the perimeter of the port area, so that the port area is free from rats which are vectors of quarantine disease (PES) [15]. The results of this activity are the basis for actions to eradicate rats as an effort to detect and respond to disease risk factors that can harm public health, especially the people of Kendari Port. The results of the installation of rat traps in order to monitor the presence of rats in the KKP area of Kendari in 2018, that the highest rat index is in the Kendari Port area with a value of 17.3% with the number of rats caught as many as 120 animals. While the lowest in the Baubau region with a rat index of 2.3% with the number of mice caught as many as nine (9) tails for a year.

Based on the results of Norhayati's research in 2017, the presence of mice on ships anchored at the Trisakti Port of Banjarmasin is known that of the 20 vessels, 11 ships (55%) and eligible vessels did not meet the requirements of Nine (9) ships (45%). It is known that of the 20 vessels, vessels that were found positive were signs of rats so that they did not meet the requirements of seven (7) vessels (35%) and ships that were not found to be rats so that they met requirements as many as 13 ships (65%). Of the six (6) positive vessels found signs of rat presence, there were three (3) ships whose signs of rat presence were found in different rooms. And out of ten (10) signs of the presence of rats found, the most common sign was the discovery of rat droppings in the ship's kitchen five (5) times (50%) [16].

Based on a preliminary survey of 15 local passenger ships resting in the port of Kendari City consisting of the Nusantara Sea Port (main base), boat bases and the Central Market port (river, lake and crossing transportation), and seeing the condition of the room where the goods are stored there are indications of the existence vectors such as rats, cockroaches and mosquitoes, so that ship space sanitation, temperature, humidity and lighting have an impact on the presence of vectors on the ship. vector life on a ship.

One of the things that must be adapted is climate change. Increased sea level causes more breeding places (disease breeding places) of disease vector, threats and temperature rise causing adaptation of disease vector to a wider area. Therefore, the purpose of this study was to determine the factors associated with the presence of rats on passenger ships that dock at the Port of Kendari City.

METHODOLOGY

This research is an analytic study using cross sectional design. The study was conducted on passenger ships that docked at the port of Kendari City in August-September 2019. The population of the study subjects was 44 passenger ships and a sample size of 40 respondents taken by the simple random sampling method. The measurement of physical environment parameters and the presence of them is done in the kitchen room and food storage. This room was chosen because mice are most often found in this room and is a breeding place for rats and breeding on ships. To see the presence of rats on a passenger ship, Rats Performed by looking visually signs that indicate the presence of rats such as gnawings (bite marks), run ways (paths) are usually in the corner of the wall with the floor, blackish, rub marks (friction marks) usually in the corner of the wall, in the form of loose feathers, burrows

(holes) usually on the ground or wooden walls/gypsum, dropping (feces), track path (former palm) is usually on cable pipes, in the form of a layer of black-colored candles, voice (voice), life & death rat (carcass), nests (nests), to swing marks (former leaps).

Data on sanitation conditions were collected using a sanitation checklist of marine vessels as stipulated in the Republic of Indonesia Minister of Health Regulation No.40 Year 2015: Ship Sanitation Certificate. Measurement of temperature and humidity using a hygrometer and determining the measurement point is set at the intersection point of the diagonal line of the room. Measurement of room lighting using a luxmeter in lux units and determining the measurement point based on floor area. Data were then analyzed descriptively and inferentially using chi square test and phi coefficient. This research was approved by the Research and Development Agency, Southeast Sulawesi with approval number: 070/2370/BALITBANG/2019. This research also received approval from the ship owner which was sampled before data collection.

RESULTS

Relationship of Sanitary Conditions with the Rats

The relationship of sanitation conditions with the presence of rats on a passenger ship that docked at the Port of Kendari City can be seen in the following table:

Table-1: Relationship between Sanitation Conditions and the Existence of Rats on Passenger Vessels that dock at the Port of Kendari City

Sanitation	The existence of rats				Total	Statistic test	
	Exist		Nothing				
	n	%	n	%	n	%	
Well	5	20%	20	80%	25	100%	X ² hit=14,249
Not good	13	87%	2	13%	15	100%	X ² tab=3,841
Amount	18	45%	22	55%	40	100%	(Φ) =0,649

Table-1 shows that out of 25 ships with good sanitary conditions, there were five (5) vessels (20%) found traces of rats and 20 vessels (80%) did not find any traces of rats. Whereas of the 13 ships that did not have good sanitation, there were 13 vessels (87%) that were found to have rats and two (2) vessels (13%) had no rats.

Based on the results of statistical tests using the Chi Square test at $\alpha = 5\%$ and $df = 1$, the calculated X² value > X² table (14,249 > 3,841) means that there is a significant relationship between sanitary conditions and the presence of rats on passenger vessels that lean in Port Kendari City. The results of the relationship closeness test showed the coefficient of Chi (Φ) of 0.649, this shows the strength of the relationship between sanitary conditions with the presence of rats on a passenger ship leaning in the city of Kendari strong relationship category.

Relationship of Temperature with the Presence of Rats

The relationship of temperature with the presence of rats on a passenger ship that docked at the Port of Kendari City can be seen in the following table:

Table-2: Temperature Relationship with the Existence of Rats on Passenger Vessels that dock at the Port of Kendari City

Temperature	The existence of rats				Total		Statistic test
	Exist		Nothing				
	n	%	n	%	n	%	
Effective	13	72%	5	28%	18	100%	X ² hit=7,901
Ineffective	5	23%	17	77%	22	100%	X ² tab=3,841
Amount	18	45%	22	55%	40	100%	(Φ) =0,495

Table-2 shows that out of 18 ships whose temperature conditions were effective there were 13 vessels (72%) found traces of the presence of rats and five (5) vessels (28%) found no trace of the presence of rats. While of the 22 ships that were ineffective, there were five (5) vessels (23%) that were found to have rats and 17 vessels (77%) had no rats. Based on the results of statistical tests using the Chi Square test at $\alpha = 5\%$ and $df = 1$, the calculated X² value > X² table (7.901 > 3.841) means that there is a significant relationship between temperature and the presence of rats on passenger vessels that lean in the Port of the City Kendari. The results of the closeness of the relationship test showed the coefficient Phi (Φ) of 0.495, this shows the strength of the relationship between temperature and the presence of rats on the passenger ship leaning in the city of Kendari moderate relationship category.

Relationship of humidity with the Presence of Rats

The relationship of humidity with the presence of rats on a passenger ship that docked at the Port of Kendari City can be seen in the following table:

Table-3: Relationship between Humidity and the Existence of Rats on Passenger Vessels that dock at the Port of Kendari City

Humidity	The existence of rats				Total		Statistic test
	Exist		Nothing		n	%	
	n	%	n	%			
Effective	15	63%	9	38%	24	100%	$X^2_{hit}=5,762$
Ineffective	3	19%	13	81%	16	100%	$X^2_{tab}=3,841$
Amount	18	45%	22	55%	40	100%	$(\Phi)=0,431$

Table-3 shows that out of 24 ships with effective humidity conditions, 15 vessels (63%) found traces of rats and nine (9) vessels (38%) found no traces of rats. While of the 16 ships that were ineffective ship moisture, there were three (3) vessels (19%) that were found to have rats and 13 vessels (81%) had no rats.

Based on the results of statistical tests using the Chi Square test at $\alpha = 5\%$ and $df = 1$, the calculated X^2 value $> X^2$ table ($5.762 > 3.841$), means that there is a significant relationship between humidity and the presence of rats on passenger ships that lean in the City Harbor Kendari. The results of the closeness of the relationship test showed the coefficient Phi (Φ) of 0.431, this shows the strength of the relationship between humidity with the presence of rats on a passenger ship leaning in the city of Kendari moderate relationship category.

Relationship of Lighting with the Presence of Rats

The lighting relationship with the presence of rats on a passenger ship that docked at the Port of Kendari City can be seen in the following table:

Table-4: Relationship between Lighting and the Existence of Rats on Passenger Vessels that dock at the Port of Kendari City

Lighting	The existence of rats				Total		Statistic test
	Exist		Nothing		n	%	
	n	%	n	%			
Effective	5	25%	15	75%	20	100%	$X^2_{hit}=4,949$
Ineffective	13	65%	7	35%	20	100%	$X^2_{tab}=3,841$
Amount	18	45%	22	55%	40	100%	$(\Phi)=0,402$

Table-4 shows that out of 20 vessels with good lighting conditions, there were five (5) vessels (25%) found traces of rats and 15 vessels (75%) did not find any signs of rats. While from 20 ships that were not well-lit, there were 13 vessels (65%) that were found to have rats and seven (7) vessels (35%) had no rats.

Based on the results of statistical tests using the Chi Square test at $\alpha = 5\%$ and $df = 1$, the calculated X^2 value $> X^2$ table ($4.949 > 3.841$), means that there is a significant relationship between lighting with the presence of rats on passenger ships that lean in the City Harbor Kendari. Relationship closure test results showed a coefficient of Chi (Φ) of 0.402, this shows the strength of the relationship between lighting with the presence of rats on a passenger ship leaning in the city of Kendari in the moderate relationship category.

DISCUSSION

Rats are capable of transmitting disease to humans by carrying seeds of disease, fleas, fleas, bacteria and parasites. This animal from the Muridae tribe is known as a source of several zoonotic diseases. Several types of diseases transmitted by mice include Pes / Plaque, Leptospirosis, Typhus Scub, Murine Typhus, Rat Bite Fever, Salmonellosis, Lymphatic Choriomeningitis, Hantavirus Pulmonary Syndrome and Lassa Fever. These diseases are transmitted by rats through various ways ranging from rat bites, rat urine, rat droppings, as well as those transmitted indirectly through other animals that are infected with the disease from mice or contaminated food / drink, water, or objects. The results of this study indicate that out of 25 ships with good sanitary conditions, there are five (5) vessels (20%) found traces of rats. The presence of signs - the presence of rats on the five ships is due to, at the time of measurement took place five of these ships have been more than three days leaning on the port because there was an engine repair.

This is in line with research which states that the residence time of a ship in the harbor is closely related to the presence of vectors on the ship because in the buffer area there are several potential breeding places for mice [17]. While from 13 ships that were not sanitary, there were 13 vessels (87%) that were found to have rats and two (2) vessels (13%) had no rats. Vessels that have sanitary vessels that do not meet the requirements can invite mice because food waste has the potential to invite rodents (rats).

The results of observations by researchers also note that the condition of the spaces in vessels that do not meet health requirements. The space that has the most risk factors to invite the presence of mice is a kitchen that does not meet the requirements.

Most of the vessels studied have kitchens, food rafting rooms, hatches, and liquid waste that do not meet the sanitary requirements of the ship which could potentially risk the existence of rats. This is in line with Norhayati's [16] research at Banjarmasin port which shows that kitchen sanitation has an indication very large in the presence of vectors with found as many as 5 ships from 9 ships and the results of the chi square test showed that there is a relationship between kitchen sanitation with the presence of vectors and rodents. The research of Tawaddud [18] states that ship sanitary compartments are most often found in vectors and signs of rat life with wet feces in the kitchen compared to other ship parts [18].

The results of data analysis using Chi Square test, obtained count $X^2 > X^2$ table (14,249 > 3,841), and the coefficient of Chi (Φ) of 0,649, meaning that there is a strong relationship between sanitary conditions and the presence of rats on passenger ships that lean in the Port of Kendari City. This research is in line with research conducted by [19] which states that there is a relationship between ship sanitation variables and the presence of rats on the ship using the chi square test shows the results of p value 0,000 smaller than α : 0.05 then it is stated there is a relationship between ship sanitation and the presence of mice. On ships that have sanitary vessels meet the requirements and there are no signs of the presence of rats or the presence of rats as many as 26 ships, while on ships that have sanitary vessels do not meet the requirements and there are no signs of the presence of rats or the presence of rats as many as 3 ships. Vessels that have signs of rats - and the presence of rats in the category do not qualify as many as 8 ships.

According to research [20] which states from the exact fisher test results obtained $p = 0.023$ ($p < \alpha$) which means there is a significant relationship between sanitation of the ship with signs of the existence of rats and the presence of rats on ships flagged RI. This is indicated by the presence of rats on ships with sanitation vessels not meeting the requirements as much as 43% and the signs of the presence of rats on ships that meet sanitary requirements by 4%, it appears that with sanitary conditions of ships that do not meet the requirements the signs of rats higher [20]. This study has the same results as previous research conducted by Budiman in 1999, this study has the results of the relationship between ship sanitation and the presence of rats on a ship. The number of vessels that meet the requirements is 25 vessels with a percentage of 78%, while ships with sanitary conditions do not meet the requirements 7 Ships with 22% and signs of rats found were dirt, road marks, and signs of rats.

The results of this study indicate that out of 18 ships whose temperature conditions are effective there are 13 vessels (72%) found a trace of the presence of rats. This illustrates that the temperature conditions participated in increasing the rat population in ships, this is evident from the observation that the storage section often found signs of the presence of rats. This was supported by the results of researchers' interviews with KKP officials who stated that every time a rat eradication or fumigation was found, rats were found in food storage warehouses.

While of the 22 ships whose ship temperatures were ineffective, there were five (5) vessels (23%) that were found to have rats. This is due to unfavorable behavior of ship crews, where there are still a lot of ship crews behavior that is less concerned with environmental sanitation and lack of concern of ship crews for cleanliness on ships, especially places that can be a source of food and a breeding place for rats.

The existence of ship vector of disease is caused not only by physical factors on the ship, namely the room / ship compartment, it is also inseparable from the actions of the crews (ABK), as well as every ship that is leaning, on the ship's rope is not installed with a mouse shield, lighting in the room / ship compartments often do not turn on. This can cause vector breeding in the room or ship compartment which is a risk factor for the source and transmission of disease. The ship owner company provides knowledge through counseling about the dangers of rats on the ship, how to control it and personal hygiene in order to increase the awareness of the crew. The captain of the ship should make sanctions for the crew if it violates environmental sanitation. Pay attention to the rat guard (Rat Guard) on the mooring rope of the ship which becomes the entrance of the rat from the dock to the ship to keep it installed as a preventative measure.

The results of data analysis using the Chi Square test, the calculated X^2 value > X^2 table (7,901 > 3,841), and the coefficient of Chi (Φ) of 0.495 means that there is a significant relationship between temperature and the presence of rats on passenger ships that lean in the Port of Kendari City. This study is in line with research conducted by [21], which states that temperature is a supporting factor for the presence of signs of rats on ships.

The results of this study indicate that of the 24 ships whose humidity conditions were effective there were 15 vessels (63%) found traces of the presence of rats. This is because based on the measurement results it is known that rats are most commonly found in warehouse spaces where the average humidity ranges from 75% -78%. This is the optimal humidity (76 - 90%) for the development of mice.

While out of the 16 ships that had ineffective ship humidity, there were three (3) vessels (19%) that were found to have rats. This is more due to the sanitary conditions of the ship, food availability, long stay of the ship > five hours to the behavior of the crew who are not good, where there are still many behavior of the crew who are less concerned with environmental sanitation and the lack

of concern for the crew towards cleanliness on the ship, especially places that can be a source of food and breeding grounds for rats. Behavior that can invite the presence of rats on a ship is largely in the behavior of separating waste.

The results of data analysis using the Chi Square test, the calculated X^2 value $> X^2$ table ($5.762 > 3.841$), and the coefficient of Chi (Φ) of 0.431, means that there is a moderate relationship between humidity and the presence of rats on the passenger ship that rests in the Port of Kendari City. This research is in line with research [22] which states that room humidity is a supporting factor for the presence of rats in ships.

Enough lighting and cleanliness can guarantee the health, welfare and safety of ABK and passengers. If natural lighting is inadequate, then mechanical lighting is provided using fluorescent lamps. Lighting devices on the ship may not use candles or oil lamps. The purpose of the exchange is to enter fresh air and remove dirty air. If the room does not have a good air exchange system, it will cause several conditions that can be detrimental to health such as shortness of breath.

The results of this study indicate that of the 20 ships with good lighting conditions there are five (5) ships (25%). This is because in the ship food is available for rats, this is when related to the observations of the sanitary conditions of the five ships in the unfavorable category, where the researchers observed that there were no qualified trash bins around the ship, and this ship also had lean for several days at the port, so that the rats in the buffer area find food on the ship.

The lighting conditions in the ship are good, this can help the humidity of the room under normal conditions and cannot become a breeding ground for infectious bacteria. This condition is in line with research by Wulandari [23] which states that temperature, humidity, and poor space sanitation can be a source of breeding of Streptococcus bacteria which is one of the pathogenic bacteria in the air that is often associated with morbidity in humans [23].

While of the 20 ships that were not well-lit, there were 13 ships (65%) that were found to have rats. This illustrates that with light intensity < 50 lux (measurement results) belong to the intensity that is not blazing and is an optimal value for life vector like a mouse. This is in line with research conducted by Arumsari [24] which states that light intensity < 50 lux supports vector life [24].

Rat habitat almost spreads throughout all corners following the pattern of population distribution where we often encounter the presence of rats in homes, yards and prefer dark places such as on rooftops, between furniture, gutters, warehouses, markets and offices. Rats can live side by side with humans, according to their habitat, rats can be divided into domestic species, peridomestic types and silvatic types. *Rattus tanezumi*, *Rattus norvegicus*, *Mus musculus* and *S. murinus* mice are domestic animals whose life activities are in searching for food, shelter and nesting and breeding in the home environment.

The results of data analysis using the Chi Square test, the calculated X^2 value $> X^2$ table ($4.949 > 3.841$), and the coefficient of Chi (Φ) of 0.402, means that there is a significant relationship between lighting with the presence of rats on passenger ships that lean in the Port of Kendari City. This research is in line with research conducted (Priyotomo, 2015) at the port of the Cilacap Sea, it is known that lighting conditions are one of the factors that support the breeding of mice around the port buffer area.

Efforts to prevent the entry and exit of bubonic plague at the port are absolutely carried out with various efforts, including preventing rat infestation at the port by eradicating rats, making all installations at the port or airport free of rats, and other necessary efforts. Based on the Surabaya KKP research in 1983/84, the eradication of rats by poisoning was not effective, because the rat population before and after eradication was not significantly different. Derating Certificate or SKHT and Derating Exemption Certificate or SKBHT are ship health documents showing free and whether or not rat infestation is on board, which is valid for six months and must be owned by each ship, as one of the efforts to prevent bubonic plague on the ship and at the port. Deratization or the act of removing mice, is just fumigation. Recommended fumigants in Indonesia are HCN, CH₃Br, and SO₂. In the implementation in the field of effective fumigant is HCN, because of its high killing power, non-corrosive, the time required is relatively short and available antidotes. The early alert system for bubonic plague is carried out by means of surveillance, health documents, Visum et Repertum and observation of the fleet index.

CONCLUSION

Factors related to the presence of rats on a ship that docked at the port of the city of kendari, namely there is a relationship between sanitary conditions, temperature, humidity and lighting with the presence of rats on a passenger ship that docked at the Port of Kendari City. Therefore, regular maintenance and cleaning efforts are needed to be carried out for lighting and room maintenance facilities so that the temperature, humidity and lighting in the room always meet the requirements and can reduce the potential activity of rats on the ship and it is hoped that shipowners can provide pest control personnel on their ships and the Port Health Office should increase efforts to supervise ship sanitation, so that the owner of the Ship Company pays attention to and is responsible for his ships so that passengers and goods are free from disease risk factors as an application to prevent the threat of disease.

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