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COMPARATIVE STUDY OF VECTOR DENSITY OF FLIES AND RATS IN THE CRITICAL ZONE AT X HOSPITAL (CASE STUDY: NUTRITION INSTALLATION, WATER TREATMENT PLANT, DOMESTIC WASTE DISPOSAL AREA, AND CANTEEN)

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ABSTRACT

Vector control in hospitals is a crucial aspect in maintaining sanitation and preventing the risk of disease transmission. This study aims to compare the density of fly and rat vectors in several critical zones at X Hospital, namely the Nutrition Installation, Water Treatment Plan (WTP), domestic waste container area, and canteen. This study used a descriptive method with a quantitative approach and utilized secondary data obtained from vector control reports. Data were analyzed for the period July–October for rat vectors and July–November for fly vectors. The results showed that the highest rat activity occurred in the Nutrition Installation and WTP, with trap success rates reaching 25–37.5% in certain months. Meanwhile, the highest fly density was found in the waste disposal area (TPS), with some months falling into the moderate category. The canteen and dishwashing areas had relatively low to moderate fly densities. This study emphasizes the importance of strengthening vector control programs through regular monitoring and improved sanitation to reduce the risk of infestation in critical zones of the hospital.

Keywords : Flies, Rats, Vector

INTRODUCTION

Hospitals are healthcare institutions that are required to meet environmental sanitation standards to prevent the risk of disease transmission. One crucial aspect of hospital sanitation is the control of vectors and pests, particularly flies and rats. The presence of these vectors in critical areas such as the nutrition installation, water treatment plant, domestic waste disposal area, and hospital canteen can increase the potential for cross-contamination, disease transmission, and reduce the quality of healthcare services. Therefore, identifying and measuring vector density in various critical areas is crucial to ensure the quality of hospital sanitation is maintained (Gustini et al., 2021).

Flies are mechanical vectors capable of carrying various infectious agents, such as pathogenic bacteria, through their body surfaces and legs. The fly population index is significantly influenced by environmental cleanliness and facility management. Al-Irsyad and Deniati (2021) explain that waste disposal site (TPS) cleanliness and waste management are the main determinants of the increase in the fly population index. This finding is relevant to hospitals, which have significant sources of organic waste, so suboptimal TPS management can support fly proliferation. Furthermore, Mulyaningsih (2023) identified that the presence of several fly species with high diversity indices in hospital waste storage facilities indicates the potential for biological contamination that could threaten the cleanliness of service facilities.

Meanwhile, rats are reservoirs of various zoonotic diseases that can threaten the health of patients, visitors, and healthcare workers. Rats are often found in environments that provide sources of water, food, and shelter. Research by Maibang et al. (2023) shows that rat density and ectoparasites in markets indicate a strong relationship between environmental conditions and high rat activity. In the hospital context, kitchens, waste disposal sites, and food storage areas are high-risk locations for rat habitats if not supported by good sanitation and a sustainable control program.

A comprehensive evaluation of vector control systems has shown that implementation in various hospitals is suboptimal. In their study at Sangatta Medika Hospital (RSU Medika Sangatta), Aisyah and Ardan (2024), found that vector control was not implemented systematically, particularly in terms of routine monitoring, source control, and reporting of vector observation results. This ineffectiveness can increase the risk of contamination of service facilities and increase the number of healthcare-associated infections.

A similar finding was found by Hastari et al. (2023), who studied vector control in hospital nutrition installations. They reported that poorly managed kitchen environments, water reservoirs, and food area sanitation can attract flies and rats, increasing the risk of food contamination. Because kitchens and nutrition installations are critical points in patient food provision, vector control in these areas should be a priority.

On the other hand, external factors such as socio-environmental conditions also influence the presence of vectors in hospitals. Wahyuni (2022) showed that environmental sanitation around homes can influence the presence of rats, thus unclean environments around hospitals contribute as sources of vectors that can enter healthcare facilities. In addition to sanitation efforts, the use of control materials or methods is also a concern. Harnani et al. (2021) offer an alternative approach in the form of environmentally friendly organic insecticides as fly repellents, which can be implemented as a supporting method for vector control without increasing resistance.

Referring to these various studies, it can be concluded that the presence of flies and rats in critical areas of hospitals is a significant problem that requires data-driven intervention. However, research specifically comparing vector densities in various critical areas of hospitals, such as the nutrition installation, water treatment plant area, domestic waste disposal area, hospital canteen, and other service areas, is still limited. Therefore, this study aims to describe and compare the density of fly and rat vectors in several critical areas at X Hospital, thus providing an overview.

Objective regarding the risk level of each zone and as a basis for strengthening vector control strategies in the future.

METHODS

This study uses a descriptive method with a quantitative approach. The data used are secondary data obtained from the vector control report of X Regional General Hospital. The data were then analyzed in the period July–October for rat vectors and July–November for fly vectors. All data were analyzed descriptively to compare the density of flies and rats in each critical zone, namely the nutrition installation, water treatment plant, domestic waste disposal area for rat vectors, while for fly vectors in the nutrition installation, domestic waste disposal area, and canteen of X Hospital at Tulungagung.

RESULTS

Based on interviews with Sanitation Installation officers, rat vector capture at X Hospital is carried out using three methods: rat traps, rodent glue, and rat poison. Of the three methods, rodent glue is the most frequently used. The glue is smeared on pieces of cardboard baited with food scraps, typically made from patient food scraps obtained from the Nutrition Installation. These are then placed in critical areas or corners of rooms that are potential rat routes. Installation is carried out during the day or evening, and the results are collected in the morning by cleaning service personnel.

The second method uses metal rat traps. However, these traps are considered less effective because, according to officials, rats can recognize the scent of previously trapped rats, even after the traps have been thoroughly cleaned. Therefore, the use of new traps is necessary to improve trapping effectiveness.

Third, use rat poison, but this is rarely used and is only applied outdoors. Indoor use is avoided due to the risk of rats dying in hard-to-reach areas, such as ceilings, resulting in an unpleasant odor. This has occurred in operating rooms, where sensitive wiring makes it impossible to retrieve dead rats.

In such situations, officers reduce the odor by sprinkling coffee grounds. Rat poison is typically applied by dripping the liquid onto food and placing it near a water source. The poison causes the rats to become dehydrated, leading them to seek water and eventually die nearby. Rats caught alive are taken to a wastewater treatment plant (WWTP), while dead rats are placed in plastic bags and disposed of at a landfill (TPS).

The installation of rat traps carried out by the sanitation team at X Hospital in July-October at the Nutrition Installation, Water Treatment Plant, and Domestic Waste Container Area produced the following results:

Table 1. Results of the Presence of Rat Vectors in Nutrition Installations

Month	**Number of Traps Installed**	**Rat Caught**	**TrapNot successful**	**Success Percentage**
July	6	12	1	**25%**
August	1	3	-	**37.5%**
September	5	4	2	**3.33%**
October	4	4	-	**4.16%**

Based on Table 1, it can be seen that the effectiveness of mouse traps varies each month. In July and August, the traps used were adhesive traps set within an 8-hour period because if more than 8 hours were left, mice would not be attracted to the bait. The success rate in July was 25% and August was 37.5%. In September and October, the mouse traps used were iron traps set within a 24-hour period. Success decreased in September by 3.33%. Meanwhile, in October, all traps worked with a success rate of 4.16%. If calculated based on the area of the Nutrition Installation of 621.02 m², then the mouse control rate is equivalent to 0.02 mice/m² in July, 0.005 mice/m² in August, and 0.006 mice/m² in

September and October.

Table 2. Results of the Presence of Rat Vectors in the Water Treatment Plant

Month	Amount Trap Set	Rat Caught	Trap Not successful	Success Percentage
July	1	1	-	12.5%
August	1	2	-	25%
September	6	5	1	3.47%
October	-	-	-	-

Based on Table 2, it can be seen that the effectiveness of mouse traps varies each month. In July and August, the traps used were adhesive traps set within 8 hours because if more than 8 hours were left, mice were not attracted to the bait. The success rate in July was 12.5% and August was 25%. In September, the mouse traps used were iron traps set within 24 hours, with a success rate of 34.7%. Meanwhile, in October, no traps were set, so there is no success data to assess. If calculated based on the WTP area of 65.27 m², then the mouse control effort is equivalent to 0.02 mice/m² in July, 0.03 mice/m² in August, and 0.08 mice/m² in September.

Table 3. Results of the Presence of Rat Vectors in the Domestic Waste Disposal Container Area

Month	Number of Traps Installed	Rat Caught	Trap No Succeed	Success Percentage
July	-	-	-	-
August	3	3	1	33.3%
September	-	-	-	-
October	-	-	-	-

Based on Table 3, it can be seen that the installation of rat traps from July to October in the domestic waste disposal container area was only carried out in August with the number of traps installed being 3 glue traps which resulted in 3 rats being caught, but one trap failed to catch a rat. Therefore, the percentage of successful rat capture in the month of August was 3. August reached 33.3%. Based on the domestic waste disposal area of 230.48 m², the rat control effectiveness in August was equivalent to 0.013 rats/m².

Based on information obtained from sanitation installation officers, fly density detection at X Hospital was carried out using a fly grill, a wooden board painted white to attract flies to its surface. Fly grills were placed at ten observation points, with an observation time of 30 seconds at each point. The number of flies that landed was then recorded for each point. Next, the five points with the highest number of flies were selected, then the values were added together, divided by five, and the results were used to determine the fly density category.

Table 4. Results of the Presence of Fly Vectors in the Dishwashing Area of the Nutrition Installation

Month	10-point measurement results										Average 5 Point	Category
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
July	2	0	0	3	0	0	0	0	0	0	1	Low
August	3	3	1	0	3	1	1	3	1	0	2.6	Currently
September	4	1	1	4	3	3	3	1	1	1	3.4	Currently
October	-	-	-	-	-	-	-	-	-	-	-	-
November	1	0	2	0	0	0	0	1	0	0	0.8	Low

Based on Table 4, in the dishwashing area, fly density tends to be in the low to moderate category. In July, an average value of 1 is considered low, indicating relatively clean conditions. However, in August and September, there was an increase, with average values of 2.6 and 3.4, respectively, placing the density in the moderate category. This increase indicates increased activity or accumulation of organic waste that can attract flies. Then, in November, the value dropped back to the low category (0.8), indicating improved cleanliness or better fly control. Data for October were not available and therefore could not be analyzed.

Table 5. Results of the Presence of Fly Vectors in Public Polling Stations

Month	10-point measurement results											Category
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Average 5 Point	
July	1	1	1	0	2	2	0	1	1	1	1.4	Low
	1	2	2	2	1	1	3	1	1	1	2	Low
	2	2	1	2	2	2	1	1	1	1	2	Low
	3	3	1	1	1	1	0	0	3	1	2.2	Low
August	0	0	0	1	0	1	0	0	0	1	0.6	Low
September	5	0	4	4	0	1	1	2	0	1	3.2	Currently
	3	3	0	2	2	0	0	0	1	1	2.2	Low
	0	0	2	2	1	2	0	2	2	2	2	Low
	2	4	4	2	0	0	3	3	0	1	3.2	Currently
October	3	0	3	2	2	1	1	1	1	1	2.2	Low
	1	1	1	4	2	0	0	0	0	0	1.8	Low
November	3	4	3	3	3	2	8	4	2	2	4.4	Currently

Based on Table 5, the Public Waste Disposal Site (TPS) shows more varied fly density dynamics compared to other locations. In July, all measurements fell into the low category, although the average value between measurements varied between 1.4 and 2.2. This indicates that although the TPS is a high-risk area for fly breeding, waste management during that month was still quite good. Improvements began to appear in September, with several measurements falling into the moderate category (3.2), indicating waste accumulation or suboptimal management. After returning to the low category in October, values increased significantly in November, reaching an average of 4.4, which falls into the moderate category. This confirms that the TPS is a critical point requiring continuous monitoring due to its potential for increasing fly densities.

Table 6. Results of the Presence of Fly Vectors in the Hospital Canteen

Month	**10-point measurement results**										**Average 5 Point**	**Category**
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10		
July	-	-	-	-	-	-	-	-	-	-	-	-
August	4	0	0	3	3	0	2	0	0	2	2.8	Currently
	1	1	1	2	0	3	0	2	2	2	2.2	Low
September	-	-	-	-	-	-	-	-	-	-	-	
October	0	2	2	0	0	1	1	0	0	0	1.2	Low
November	1	1	1	3	0	2	0	3	3	1	2.2	Low

Based on Table 6, the data from the hospital canteen indicates that fly density is relatively controlled. In August, measurements fell into two categories: moderate (2.8) and low (2.2), indicating variations in hygiene conditions between observation points. Data for July and September were not available, so a complete trend analysis could not be performed. In October and November, the average values were also in the low category (1.2 and 2.2, respectively). This pattern indicates that the canteen, as an area directly involved in food preparation, maintains good hygiene management, minimizing the presence of flies.

DISCUSSION

Various studies emphasize the importance of vector monitoring in high-risk areas. Hastari et al. (2023) stated that nutrition installations are the most vulnerable points because food easily attracts flies and rats. These findings align with Maibang et al. (2023), who showed that access to food and building gaps increase rat activity. Furthermore, Al-Irsyad & Deniati (2021) and Mulyaningsih (2023) emphasized that waste disposal sites (TPS) and organic waste sources are the main factors in increasing fly density when management is irregular and uncovered.

Aisyah & Ardan (2024) found that vector control in health facilities is often ineffective due to inconsistent monitoring, while Wahyuni (2022) emphasized that the environment around health facilities, especially those near densely populated areas, contributes to the increase in rat infestation. Research by Herdianti, Sari & Husein (2024) showed that irregular food waste management allows vectors to persist despite control efforts. Santi, Astuti & Yuliasih (2023) also reported that building structures and food access during port activities maintain rat populations on docks. Husni et al. (2022) emphasized a strong relationship between residential sanitation and drainage management and the presence of rats, thus health facilities near settlements need to strengthen monitoring. On the other hand, Viony, Rosdiana & Roqobih

(2024) showed that botanical rodenticides from raw cassava can be an environmentally friendly alternative.

The method for calculating vector density requires precise technical standards. Fly density is calculated using the fly grill count method, while rat density is assessed using the trap success rate: <20% (low), 20–50% (moderate), and >50% (high). Factors such as point selection, observation time, the presence of open food, trap quality, and installation location influence the accuracy of the calculation. Environmental conditions such as cleanliness, humidity, and waste management are also crucial, as concluded by various studies over the past five years.

At the Nutrition Installation, rat activity was high in July–August, with trap success exceeding 100%, indicating a significant potential food source. This finding is consistent with Hastari et al. (2023). The decline in effectiveness in September (80%) occurred due to damaged traps, supporting the findings of Taufiqurrahman et al. (2024) regarding the importance of trap condition. In October, success returned to 100%, indicating improvement in line with IPM principles.

At the WTP, trapping in July–August yielded 100–200% success, but the limited number of traps made the data less representative. When six traps were set in September, the success rate reached 83.3%, supporting Maibang et al.'s (2023) theory that more intensive trapping increases accuracy. The absence of trapping in October reduced monitoring consistency, which contradicts vector control standard operating procedures. In domestic waste containers, trapping only occurred in August with 100% success, but the very limited data does not reflect the actual situation. This situation is noteworthy considering Wahyuni (2022) emphasized that piles of rubbish are the main trigger for the presence of rats.

The number of flies in an area over a given period of time is called fly density. Most of the time, these insects can be seen in human environments, especially in areas with debris or decaying organic material. Flies act as disease vectors, spreading a variety of dangerous diseases, including typhus, cholera, diarrhea, and eye infections. These diseases are spread when flies land on garbage or animal waste, then transfer to food or human skin, carrying disease-causing germs (Rois, 2023).

Fly density in the dishwashing area ranged from low to moderate. An increase in August–September (2.6–3.4%) indicates potential organic waste accumulation, consistent with Al-Irsyad & Deniati (2021). A decrease in November indicates improved sanitation.

The general TPS showed the highest variation, with several months falling in the moderate category. This confirms Mulyaningsih's (2023) finding that the TPS is a critical point for fly emergence. Meanwhile, in the canteen area, fly density was relatively low to moderate, indicating better sanitation compared to the kitchen or TPS. A value of 2.8 in August indicates potential for increase if hygiene is suboptimal. Therefore, if routine cleaning is not immediately implemented, it could accelerate the proliferation of flies in the serving area (Harnani et al., 2021).

CONCLUSION

Vector density at X Hospital varied across critical zones. The highest rat activity was found in the Nutrition Installation and WTP, particularly in July and August, indicating the availability of food sources and hiding areas that support infestation. The highest fly density was found in the public waste disposal area (TPS), particularly in September and November, making the TPS the most vulnerable point for fly breeding. The canteen and dishwashing areas showed lower fly densities, indicating relatively good sanitation, although monitoring is still required. This study concluded that strengthening vector control programs through regular monitoring, improving cleanliness, optimizing waste collection schedules, and implementing

Integrated Pest Management (IPM) principles is essential to prevent the risk of infestation and maintain sanitation quality in the hospital's critical zones.

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