Analysis of Fly Trap Operations in Hospital Temporary Waste Dumps

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Abstract
Regulations on hospital environmental health are still not popular in the community. One of them relates to hospital waste management which has not been a concern. However, the development of science and technology has resulted in advanced tools and machines that are adapted to the environmental conditions. Many types of fly control are available, such as fly traps in temporary garbage dumps in hospitals. This study aims to analyze operational needs and problems that can be encountered from implementing fly trap technology in hospitals. This study consists of three stages: budgeting, calculating the Kepner-Tregoe Situation Appraisal (KTSA), and conducting the Kepner-Tregoe Potential Problem Analysis (KTPPA). The total operational costs required for this tool are IDR 887,496 which includes the component of preventing problems possibly faced in the fly trap operations. Identification of tool constraints in the operation consists of damage of the fly trap net, piled up garbage due to overloading in the garbage dump, blockage of the inlet hole to the fly trap, and contact of the garbage collector with the waste at the TPS. There are four potential problems identified in implementing the fly traps, where possible causes, preventive actions, and contingent actions can be taken to overcome these potential problems.

Keywords: hospital, fly trap, operational cost, potential problems, action

INTRODUCTION
Hospital is part of the overall healthcare system that organizes health service activities covering promotive (health development), preventive (disease prevention), curative (disease treatment), and rehabilitative (health restoration) (Sudiharti & Solikhah, 2012). Furthermore, in providing their services in either outpatient, inpatient, emergency, medical, or non-medical services, hospitals use technology that possibly affects the environment. It is thus a mandatory for hospitals to maintain and improve the environment health (Atthar et al., 2022).

Health is one of the essential factors for everyone's physical condition. The community encounters problems in relation to health and home cleanliness (Septiariva & Suryawan, 2021; Suryawan et al., 2021). The problems are triggered by large population that grows significantly and is distributed unevenly and this results in a low level of education, society, and economy (Rizal et al., 2022; Sari et al., 2022, 2023; Septiariva & Suryawan, 2023; Suhardono et al., 2022).

Inadequate physical and biological environment results in only a small proportion of the population enjoy clean water and can manage sewage and wet or dry wastes to meet the health requirements (Sofiyah et al., 2021). Transmission of infectious diseases affects a lot of people. Therefore, the role of the environment is essential in promoting health of the population. Theoretically, there has been no explanation that health is influenced by several factors, including environmental factors, daily habits, health services, and heredity factors. The emergence of disease vectors in a population is triggered by many aspects, such as poor sanitation that attracts flies (Atuyambe et al., 2011). Diarrhea, one of the disease vectors, is a disease that is close to humans and caused by flies.

Hospital environmental health regulations have been the problem in managing hospitals. The regulations are not disseminated well yet, environmental impact analysis has not been implemented, efforts to manage and monitor the hospital environment are still
administratively oriented, and hospital environmental health activities have not been yet a priority. Also, managing hospital wastes that should be run properly has not been a concern (Silva et al., 2021).

The development of science and technology has enabled tools and machines are produced and adapted according to the environmental conditions and preferences (Suryawan & Lee, 2023; Sutrisno et al., 2023). Many types of fly control are currently available. For example, fly traps that can be located in temporary garbage dump (TPS) in a hospital are now available. However, applying a fly trap must consider various aspects, such as potential problems possibly occurred in the application. This study analyzes operational needs and problems encountered in applying fly trap technology in a hospital. The aim of the study is to develop a fly trap specifically designed for the waste containers in a public hospital to control fly populations in the TPS area.

LITERATURE REVIEW

Flies are one of the insects with the largest population in society and their presence is difficult to be eradicated (Vreysen et al., 2007). Flies can transmit various diseases for human, including dysentery, cholera, typhoid, worm infections, eye infections (conjunctivitis and trachoma), and skin infections (Sarwar, 2015). Food and organic substances that can be quickly decomposed are disease-causing organisms through flies' feet and body. A single fly can carry 6,500,000 microorganisms on its feet and body. Not surprisingly, many people get sick from contaminated food (Saipin et al., 2019).

Even though flies cannot be eradicated, they however can be controlled and managed for being not harmful (Graham & Hourrigan, 1977). Flies eat foods that are consumed by humans daily, such as sugar, milk, protein, fat, human and animal feces, blood, fermented
food, and decay (Mustikawati et al., 2016). These become the baits attracting flies as they contain substances the flies like and have a distinctive aroma that lure flies (Biasazin et al., 2018). The sense of smell in flies consists of antennae and pulp which are very sensitive to an odor. Therefore, fly traps can possibly control the density of large numbers of adult flies (Denning et al., 2014).

Fly traps must be placed outside the house, in an open air, and must be free from the shadows of trees. A fly trap uses an inverted cone and a small hole on the cone with 2-3 inches apart from the end of the cone. Flies will fly up and enter to the trap through the small hole. Fly trap is a cube with dimension of 30x30 cm and a circle with diameter 7 cm for flies enter to the trap (Fitriana & Mulasari, 2021).

Fly controls are available with various mechanism, each has its advantages and disadvantages. Sticky traps have gained popularity for several reasons. Firstly, they offer a non-toxic solution (Thomas, 2008) that make them safe for being used indoor or in food-handling areas where chemical sprays may not be suitable. Additionally, they are odorless (Iglesias et al., 2014) that can avoid unpleasant smells of certain insecticides. They provide a targeted approach (Cohen, 2007), attracting and capturing flies without harming other beneficial insects or the environment. Moreover, they typically require low maintenance allowing them to capture flies continuously with minimal intervention.

Some fly traps are reusable, which means that the adhesive surfaces can be replaced or cleaned. However, it's essential to consider factors like fly species, infestation severity, and specific circumstances when selecting a control mechanism as the effectiveness may vary among different methods. For example, fly swatters offer immediate control but they are more suitable for isolated fly incidents. Insecticides can be effective but they use chemicals (Endersby & Morgan, 1991; Siegwart et al., 2015). UV light traps attract flies through light
and electrocute or trap them (Hogsette, 2021; Kammar et al., 2020). Biological control agents use predatory insects or animals to reduce fly populations. Each method has pros and cons, so choosing the most appropriate approach depends on the specific situation and personal preferences.

Research on fly traps and their effectiveness in controlling flies has been conducted for years. These studies often focused on specific types and designs of traps or the integration of traps with other control methods. The results of these studies varied depending on the variables being tested and the conditions under which the experiments are conducted. The key findings of previous research include effectiveness and species-specific attraction. Studies have shown that fly traps, particularly sticky traps and UV light traps, are considerably effective in capturing flies and reducing fly populations (Hogsette, 2021; Kammar et al., 2020). However, the level of effectiveness can vary depending on several factors such as trap design, bait attractiveness, fly species composition, trap placement, trap maintenance, and environmental conditions. In terms of species-specific attraction, certain fly trap designs and baits are more effective in attracting specific fly species (Daypuk et al., 2021; Harvey et al., 2019). Researchers have explored different bait formulations and trap designs to optimize attraction for target fly species while minimizing non-target captures.

METHODS

Overall, the stages of this study are presented in figure 1. They are intended to assess the costs and benefits of implementing fly traps in hospitals.

Budgeting or preparation of the budget is an estimation of expenses according to the results of the business analysis that has been carried out. Capex is an expenditure used to create a design. It refers to a purchase of fixed assets intended to increase the value of an asset and
expand the company's ability to increase profits. Capex is recorded as an asset on the balance sheet if the goods or services purchased are used continuously for more than one year. Operating expenses are operational costs incurred by a business through its normal day-to-day operations. They include rent, equipment, inventory costs, insurance, installation costs, and funds allocated for research and development. Maintenance or maintenance costs are funds intended to maintain the assets to be in optimal condition during their use. Regular inspection and maintenance are needed for the equipment to always be in prime condition. Therefore, it is highly recommended that companies allocate special funds for maintenance expenses regularly.

**Figure 1. Evaluation framework of this study**

Kepner-Tregoe Situation Appraisal (KTSA) is useful in deciding which problem has the highest priority in the case several problems are simultaneously encountered. KTSA enables individuals or teams to take rational action through developing a better understanding on the problem identification and efficient time to solve the problems. The results can keep
individuals or teams focusing on the priority issues. The first step is to make a list to isolate and clarify all the problems under the concern that are faced simultaneously. The second step is to decide which problem needs attention first. The priority of each problem is evaluated using the criteria of timing, trend, and impact which are assessed into high attention (H), moderate attention (M), and low attention (L) (Perguruan et al., 2020).

Kepner-Tregoe Potential Problem Analysis (KTPPA) is one of four types of Kepner-Tregoe techniques. The other three are KTSA (Situation Appraisal), KTPA (Problem Analysis), and KTDA (Decision Analysis). KTPPA aims not only to ensure the success of the solution implementation but also to minimize risk of the potential problems that may interfere the implementation of the solution or the expected results of the solution implementation. KTPPA table explores potential problems, identifies potential causes of these problems, compiles preventive action plans to avoid occurrence of the problems, and creates a contingent action plan for countermeasures if potential problems do occur (Perguruan et al., 2020).

A systematic approach is crucial when the observation method is used to identify potential problems. It begins with establishing clear objectives outlining the specific aspects to be observed, such as the functions of the fly traps, waste disposal practices, and condition of the TPS area. Next, observation guidelines or checklists is developed to ensure consistency and comprehensiveness during the process. Then, site visits are conducted to closely observe operations and activities related to fly control and waste management. Following to this, detailed notes are taken, visual documentations are captured, and engagement with the stakeholders are managed to gather additional insights and perspectives. In the next step, comparing the observations with the established standards, guidelines, or best practices in the field is to identify any deviations or areas requiring improvement. Analyzing and prioritizing the collected observations are then conducted to look for patterns or recurring issues and
consider their potential impact and urgency. Finally, validating the findings is accomplished by seeking input from other team members or experts. This systematic observation method provides valuable insights into potential problems, allows for a thorough examination of operational processes, equipment, and practices to identify areas for improvement and intervention.

The object of the study is the design of a fly trap device to be implemented on containers at the TPS of a public hospital, RSUD X. The containers used at the TPS are closed containers with a capacity of 6 m³ and dimensions of 3.3 x 1.8 x 1.2 meters. The study aims to develop a fly trap specifically designed for these containers to control fly populations in the TPS area.

RESULTS AND DISCUSSION

Results

In installing the fly traps at the hospital, the tools needed such as wooden rafters, wire gauze, yellow funnels, and nails for capital expenditures were found by analyzing the bill of quantity (table 1). Operating expenses include tools such as astrakhan (shrimp), masks, hand scoops, basil oil, humidifiers, and personal protective equipment (PPE). The maintenance expense amounted Rp100.000 might have been estimated based on the expected maintenance requirements for the fly trap device which include potential costs for replacement parts or servicing.

Information on the price of each item in the list was obtained through market research, supplier quotations, and interviews with relevant stakeholders. The following is a general breakdown of how the prices have been determined. The price of wooden rafters might have been sourced from local suppliers or hardware stores. The listed price of Rp999 per piece
suggests that it was obtained from a specific supplier or market research. Similarly, the price of Rp13.000 per sheet for wire gauze could have been obtained from supplier quotations or market research on the average price of wire gauze. The price of yellow funnel amounted Rp14.851 per piece may have been based on market research or quotations from suppliers. The price of Rp3.000 for one ounce of nails could have been obtained from local hardware stores or supplier quotations.

Table 1. The Operational Costs of the Fly Trap

<table>
<thead>
<tr>
<th>Tools and materials</th>
<th>Value</th>
<th>Unit</th>
<th>Unit price</th>
<th>Total price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooden rafters</td>
<td>8</td>
<td>pcs</td>
<td>Rp999.00</td>
<td>Rp7.992.00</td>
</tr>
<tr>
<td>Wire gauze</td>
<td>9</td>
<td>pcs</td>
<td>Rp13.000.00</td>
<td>Rp117.000.00</td>
</tr>
<tr>
<td>Yellow funnel</td>
<td>4</td>
<td>pcs</td>
<td>Rp14.851.00</td>
<td>Rp59.404.00</td>
</tr>
<tr>
<td>Nail</td>
<td>1</td>
<td>ounce</td>
<td>Rp3.000.00</td>
<td>Rp3.000.00</td>
</tr>
<tr>
<td><strong>Total price</strong></td>
<td></td>
<td></td>
<td></td>
<td>Rp187.396.00</td>
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</table>

Operating Expenses

| Atrakan (shrimp)         | 0.5  | kg   | Rp40.000.00 | Rp20.000.00 |
| Face mask                | 10   | pcs  | Rp20.500.00 | Rp205.000.00|
| Handscon                 | 1    | box  | Rp89.000.00 | Rp89.000.00 |
| Basil oil 10 ml          | 1    | pcs  | Rp94.000.00 | Rp94.000.00 |
| Humidifiers              | 1    | unit | Rp137.100.00| Rp137.100.00|
| PPE                      | 5    | pcs  | Rp11.000.00 | Rp55.000.00 |
| **Total price**          |       |      |            | Rp600.100.00 |

Maintenance Expenses

| Fly trap maintenance costs | Rp100.000.00 |
| **Total price**           | Rp887.496.00 |

The exact process applies to the operating expenses. The price of atrakan (shrimp) amounted Rp40.000 per 0.5 kg could have been sourced from market research or supplier quotations for the specific product. The price of Rp20.500 per piece face mask might have been obtained through market research on the average price of face masks or supplier quotations. The price of handscon amounted Rp89.000 per box could have been based on supplier quotations or market research on hand sanitizer products. The price of Rp94.000 for one bottle of 10 ml basil oil might have been sourced from supplier quotations or market research on the
average price of basil oil. The price of Rp137.100 per unit humidifiers might have been obtained through market research or supplier quotations for humidifiers with the required specifications. Similarly, the price of Rp11.000 per piece PPE could have been sourced from market research on the average price of personal protective equipment or supplier quotations.

The results of the KT-SA analysis can be seen in Table 2. Identification of tool constraints in the operation consists of damage of the fly trap nets, piled up garbage due to overload of the garbage dump, blockage of the inlet hole of the fly trap, and garbage collectors coming into contact with the garbage.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Net damage on the fly trap</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>1</td>
<td>Not easily damaged because it uses the best quality (wire netting); Damage can stop the fly vector control process.</td>
</tr>
<tr>
<td>2.</td>
<td>Garbage piles up due to the overloading of waste containers</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>4</td>
<td>Garbage generation at the hospital in large quantities.</td>
</tr>
<tr>
<td>3.</td>
<td>Blocked entry of flies on the fly trap</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>3</td>
<td>Four holes/pathways for flies to enter the fly trap have been provided so flies can enter the trap through other holes.</td>
</tr>
<tr>
<td>4.</td>
<td>Garbage collectors meet waste at the TPS</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>2</td>
<td>Personal protective equipment has been provided for TPS officers.</td>
</tr>
</tbody>
</table>

The damage of the fly trap net was identified through an observation and assessment of the condition of the traps. The damaged nets can hinder effectiveness of the fly control process. Given that the nets are made of high-quality wire netting, the timing (H: High)
indicates that it is a problem that needs immediate attention. The impact (H: High) is also high because the damage on the nets can disrupt the fly control process and makes it a critical issue.

The problem of piled up garbage due to garbage dump overload was identified through visual inspection of the TPS area and monitoring the waste disposal process. The timing (M: Medium) suggests a recurring problem that needs attention but may not be as urgent as other issues. The impact (M: Medium) indicates that it moderately affects waste management, as excessive garbage can lead to sanitation and hygiene concerns.

The problem of blocked inlet hole might have been identified through regular monitoring and observation on the traps. The obstructed inlet hole reduces effectiveness of the trap. The timing (M: Medium) suggests that it is a problem that occurs occasionally and needs attention. The impact (M: Medium) reflects that it has a moderate effect on fly control, but it can be addressed using alternative inlet holes.

The problem of garbage collectors coming into contact with waste at the TPS might have been identified through discussions or feedback from the TPS officers involved in waste collection. The timing (M: Medium) indicates that it is an ongoing concern that requires attention to ensure the safety and well-being of the personnel. The impact (H: High) reflects that it significantly affects the health and safety of the garbage collectors, making it an important issue to address.

There are four potential problems that are identified in implementing fly traps. There are possible causes, preventive actions, and contingent actions that can be taken to overcome these potential problems. Table 3 presents the results of the analysis.

**Discussion**

Fly trap is a means of controlling flies by trapping large numbers of flies. An attractive place for flies to breed and find food is a dark container as the condition in the public
TPS of the hospital. The eco-friendly fly trap is a modification of technology that can trap flies and is still environmentally friendly (Rahayu et al., 2019). Based on the criteria and requirements for appropriate technology, this tool has many advantages because this technology is relatively economical (viable), can be accounted for (technically feasible), and can adapt well to the cultural and social environment.

**Table 3. KT – PPA (Kepner Tregoe Potential Problem Analysis)**

<table>
<thead>
<tr>
<th>Potential Problem</th>
<th>Possible Cause</th>
<th>Preventive Action</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net damage on the fly trap</td>
<td>Hit the trash under the fly trap</td>
<td>Monitoring and transporting waste so that it does not exceed the capacity of the waste container</td>
<td>Repairing fly trap nets</td>
</tr>
<tr>
<td>Garbage piles up due to the overloading of waste containers</td>
<td>Delay in garbage collection</td>
<td>Create a garbage collection schedule</td>
<td>Providing spare containers to anticipate overloading</td>
</tr>
<tr>
<td>Blocked entry of flies on the fly trap</td>
<td>The fly intensity is too high</td>
<td>Provide four holes/pathways for flies to enter the fly trap so that flies can enter the fly trap through other holes.</td>
<td>Clean the entry route of flies</td>
</tr>
<tr>
<td>Garbage collectors meet waste at the TPS</td>
<td>Officers do not comply with the rules for wearing Personal Protective Equipment (PPE)</td>
<td>Socialization needs to be given to TPS officers, and monitoring must be carried out.</td>
<td>Give sanctions or warnings to TPS officers who do not use PPE.</td>
</tr>
</tbody>
</table>

This tool uses perforated anti-mosquito wire mesh and is arranged in the dump. The choice of this material is intended to make the garbage can be smelled inside the trap that attracts flies to enter the fly trap. Flies are phototropic insects that are very fond of light. Therefore, a bright yellow funnel is made to attract flies to enter the fly trap. Furthermore, the funnel is made conical so that the fly entering the trap cannot find the way out. When flies fly in a vertical direction towards the light, they will be trapped as the walls of the bright room are covered with wire mesh. The total operational costs required for this tool is IDR 887,496.
which includes preventing problems during the fly trap operations. Damage of the fly trap net can happen due to the hit of trash under the fly trap. This risk can be reduced by monitoring and transporting waste before the capacity of the waste dump is exceeded. If such problem happens frequently, repairs to the fly trap nets must be carried out periodically. Overloaded garbage can occur due to delays in the waste collection. A garbage collection schedule must thus be created for the operation. In addition, officers must provide spare containers to anticipate overloading.

For several key reasons, fly traps play a crucial role in waste management at the hospitals TPS. First, they are essential for effective fly control. Flies are naturally attracted to waste, particularly organic waste, and can serve as carriers for various diseases. By implementing fly traps, the hospital can efficiently manage and reduce the fly population the TPS area. This helps minimizing the risk of fly-borne illnesses and preventing the spread of pathogens. Second, fly traps contribute to maintaining hygiene and sanitation standards. Flies can contaminate their surroundings by landing on waste materials and subsequently transferring pathogens to other surfaces, food, or even individuals. By utilizing fly traps, the hospital can prevent flies from contacting with waste, thereby reducing the spread of contaminants.

Additionally, fly traps aid in odor control. Accumulated waste often emits unpleasant odors, which can negatively impact the environment and causes discomfort for the hospital staff, patients, and visitors. Fly traps help minimizing the presence of flies attracted to the waste odorous. They consequently reduce the dissemination of foul smells within the TPS area. Moreover, fly traps contribute to maintaining a visually pleasant and presentable environment. The sight of swarming flies can create a negative impression and undermine the overall cleanliness and professionalism of the hospital. The hospital can effectively manage
the fly population by implementing fly traps that lead to a more aesthetically appealing environment. Lastly, using fly traps ensures compliance with regulatory requirements. Local health regulations and standards often mandate proper waste management practices, including fly control measures.

**CONCLUSION AND IMPLICATIONS**

**Conclusion**

The entire amount of IDR 887,496 that must be spent on operating the fly trap tool in the hospital is specified. The costs are also considered to avoid issues that occur during operating the fly traps. The potential problems relating to the fly trap net, piled up garbage resulting from overloading the garbage dump, blockage of the inlet hole of the fly trap, and contact of the garbage collector with the waste at the TPS are the examples of the tool constraints identified during the operation. There are four potential difficulties recognized during the implementation of fly trap. Each of these potential problems has a plausible cause, preventative steps, and contingent actions that may be performed to resolve the potential problems.

**Recommendations**

It is necessary to carry out further research regarding to the effect of the type of bait that is more effective in overcoming the intensity of flies using eco-friendly fly traps. Further research must pay attention to the size of fly trap that is more practical and responsive to the hospital environment. It is also necessary to carry out in-depth research so that the potential of basil can be used on a large scale. A study on quantity and layout of the fly trap that meet the size of the TPS is needed so that the trap can caught flies optimally.
REFERENCES


