GREEN HOSPITAL IMPLEMENTATION IN INDONESIA: A LITERATURE REVIEW

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ABSTRACT

Hospital is one of the institutions that use a considerable amount of energy and contribute the largest amount of waste. In order to reduce its impact, initiatives have emerged in the form of green hospitals for the effective use of resources. Although there are standard criteria for each country in applying environmentally friendly buildings in each country, there is still no internationally referenced certification. This study intends to compare the implementation of green hospitals in various hospitals in Indonesia. The comparisons will be taken from the elements of a green hospital, namely energy efficiency, green building design, alternative energy generation, transportation, food, water, and the availability of green open space. This research type is a literature review, with data taken from an online database. The online databases used are Science Direct and Google Scholar. The criteria used are elements of the implementation of green hospitals in Indonesia, and must mention the name of the hospital or the area where the research was carried out. There were 12 studies that matched the inclusion criteria. It can be seen that there are various efforts by hospitals in Indonesia in implementing green hospitals. However, there is unpreparedness in the application of all of its elements, especially in the transportation and food elements.

KEYWORDS

Green hospital, environmentally friendly

INTRODUCTION

Hospital is a public facility that operates 24 hours a day. Hospitals consume large amounts of resources such as clean water, electricity, fuel, and paper and produce solid and liquid waste every day. In 2019 it was reported that 4.4% of the world's carbon footprint was generated from health care systems including hospitals. The health care system, including hospitals, should promote and elevate a healthy lifestyle, but in fact, it becomes a quite dangerous threat to the environment.

Hospital is a health service institution that provides complete individual health services. This statement is asserted in the Laws of Indonesia No. 36 of 2009 concerning health which ensures that everyone has the right to health and everyone has the right to a healthy environment for the attainment of health status. Apart from providing hospital treatment, it is also hoped to create a clean and friendly environment for the surrounding environment.

An environmentally friendly hospital or a green hospital is a hospital designed, built/renovated and operated, and maintained by considering the principles of health and a sustainable environment. Creating a green hospital is a long and complex effort, so many aspects are involved in determining its success. The application of green hospitals in Indonesia has now developed into a new side approach in hospital management. In designing its development, operation, and maintenance, Green Hospital will always apply the principles of sustainability and eco-friendly practices.

Environmentally friendly hospitals in Indonesia are a concept that emphasizes the efficient use of water and electrical energy effectively and efficiently, as well as environmentally sound waste management. The purpose of implementing environmentally friendly hospitals is to protect residents, surrounding communities, the efficiency of resources, take measures to prevent increased mortality rates, and control the adverse effects of global warming. The elements that must be considered in an environmentally friendly hospital are energy efficiency, green building design, alternative energy generation, transportation, food, waste, and water.

The Joint Commission International Accreditation has formulated green principles in hospitals related to design and construction as follows: 1) The hospital in the future must be a healthy place both in and in its surrounding environment. 2) Reducing the level of toxicity to materials used by the hospital. 3) The hospital must use energy and water resources to a minimum and reduce the production of waste produced. 4) Align environmental health in considering health system priorities following the provisions of green buildings. 5) Include the "concept of sustainability" in health services. There are various opinions regarding the green hospital concept, but it can be concluded that this concept is a new thought in environmental responsibility in order to create a sustainable environment (sustainability).[1] The current green concept is intended to address climate change and the sustainability of natural resources which is increasingly worrying, considering that hospitals are one of the largest contributors to waste and garbage.

The principles of a green hospital should cover several areas as follows: 1) Sustainable location, which is site management that is environmentally friendly and sustainable. 2) Efficiency in water use; in this case the hospital strives for efficient use of water and conservation of water resources. 3) The use of energy and outdoor air, the hospital, strives to achieve energy efficiency and use of alternative energy and reduce carbon emissions. 4) The use of materials and resources, in this case the hospital uses non-toxic, environmentally friendly, sustainable, and recycled materials. 5) The indoor air quality has good circulation, is free from pollution, improves indoor air quality and occupants' comfort. 6) Development of innovation, namely hospital management, can develop innovation and creativity in green hospital-based activities.[1]

The application of environmentally friendly hospitals can be adjusted to the conditions of each country, as there are no mandatory criteria standards that can be applied generally. This condition is linked to local needs as well as environmental actions and primary prevention practices that are actively involved in efforts to improve public environmental health, health equity, and a green economy. Regulations regarding green hospitals refer to the guidelines for Global Green and Healthy Goals, Green Building Council Indonesia (Green Building Tools For Existing Buildings), PROPER assessment of the Ministry of Environment, Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia No. 2 of 2015 concerning green buildings, as well as the Decree of the Minister of Health of the Republic of Indonesia No 1204/MENKES/SK/X/2004 concerning hospital environmental health requirements. The assessment instrument regarding green hospitals that the authors report in this study covers several aspects, including energy efficiency and conversion, green building design and materials, waste management, food management, water conservation, transportation management, and the availability of green open space. These instruments were synthesized based on some of these regulations and guidelines.

Based on the explanations above, this article is written with the aim of determining the implementation of environmentally friendly hospitals in Indonesia based on several criteria that have been implemented and intended on creating green hospital practices in Indonesia.

MATERIALS AND METHODS

his article aims to comprehend green hospital implementation associated with its various elements in Indonesia. The features discussed are following the multiple aspects of the existing green building. The various current criteria are obtained from the elements that will be discussed further. These elements are *energy efficiency, green building design, alternative energy generation, transportation, food, waste, water, and availability of green open space.* The authors will discuss the elements regarding the implementation and the results obtained by hospitals in Indonesia.

This study is related to the impact felt by the hospital and its impact on the environment. It is expected that the implementation of green hospitals could be found that have been implemented in Indonesia. The recommendations are provided, and suggestions can be found for other hospitals in Indonesia that implemented and improved the green hospital pattern in the future since the green hospital concept has considerable benefits for the hospital, patients, the community, and the environment.

The research was conducted using the literature review method. The literature was reviewed by 5 (five) reviewers. A literature review or library research is research that reviews the knowledge, ideas, or findings contained in the academic-oriented, and formulates theoretical and methodological contributions to the one topic. This research article is a descriptive analysis, regularly breakdown of the data obtained, then given an understanding and explanation so that the readers can understand it. Data was collected by searching scientific publications on several online databases, namely Google Scholar and ScienceDirect.

The language used in the articles search process only in 2 (two) languages, Indonesian and English, in the last 10 years (2011-2021) literature review journal articles that could be accessed in full

text in pdf format. The keywords are green hospital Indonesia and *rumah sakit ramah lingkungan* di Indonesia. We found 15 articles that match the keywords. One article was obtained from ScienceDirect, fourteen articles were from google scholar, then a selection process was adjusted to the inclusion criteria. The inclusion criteria used in this article are research conducted in Indonesia.

The research journals that match with the inclusion criteria were collected and a summary is made including the name of the researcher, the year of publication of the journal, the name of the research hospital and its area, and a conclusion or findings which we summarize in the attachment. The research must also discuss at least one of the green building elements. Then after an abstract review, the authors found 11 articles that were suitable with the criteria (Figure 1).

RESULTS AND DISCUSSION

Green hospital standard has undergone many changes, in line with policy, regulation, and technical guidelines development about environmental health. Meanwhile, on the other side, the general public is demanding hospital service improvement through environmental health betterment. Here are some elements of green Buildings and their application in Indonesia. Here are some elements of green buildings and their application in several hospitals in Indonesia:

1. *Energy efficiency and conversion*

The health sector consumes a large amount of electrical energy; for example, a Hospital in Brazil consumes 10 % of electrical energy from domestic commercial sector total energy [2]. While in India, the health sector consumes 7.6% of total energy consumption [3]. In Indonesia, electrical energy from the hospital is still quite high, that is 225 kWh/m^2 , compared to Japan with 175 kWh/m^2 [4].

Energy efficiency and conservation is becoming a fundamental matter because energy consumption in hospitals is one of the highest. The consequences are increased cost and a big impact on climate change and global warming because of the enormity of the energy emission.

To create a green hospital, the hospital should achieve energy efficiency by: (1) Constructing a building equipped with a separate electrical meter in every sub-system, mainly between hospital service and medical facilities, (2) calculating electrical usage, (3) Measuring energy efficiency using natural light, (4) Making up ventilation, and (5) Calculating local climate change impact through CO2 emission and using new and renewable sources of energy.

Some hospitals that have been studied have implemented energy efficiency. That efficiency consists of timely control of lamp usage, and the use of energy-saving lamps [5]. Research done in RSUD Batang states that the hospital is already using energy-saving lamps, energy-saving electrical appliances, and installing electrical switches in easily accessible locations when opening or closing the door [6].

In another research done in PERTAMINA Hospital Cirebon, it has been found that energy efficiency effort is implemented in air conditioner temperature settings, and training for hospital medical appliances operators [7]. Related to energy usage, research from Bali shows 50% of respondents found energy efficiency attempt in their respective hospital. Meanwhile, Persahabatan Hospital Jakarta has implemented energy resource efficiency in their strategic policy [8].

Actually, alternative energy usage is not widely used in Indonesian hospitals. From our compiled reports, only one researcher in Surakarta [9] stated that their hospital design uses alternative energy, in this case in the form of solar cells.

2. Green building design and material

Environmentally friendly hospitals can also be measured from hospital building performance towards selection of sustainable material construction. To achieve high-performance building, a hospital should use long-lasting and easy to clean material. The material being used should be locally produced so that gas emissions produced from the production until the distribution process are kept low compared to imported material.

Other than that, environmentally friendly construction should also pay attention to the green factor by incorporating design components such as sunlight, natural ventilation, alternative energy, and so on.

Research from Pramata et al (2017) state that UIN Maulana Malik Ibrahim Hospital Malang uses a non-harmful material (having a low VOC level), a pre-fabricated material, and locally sourced. Furthermore, building plafond is using a non-porous, strong, and sound absorbent material. Therefore, the building material concept of UIN Maulana Malik Ibrahim Hospital Malang has adopted sustainable principles that become the base of the Green hospital concept [10].

A research conducted on Universitas Sumatera Utara Hospital for green building rating revealed the importance of green concept to protect, preserve and reduce natural resources usage. Besides, it also preserves indoor air quality and takes care of inhabitant health, all of which stand from sustainable building principles [11].

3. Transportation

The hospital should be able to provide facilities and easy access to public transport such as public transport, city bus, and others by facilitating pedestrian path/pedestrian access regarding the Regulation of the Minister of Public Works No. 30 / PRT / M / 2006 concerning Technical Guidelines for Facilities and Accessibility in Buildings and the Environment. In addition, hospitals can use vehicles that are low in emissions and fuel-efficient and encourage the use of bicycles for hospital users by providing adequate facilities to reduce motorized vehicle use.

Research conducted by Putri et al. (2017) at Saiful Anwar Hospital Malang mentioned that the transportation management has a fairly good performance, but it needs further attention to control, especially vehicle exhaust emissions, both ambulances and common official cars. This study has not been specifically measured, which analyzes the dimensions of transportation concerning the green hospital concept [12].

However, it is different from the research conducted by Putri et al. (2016). She has found that several hospitals in Malang City were not ready to implement green hospitals from the transportation dimension. One of the assessment criteria in this study is the use of a hospital vehicle that is free from pollution. However, the provision of these vehicles is considered quite heavy because it is related to investment planning considerations. The drawback of this study, it was not explained in which hospital it was conducted.

The authors conclude that there is no research specifically discussing the application of environmentally friendly modes of transportation in Indonesian hospitals. In addition, there is a research outside of Indonesia, Rocky Mountain Hospital found that the cost of replacing a fossil-based ambulance with one using a solar cell was $ 10,000. These costs can be covered within 2 years with savings in fuel costs [13].

4. Food Management

The hospital provides food for patients and employees with local organic food ingredients that are fresh and toxic-free. The hospital also applies food sanitation and hygiene principles in all aspects of food handling in the hospital. It uses food serving equipment/materials safe from ingredients toxic and dangerous toxic materials. This is one of the principles of green hospitals for managing hospital nutrition according to the Guidelines for Environmentally Friendly Hospitals [1].

Furthermore, green principles in hospital nutrition management also cover food waste from production to food consumption. The amount of food waste from hospitals is far greater than that of other sectors such as restaurants and educational institutions. If you look at the economic and environmental sectors, hospital food waste has wasted approximately 300,000 US dollars per year. Several previous international studies have shown that hospital food waste occurs when serving food (plate waste) to patients who are hospitalized.

According to the Ireland Environmental Protection Agency, food waste is divided into three broad categories, including:

- Unserved Food Waste
- Untouched Food Waste
- Uneaten Plate Waste

49% of hospitals and health facilities in Ireland never really calculate how much food waste is wasted and its impact on economic and environmental factors. A case study at University Hospital Galway (UHG), Ireland showed that they dispose of about 5.3 tonnes of food waste each year; in 2013 they made changes to the food waste management process by implementing several strategies, including:

- Using new food containers that are more efficient in terms of product durability and container volume.
- Ordering food the night before to better predict the required amount of each food choice
- Recording the number of portions of food that have not been served, to identify unpopular food choices
- Improving interaction with medical staff, to identify patients who are absent at mealtimes (absent for surgical procedures, fasting, etc.) or patients with special dietary needs requiring portion adjustment
- Reducing the number of seasonings (salt, pepper, sugar, etc.) packaged in sachets that are available in each patient's food tray.

These food waste reduction measures have resulted in significant cost savings for the hospital. In the first year of implementing these strategies, UHG saved and reduced 300 kg of food waste. The hospital continues to reduce the amount of waste generated to minimize food waste production of food waste. [15]

Research at RSUD Kabupaten Batang shows that efforts have been made in the hospital to create a food and beverage sanitation program and educate the implementation of green hospitals. This helped the Batang District Hospital to get a silver rating according to the Greenship Rating Tools version 1.1 [6].

5. Waste Management

In addition to consuming great energy, the hospital also generates large volumes of waste. This can be seen from a study of 100 hospitals in Java and Bali, which found that each bed produced 3.2 kg of waste per day, while for liquid waste it was found that per bed per day produced 416.8 liters. Therefore, when aggregated nationally, hospitals in Indonesia produced 376 089 tonnes of solid waste per day and amounted to 48 985 tonnes of liquid waste per day [16].

Global Green and Healthy Hospital proposed that in the Green hospital, the hospital must give special attention to waste management, waste minimization, and segregation Hospital waste management, which includes avoiding waste, reusing, recycling, and sorting waste, is significant in waste management, one of the indicators in Green hospital [17].

In the search carried out, the most research aspect is the waste aspect. Putri's research in 2016 stated that the hospital in Malang still needed increased readiness in managing waste. This mainly concerns Air Waste and Hazardous Waste [5]. A relatively similar condition in the lack of readiness to handle B3 waste is also experienced by hospitals in Batang district [6]. Research in a hospital in Manado shows that the hospital is not ready to implement a green hospital, especially because it does not meet the requirements of the government [18].

Meanwhile in Surabaya, A. Yani's Mother and Child Hospital has implemented solid medical waste management quite well [19]. In Cirebon, although the waste has been handled properly, there is an opportunity for improvement by making biopore holes for compost processing [7]. From a study comparing three major hospitals in Jakarta in terms of waste treatment, it can be concluded that the hospital's environmental performance will be great if the Environmental Management Unit at the hospital has sufficient environmental human resources, budget availability, and adequate environmental facilities and technology. The environmental sector is adhered to by implementing quality standards [20].

6. Water Conservation

The principles of water management in hospitals according to the Guidelines for Environmentally Friendly Hospitals (2018) include monitoring water use so that it can be the basis for better water management implementation, increasing clean water use savings which will reduce the burden of clean water consumption and reduce waste water output, encouraging efforts water saving by installing high efficiency water features, providing water from recycled sources that come from building wastewater to reduce water requirements from the main source, using alternative water sources that are processed so as to produce clean water to reduce water requirements from the main source. Furthermore, water management in the green hospital concept aims to encourage the use of rainwater or rainwater runoff as a source of water to reduce water needs from the main source. Besides that, it can minimize the use of clean water sources from groundwater and PDAM for landscape irrigation needs and replace them with other sources [1].

A study in UNSRAT Hospital Manado stated that the use of non-conventional plumbing tools met the standards GBCI, then obtained savings amounting to 40.64% of water use. As for the amount of water saved each day by up to 27.12 cubic meters. This not only has an impact on water cost savings but also on reducing the cost of domestic waste and its sludge [21]. In studies in RS Cirebon obtained a saving of 94.9 cubic meters of water per year to the reuse of water by reverse osmosis method [7].

7. Availability of Green Open Space

Hospital is expected to provide green environment facilities in both indoor and outdoor environments with a design that can provide healing effects on patients. reduce the effects of stresses and create a garden with relaxation functions for patients and employees. This is in accordance with one of the principles of green hospital, which is creating a quality hospital environment with an ecological concept.

These conditions are the things that are directly and indirectly related to the availability of a Green Environment. The establishment of green open spaces in hospitals can improve environmental quality and provide benefits to urban areas both ecological, aesthetically, socially, and economically.

The provision of Green Open Space has also been stipulated through Law No. 26 of 2007 concerning spatial planning which requires a green open space area of 30% of the urban area with details 20% Public and 10% Private. The provision of parks or green open spaces can be outside the hospital building area, in the middle of the building, or behind the building.

The research conducted by Eka Surya Nugraha, Kusnanto (2014) showed that RSUP Persahabatan can meet 11% of the criteria and the Dharmais Cancer Hospital is able to meet 22% of

the total criteria required in the Greenship Building. The greatest potential of RSUP Persahabatan in implementing Green Hospital lies in the availability of Green Open Space which reaches 70% of the total land area, while the Dharmais Cancer Hospital has excellence in the management of hospital environment management as shown by the achievement of ISO 14001:2004 certification of Environment Management [22].

CONCLUSIONS AND SUGGESTION

Green Hospital is currently one of the needs in the change management developed in many hospitals. The green hospital is a hospital that is designed, built/renovated, operated, and maintained by considering the principles of health and a sustainable environment.

Several hospitals in Indonesia have made various efforts towards green hospitals. These efforts include energy efficiency, green building design, alternative energy generation, transportation, food, waste, and water. The waste aspect has the most research, with eight studies. Meanwhile, the aspect that cannot be found in application in Indonesia is the food aspect. The aspect of energy efficiency is the easiest to implement and has a direct impact on the hospital.

The quantity of our data limits our research. Considerable research on green hospital buildings is from private university libraries that are not accessible to the public. The author recommends further research on the model of hospital environmental management towards a green hospital, applying policies and other innovations, especially in aspects of transportation and food, to accelerate program implementation in all hospitals in Indonesia.

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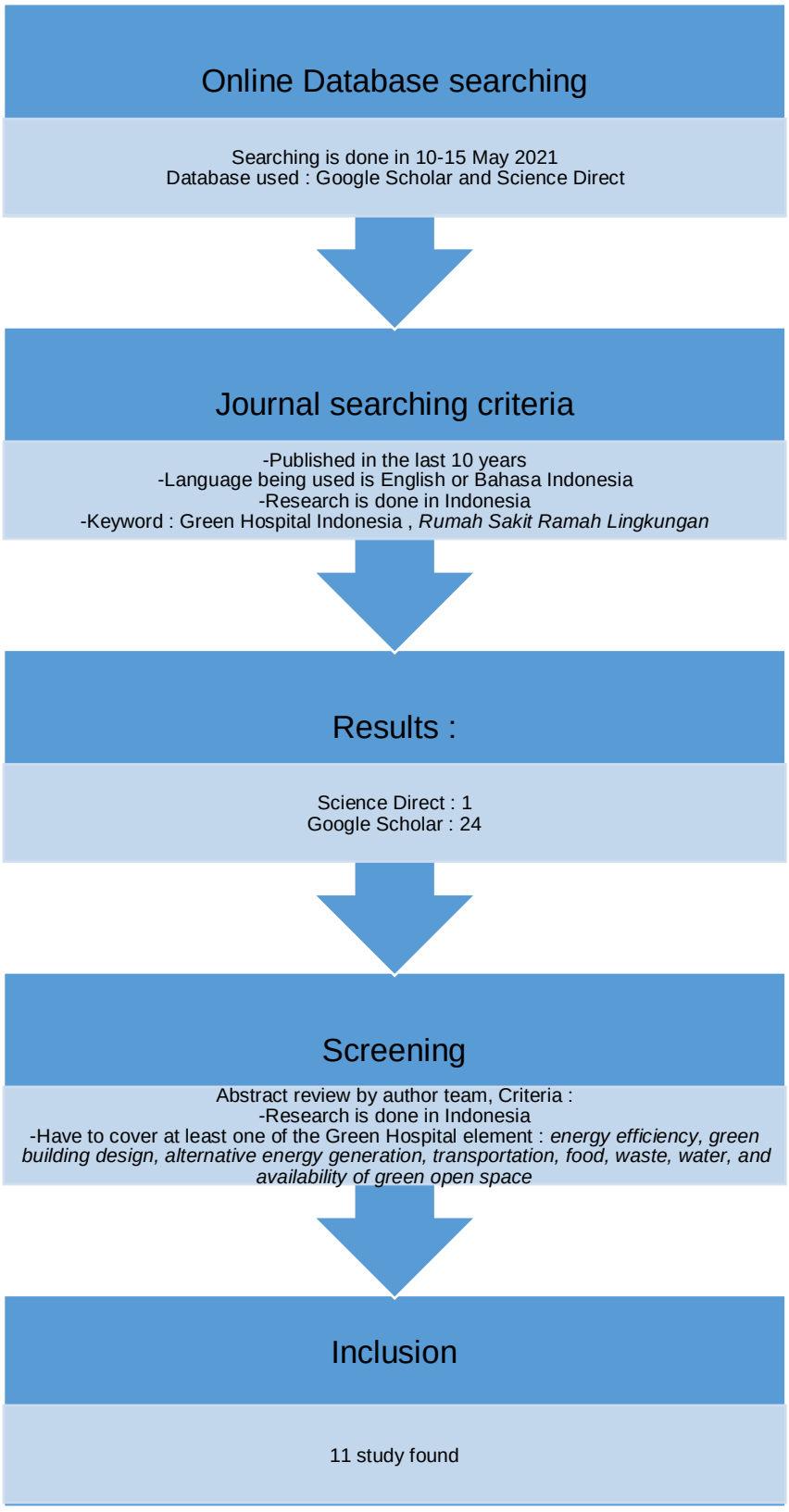

Figure 1. Steps to Select the Articles

Table 1 Summary of the Researches and Results

No	Researcher	Year of Publication	Hospital / country name	Green Hospital elements that being discussed	Research conclusions
1	E. Setyowati et al	2013	Professor Dr. R. Soeharso Hospital ;Surakarta	Green building design	Sustainability concept is required in hospital development
2	Rahayu,A et al	2020	Sam Ratulangi University Hospital; Manado	Water	By implementing the GBCI standard plumbing appliances, there is a water saving result of 40.64%.
3	Umar,F et al	2020	Pancaran Kasih Hospital;; Manado	Waste	Pancaran Kasih Hospital has implemented a few aspects from PROPER Criteria in line with Permen LH RI no 06-year 2013. That is having an environmental permit and already monitoring less than 100% parameter that is being required inline with national quality standards.
4	Alifiani,R et al	2018	Batang District Hospital; Central Java	Green building design	Batang districts Hospital is gaining 21 point from the maximum of 43 point from GBCI category with the percentage of 28.4%
5	Miqrad	2009	Untan Hospital Pontianak	Energy efficiency	Energy consumption before LED light changes is 209,865.6 kWh per year, after LED changes it is estimated to become 106,070.4 kWh per year
6	Risnawati, et al	2015	Pertamina Hospital; Cirebon	Energy efficiency	PERTAMINA Hospital Cirebon carries out energy efficiency with decreasing air conditioner load. One of them is temperature setting optimization. This setting can save up to 5% of electrical energy. With electrical usage of air conditioner of 962,295.36 kWh and electrical tariff of 975 rupiah /kWh, so the savings of 5% is 46,11,899.00 rupiahs
7	Risnawati, et al	2015	Rumah Sakit Pertamina Cirebon	Waste	The making of Biopores Hole as an effort to maximize organic waste optimization for creating compost fertilizer. A total of 75 kg leaf waste every day produces about 45 kg compost fertilizer.
8	Mihrajhusnita, I	2014	RSUD Bendan; Pekalongan	Green building design	In terms of building and environmental aspects, Bendan Pekalongan General Hospital is included in the reliable category, it can be concluded that the Bendan Regional General Hospital Building is an Environmentally Friendly Hospital.

9	Hardyansyah, et al	2016	RSUD R. Syamsudin, SH Kota Sukabumi	Greenship building	The implementation of Green Hospital at RSUD R. Syamsudin, SH, Sukabumi City was carried out by launching an eco-friendly hospital program which includes: water saving, energy saving, waste management and eco-protection.
10	Sutanto, et al	2020	Rumah sakit Kanker Dharmais (RSKD), RSUP Persahabatan (RSUPP), Rumkital Dr. Mintohardjo (RSMTH) dan RS Mekarsari Bekasi (RSMS)	Greenship building	The results of the assessment of the status of the sustainability of environmental management are a measure of the success of the implementation of the green hospital program in Indonesia.
11.	Alatas H, Ayuningtyas D,.	2019	R. Syamsudin, SH Hospital; Sukabumi	Greenship building	Green hospital implementation in R.Syamsudin Hospital is already good enough, nevertheless there is room for improvement so that green hospital can be optimized.
12	Y. Chrisyanti, H. Suryono	2018	Ahmad Yani Islamic Hospital; Surabaya	Waste	Solid Medical Waste management in Ahmad Yani Islamic Hospital is running with the median results of 96.8%.