The planning of non-medical solid waste management at Universitas Airlangga hospital

S Hariyanto, H N Rachmayani, N Citrasari, Z A Zalika and H M Faruqi

1Environmental Science and Technology, Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Surabaya

Email: sucipto-h@fst.unair.ac.id

Abstract. This non-medical solid waste management plan aimed to draft a plan for the management of non-medical solid waste at Universitas Airlangga Hospital (RSUA), which is adjusted to the existing conditions in the hospital. Planning included the containment, collection, and type I temporary disposal site. The sampling method was carried out for 8 consecutive days based on SNI 19-3964-1994 to find out the amount of non-medical solid waste generation, composition, and density. These parameters were used to design waste containers, collection trolleys, and type I temporary disposal site designs consisting of disposal and sorting places. The mean generated value was 100.97kg/day or 0.11kg/person/day with the composition of organic non-medical solid waste 23.57 kg/day and inorganic 75.17 kg/day, and the density of 164.94 kg/m3. The planned waste containers have capacities of 5L, 10L, 15L, 20L, and 25L with 677 units in total, while the collection trolleys with 360L capacity number 28 units. The planned construction of the sorting site with length, width, and height of 3m x 2m x 1.5m each The Budget Plan (RAB) of this plan is Rp. 145,054,500.00.

1. Introduction
Hospital, as an institution in charge of providing health services to the community and place of education, cannot be separated from its responsibility for the cleanliness of its surrounding environment, which can be done by conducting waste management system [1]. Solid waste management is a systematic, comprehensive, and continuous activity that includes reduction and handling [2]. The solid waste management efforts that has been done by many hospitals focuses more on the management of medical solid waste [3]. However, the facts on the ground say that the amount of non-medical solid waste is more than the amount of medical solid waste, as reported by the World Health Organization (2007) that 80% of hospitals' solid waste is non-medical solid waste while the remaining 20% is medical solid waste [4]. The amount of non-medical solid waste is higher than that of medical solid waste, allowing non-medical solid waste to have higher risk for environmental pollution, so there needs to be a proper management of non-medical solid waste in accordance with the applicable requirements of the regulations and the Indonesian National Standard (SNI), such as Minister of Health Decree No.1024 of 2004, Government Regulation no. 81 of 2008, SNI 19-2454-2002, and SNI 3242-2008. Important elements of waste management are minimization, sorting, collection, transportation, storage, up to destruction and landfilling [5]. Based on several studies done, there are still problems of non-medical solid waste management in almost all hospitals.

Therefore, this study aimed to determine the generation and composition of waste; conducting management reviews covering the containment, collection and type I temporary disposal site, as well as to conduct management planning. Airlangga University Hospital (RSUA), which is an educational
hospital, was selected as a non-medical solid waste management planning area because it is still in one area with the campus of the Faculty of Science and Technology, Universitas Airlangga. The Universitas Airlangga Hospital also seeks to improve the management of non-medical solid waste, including containment, collection, and temporary disposal site. The preparation of this plan is expected to provide recommendations on the proper management of non-medical solid waste in accordance with the existing conditions in RSU.

2. Research Methods
Planning was performed at Universitas Airlangga Hospital, C Campus Mulyorejo, Surabaya, from December 2015 to March 2016. The equipment used was a Dacin scale with a capacity of 100 kg; 40-liter black trash bags; raffia strings; meter; documentation tools; wooden box measuring 20cm x 20cm x 100cm; cloth mask; gloves; AutoCAD software; and sketchup software. Meanwhile, the materials are non-medical solid waste generated from RSUA activities.

The planning activities started from the collection of primary data, i.e., determination of sampling point, measurement of generation, density, and composition of non-medical solid waste based on SNI 19-3965-1995 for 8 consecutive days, collection route, cost budget plan (RAB), and questionnaire with Solvin method to determine the number of respondents. The secondary data collection was in the form of the profile of Universitas Airlangga Hospital about all activities that take place in the hospital and administrative data about number of employees, number of visitors or patients, number of rooms, and number of facilities and infrastructures of non-medical solid waste management. The primary and secondary data obtained were analyzed descriptively.

Planning techniques include warehousing planning (volume, quantity, placement, and cost budget plan), collection (trolley volume, route determination, and collection time), and temporary disposal site (dimensions, construction, and cost budget plan).

3. Result and Discussion
In non-medical solid waste management planning in RSUA, solid wastes are residual or solid waste materials that are not used and disposed of [6]. The result of non-medical activities within the RSUA building include activities in the kitchen, canteen, hospital management, waiting room, bank, and learning activities.

3.1 Generation, density, and composition of waste at Universitas Airlangga Hospital
The average non-medical solid waste generation was 100.97 kg/day, while the average per person was 0.11 kg/person/day. The total generation produced by RSUA per day was 730 L. This data was obtained from the sum of solid waste generation data from activities and places in RSUA. Generation data collection was the initial stage of planning. The data was used to design a container that is appropriate to the amount and collection of non-medical solid waste. Density or ratio of weight and volume of non-medical solid waste in RSUA was 164.94 kg/m3. The density value was used to determine the volume or capacity of containers used and the area of temporary disposal site to be used. Non-medical solid waste in RSUA were organic waste at 23%, plastic at 5%, bottles at 15%, papers at 4%, cardboards at 17%, cans at 3%, residue such as tissue and oil paper at 29%, and toxic and hazardous materials at 4%. The composition of non-medical solid waste was used for collection planning.

3.2 The planning for the management of non-medical solid waste in RSUA
The planning phase of non-medical solid waste management includes planning of temporary containment, collection, and temporary disposal site in accordance with the conditions in RSUA based on prevailing standards and regulations in Indonesia, including the Decree of the Minister of Health no. 1204/MENKES/SK/X/2004, Government Regulation No.81 of 2012, SNI 19-3964-1994, and SNI
The goal of this plan is to achieve a good level of sanitary environment sanitation and avoid the disruption of non-medical solid waste generated from activities in RSUA.

1. Waste Containment

In this plan, the design of the container was made in the form of a tube with a pedal on the bottom to help open the lid without contact with hands, and stainless-based materials was used to ensure a longer lifetime. Each container will be labeled with stickers to differentiate the function of waste containers for organic or inorganic waste. The capacity of each waste container in RSUA differs, adjusted to the number of people or activity in each room. The planned waste containers have capacities of 5L, 10L, 15L, 20L, and 25L.

![Waste Containers](image)

**Figure 1.** Stainless waste containers in the market, A: 10 L and 15 L capacities. B: 25 L capacity. C: 5 L capacity (Source: Ace Hardware)

The waste container will be placed on any non-medical solid waste-generating source in RSUA. Containment by putting the trash container directly at the source is in level 1 containment [7]. In each room, the number of units of waste containers to be placed varies, depending on the needs. Rooms that could potentially produce organic and inorganic non-medical solid waste are given 2 units of containers, while those that produce only inorganic non-medical solid waste are given 1 unit of waste container. The total number of containers required is 677 units.

2. Waste Collection

The plan for the collection of non-medical solid waste was adjusted to the circumstances of the RSUA environment by taking into account the types and capacities of non-medical solid waste, time, and appropriate collection routes so as not to interfere with hospital activities, as well as considering cleaning service work hours.

The non-medical solid waste collection pattern in RSUA was planned to use an indirect pattern, i.e. collecting non-medical solid waste from each source or room using a trolley to be brought to the temporary disposal site. The collection of non-medical solid waste was done before the waste containers are fully loaded, precisely at 2/3 of the capacity of the waste containers in accordance with the Minister of Health Decree no.1204 of 2004. The non-medical solid waste collection route starts from the western building to the central part up to the east part of the building and exits the building using the easternmost door to be brought to the temporary disposal site. Collection is done 3 times a day, namely at 06.00; 14.30; and 21.00. The collection time is based on consideration of the convenience of the patients or visitors and employees, as well as the cleaning service work hours.

The recommended non-medical solid waste collection route follows the existing route, namely from the western building towards the middle chart and continued to the east side of the building.
Non-medical solid waste is then disposed through the easternmost door to the temporary disposal site. The use of the collection route is the same as the existing route, since there is no other passable route for non-medical solid waste collection operations.

The collection of non-medical solid waste for the 2nd to 8th floors uses the elevator on the east side of the building. The use of elevators for non-medical solid waste collection is done separately with patient or visitor elevator to maintain patient or visitor comfort and avoid the contact of non-medical solid waste that can transmit disease [8]. Therefore, an alternative is provided in the form of sharing the use of the elevator by sticking a sticker on the door outside the elevator to distinguish the function of the elevator.

The process of collecting non-medical solid waste uses trolleys adapted to the non-medical solid waste types found in RSUA, which are organic and inorganic, as well as their generation. The selection of trolley capacity was adjusted to the ideal trolley carrying capacity of 1.20 m³/day [9], so the trolleys selected have a capacity of 360 L. The total number of trolleys required were 28 units.

3. Personal Protective Equipment

The Personal Protective Equipment (PPE) planning for cleaning service personnel conducting non-medical solid waste collection is part of personal hygiene to reduce the risk of disease transmission from non-medical solid waste. The risk of transmission will arise during the collection of non-medical solid waste from the source until transfer to the temporary disposal site [10]. The personal protective equipment planned for cleaning service include mask, apron, heavy duty glove, and boots.

4. Temporary Disposal Site

The Temporary disposal site in RSUA have physically fulfilled the requirements of temporary non-medical solid waste disposal site according to the Minister of Health Decree no. 1204 of 2004 in the form of a rectangular permanent building with porcelain walls and equipped with a partition in the middle. The building must also be waterproof and has a cover on it. However, in practice, the temporary disposal site has not been functioned optimally. The temporary disposal site, other than functioning than as temporary storage before non-medical solid waste are transported to temporary disposal site, also acts as a regional-level processing center such as for sorting between reusable and non-reusable non-medical solid waste [7]. Therefore, there needs to be a re-planning to maximize the function of temporary disposal site in RSUA into type I temporary disposal site.

The planning conducted did not change the form of temporary disposal site because the capacity of temporary disposal site of 7,570 L is considered to be sufficient to accommodate 730 L, and the temporary disposal site is still in good condition. The alternative plans include the addition of accents at the temporary disposal site, maintenance and construction of non-medical solid waste sorting site according to type. The addition of accents is required for temporary disposal site, namely the pallet to be placed in front of the temporary disposal site, which serves as a cleaning service or the Cleaning and Landscaping Agency's officer's footing at the temporary disposal site so as not to be exposed to water from the remains of water bottles. Maintenance planning includes discharge and cleaning of temporary disposal site in RSUA. The emptying of temporary disposal site in RSUA should be done daily in accordance with the requirements of temporary disposal site in the Minister of Health Decree (2004) to avoid the decay of organic non-organic solid waste that can cause unpleasant odor, thus inviting animals (flies and cats) [11]. The cleaning of temporary disposal site in RSUA is planned to be done every time it is emptied using disinfectant with 0.5% chlorine, then rinsed with clean water according to WHO recommendation (2005) and the Minister of Health Decree no. 1204 of 2004 [5].

From the data composition of non-medical solid waste in RSUA, it is known that many components of the waste that can still be reused. The reuse of non-medical solid waste can help
reduce the burden of non-medical solid waste that is transported to the landfill. Therefore, there is a need for type I temporary disposal site planning by adding a sorting point. The planned sorting site has an area of 2m² x 3m² with 1.5m height. This is because the unavailability of a wide enough area. In addition, this sorting site is only intended for sorting only without the recycling process. Buildings are made permanent with porcelain-plated walls in accordance with Minister of Health Decree No.1204 of 2004. Around temporary disposal site and sorting places, Sansavieria sp. or snake plant will be planted, which serves to reduce odor and convert toxic substances into organic compounds, sugars, and amino acids, and can absorb carbon monoxide gas generated by 6.92% for 0.5 hours [12].

![Figure 2](image_url)  
*Figure 2. Design of non-medical solid waste sorting facility at Universitas Airlangga Hospital  
(Source: Private Picture)*

5. Bill of Quantity and Budget Plan (RAB)  
The Budget Plan (RAB) for this plan is based on the amount of material needed for each material or supporting equipment. The price of each material is adjusted to the price in the planning year of 2016. The containment plan requires an expense of Rp. 98,166,500.00 and the collection requires a fee of Rp. 3,602,000.00, so the total cost of planning is Rp. 145,054,500.00.

4. Conclusion  
Based on the results, it can be concluded that:

1. The generation of non-medical solid waste in RSUA was 100.97 kg/day, whereas the average generation per person per day was 0.11 kg/person/day. The total generation was 730 L. The composition of non-medical solid waste in RSUA waste 29% residue; 23% organic waste; 17% cardboard; 15% bottle; 5% plastic; 4% paper; 4% cans.
2. The management (storage, shelter, and temporary shelter) of non-medical solid waste in RSUA has not complied with the relevant requirements and regulations.
3. The planning of non-medical solid waste management was done with containment using pedalled containers made from stainless steel. The planned container capacities are 5 L, 10 L, 15 L, 20 L, and 25 L. The planned collection activities will be done 3 times daily with existing routes, since no other routes can be used for waste collection operations. The non-medical temporary disposal site is planned to be of type I, equipped with sorting and storage sites. The temporary disposal site is given a wooden pallet on its footing.

5. Acknowledgements  
The authors would like to thank the Solid Waste Team, Environmental Science Technology Program, Department of Biology, Faculty of Science and Technology, Universitas Airlangga; as well as Universitas Airlangga Hospital (RSUA), which has helped the process of this research.
References

[1] Tsakona, E. M., Angnostopoulou, E. Gidarakos. 2006. Hospital Waste Management and Toxicity Evaluation: A Case Study. Waste Management Vol 27 (7): 912-920

[2] Undang-Undang Republik Indonesia. 2008. Nomor 18 tentang Pengelolaan Sampah

[3] Amin, R., Gul R., Mehrab A. 2013. Hospital Waste Management; Practices in Different Hospitals of Distt. Peshawar. Professional Med J. Vol 20 (6): 988-994

[4] World Health Organization. 2007. Waste from Health-Care Activities October 1, 2011. www.who.int. Diakses pada tanggal 29 September 2015

[5] World Health Organization. 2005. Management of Solid Health Care Waste at Primary Health Care Centers. www.who.int. Diakses pada tanggal 29 September 2015

[6] Tchobanoglous, G., Theissen, H., dan Vigil, S. 1993. Integrated Solid Waste Management: Engineering Principles and Management Issue. McGraw-Hill, Inc., Singapore

[7] Damanhuri, E. & Padmi, T. 2010. Pengelolaan Sampah, Diktat Kuliah TL-2014. Program Studi Teknik Lingkungan. Institut Teknologi Bandung

[8] Pruss, A. J., Giroult, E., dan Rushbrook, P. 2005. Pengelolaan Aman Limbah Layanan Kesehatan, (diterjemahkan oleh: Munaya F., Mulia S., dan Ela L), EGC, Jakarta

[9] Yunizar, A. & Fauzan, A. 2014. Sistem Pengelolaan Limbah Padat Pada RS.Dr.H.Moch.Ansari Banjar Saleh Banjarmasin. Vol. 1 (1): 5-9

[10] Colony, S. 2001. Hospital Waste Management at AMF. www.SMF-HospitalWasteManagement.htm. Diakses pada tanggal 5 Oktober 2015

[11] Keputusan Menteri Kesehatan Republik Indonesia. 2004. No.1204/MENKES/SK/X/2004 tentang Persyaratan Kesehatan Lingkungan Rumah Sakit

[12] Adita, B. R. C. & Ratni, J. A. R. N. 2012. Tingkat Kemampuan Penyerapan Tanaman Hias dalam Menurunkan Polutan Karbon Monoksida. Jurnal Ilmiah Teknik Lingkungan. Vol. 4 (1).