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BUILDING SUSTAINABLE WASTE MANAGEMENT BASED ON ENVIRONMENTALLY FRIENDLY BEHAVIOR IN HEALTHCARE INDUSTRY: A SYSTEMATIC REVIEW

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ABSTRACT

Establishing sustainable waste management in healthcare industries is challenging as the social, economy, environmental dimension in the sustainability needs to be complied. However, prior studies have proposed indicators to build the sustainable waste management without addressing a systematic manner leading to bias and considering the environmental dimension to drive stakeholder's behavior. This study aimed to determine how environmentally friendly behavior affects the sustainable waste management in the healthcare industries. There were 874 articles collected from the databases consisting of PubMed, Sciencedirect, Scopus, SAGE and Ebscohost after removing the duplicates and 8 articles claimed to meet the inclusion criteria. The environmentally friendly behavior is driven by stakeholders' consciousness towards environmental practices, strong belief, awareness, knowledge and perception. The behavior needs to be reinforced by regulations and institutions and improved by training and education in order to develop the sustainable waste management. Theoretically, this study contributes to sustainable waste management by addressing more on environmentally friendly behaviors of all actors. In managerial implication, this study also offers considerations for firms on the areas which need to be improved to gain sustainable practices.

Keyword: **Environmentally, Management, Sustainable Waste, Healthcare Industry**

ABSTRAK

Membangun pengelolaan limbah berkelanjutan dalam industri kesehatan sangat menantang karena dimensi sosial, ekonomi, dan lingkungan dalam keberlanjutan perlu dipatuhi. Pada kenyataannya, penelitian – penelitian sebelumnya membuat tolok ukur untuk membangun pengelolaan limbah yang berkelanjutan tanpa mempertimbangkan cara sistematis yang mengarah pada bias dan mempertimbangkan dimensi lingkungan untuk mendorong perilaku pemangku kepentingan. Penelitian ini bertujuan untuk mengetahui bagaimana perilaku ramah lingkungan mempengaruhi pengelolaan limbah berkelanjutan di industri kesehatan. Terdapat 874 artikel yang dikumpulkan dari basis data meliputi PubMed, Sciencedirect, Scopus, SAGE dan Ebscohost setelah duplikat dihapus dan 8 artikel diklaim memenuhi kriteria inklusi. Perilaku ramah lingkungan didorong oleh kesadaran pemangku kepentingan terhadap praktik lingkungan, keyakinan, kesadaran, pengetahuan dan persepsi yang kuat. Perilaku tersebut perlu diperkuat oleh regulasi dan kelembagaan serta ditingkatkan melalui pelatihan dan edukasi dalam rangka mengembangkan pengelolaan limbah yang berkelanjutan. Secara teoritis, penelitian ini berkontribusi pada pengelolaan limbah berkelanjutan dengan membahas lebih lanjut tentang perilaku ramah lingkungan dari semua pihak. Implikasi praktis, penelitian ini juga menawarkan pertimbangan bagi perusahaan di bidang terkait hal-hal yang perlu ditingkatkan guna mendapatkan praktik berkelanjutan.

Kata Kunci: **Lingkungan, Pengelolaan, Limbah berkelanjutan, Industri Kesehatan**

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Introduction

Indonesia has challenges in establishing the sustainable waste management (SWM) as a part of creating sustaining smart cities (Mahesa et al., 2019). The presence of waste management requires its managers to be committed in ecosystem stability protection. Particularly, the SWM needs a profound handling procedure when it is concerned with hazardous and infectious substances which generate issues on social and environment. The most common problem is concerned with technological performance specifically with how hazardous wastes are treated (Ansari et al., 2019). The implementation of technology requires to be supported by social performance including the availability of policy and regulations from the

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government and economic performance covering costs for developing waste treatment facilities (Nevrlý et al., 2019). The SWM regulation needs to be fulfilled and monitored as the regulation compliance reduces harmful impacts of waste handling personnel (Su and Chen, 2018). The waste handlers also demand more serious attention as hazardous materials generated form wastes affect their safety. Indeed, developing the SWM demands preparations and involves complicated attributes.

SWM is a complex problem since the technology use has taken a multi-criteria decision analysis and its assessment complies the sustainability principles (Khan and Kabir, 2020 and Lee et al., 2016). The complexity of SWM implementation emerges as it requires strategies along with their risks among stakeholders (Xu et al., 2020). Stakeholders have to take into account any possible emerging risks that workers encounter and these risks relate to the safety of workers. In fact, the issue on occupational safety of waste handling workers is not specifically addressed in prior studies. For instance, Kumar and Samadder (2017) stated economic performance is an ideal determinant to select waste-to-energy power plants. Kontogianni and Moussiopoulos (2017) claimed the waste workers' conditions in terms of hard skill and soft skill, educational background, environmental behavior influence the SWM assessment. Fetanat et al. (2019) suggested the selection of waste-to-energy technologies to SWM depends on social and environmental aspects. However, prior studies are lacking the integration in relating all sustainability principles.

Numerous study papers document sustainable waste management in healthcare industry, but none has provided the results in the form of a systematic review showing environmentally friendly behavior and sustainable waste management. The overall objective of this review was to address this by evaluating the environmentally friendly behavior from stakeholders and institutions. The aims were to review the environmentally friendly behavior, to explore its association with other sustainability principles in the waste management, and to evaluate the sustainable waste management applied in healthcare industries. For the contribution of this study, theoretically the systematic review highlights environmentally friendly behavior to support waste management in sustainable manners. In the basis of establishing behaviors oriented in the environment, this study offers industries sustainable practices which require to be implemented such as trainings aimed at developing environmental concern of all actors.

Literature Review

Sustainable Waste Management

Rolewicz-Kalińska (2016) proposes that the SWM can appropriately be established on a framework highlighting efficient logistics of waste and the balance between the medical waste generation units and treatment facilities. Das et al. (2019) sugest some main issues regarding sustainable waste management, waste generation, waste transport and logistics, waste treatment during which some challenges are found like energy consumption, skilled labor, disposal, footprint. The issue of SWM encourages healthcare services to minimize their generated wastes and partially recycle them in favor saving both the resources of

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environment and assets of finance (Zamparas et al., 2019). Saeidi-Mobarakeh et al. (2020) argues conducting a supervision towards the process of SWM and obtaining precise knowledge on both quality and quantity of wastes improve the process of medical waste management. Hong et al. (2019) argue that medical wastes are treated and managed in a way which exhibits the lowest environmental impact or low environmental burden. Thus, SWM can be defined as a process to manage the medical wastes, hazardous or non-hazardous, from waste separation to final stage of waste management taking into account the principle of sustainability including social performance.

The social performances are concerned with environmentally friendly behavior of waste workers, stakeholders, and policy for the waste management. Ibáñez-Forés et al. (2019) propose working rights and benefits, professional development, equal opportunities, health and safety. The implementation of workers' health and safety represents the implementation of behavior which conforms the environment concern (Siew et al., 2019). Safety and health have become the main goal of waste treatment assessment and the basis to determine the selection of waste treatment facilities (Mishra et al., 2020). The assessment is not only addressed to the facilities, but for the entire process of quality management as well by adapting the cleaner production policy (de Oliveira Santos et al., 2020). Sovacool et al. (2017) claim the equality of all groups needs to be taken into account. Every individual is entitled to have less health impacts of environmental problems yielded from any waste treatments. The social aspects like their behavior are considered in the process of decision making on a new policy of waste treatment (Fetanat et al., 2019). Shams et al. (2017) suggest the need for reviewing the waste management policy since there is an urgent driver to enforce the policy for the producer of waste. The reduce-reuse-recycle principle is promoted in the formulation of the policy addressing the waste separation as the main first step for attaining the sustainable waste management. Chowdhury et al. (2020) indicated the need of a collaboration between stakeholders for the recycling technologies leading to low cost technologies. However prior studies lack of addressing the assessment of environmentally friendly behavior in relation to SWM.

Research Methods

Search Strategy

The words 'sustainable waste management', 'environmentally friendly behavior', 'healthcare industries', and 'hospitals' were put into the search field specifying five databases: PubMed, SAGE, Science Direct, Scopus, Ebscohost. Limiters were activated consisting of English language, peer-reviewed journal, indexed by reputable rankings, country and city mentioned in the paper. An advance search on PubMed with the same words employing a time limit of January 2011 to December 2020 resulted in 4 articles. Using the same parameters, the total of articles in SAGE from January 1955 to December 2020 was 571; the total in Science Direct from January 2004 to December 2021 was 142; in Scopus ranging from January 2006 to December 2021 was 90; in Ebscohost limited to January 2011 to December 2020 was 15. Overall, those parameters lead to a total of 923 articles

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resulted from this, reduced to 874 automatically after duplicates were removed; 65 articles were selected for further analysis, and out of these 8 remained based on the study inclusion and exclusion criteria. Altogether, this extensive search yielded 8 relevant papers that were included in the units of analysis for this systematic review (Figure 1).

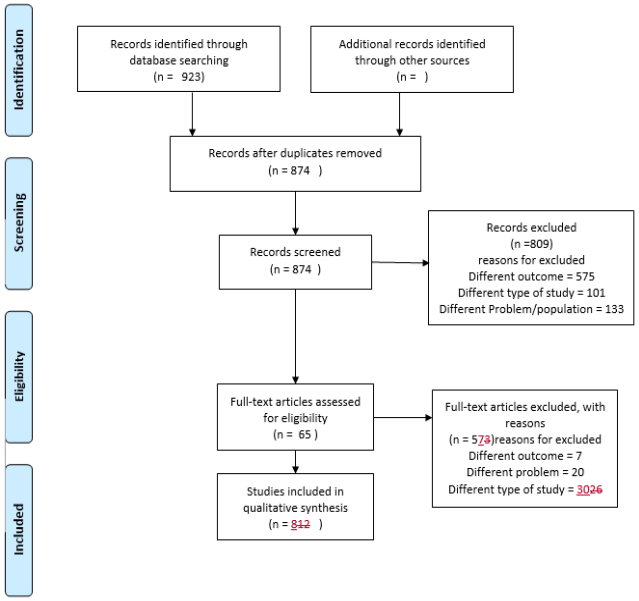

Figure 1. Flowchart of The Study Selection Process
Source: Researcher Analysis

Inclusion Criteria

Certain criteria had to be met before a study was included in the units of analysis:

a. It had to answer the research questions;
b. For the assessment of environmentally friendly behavior, the study had to have used the study design including quantitative non-interventional, cross sectional, quasi experimental, narrative literature review;
c. Study type had to be an original research paper having clear methodology;
d. Published between January 1955 and December 2021;
e. Published in the English language.

Quality Assessment

All the papers before further analysis needed to be assessed according to the Joanna Briggs Institute's critical appraisal tool (the JBI assessment). The JBI tool is required to reduce bias, comprehend the systematic reviews, and present the diversity in an easy approach. In this study, the JBI could exclude four articles that had already been included in the final process due to the lack of sufficient method. The JBI – Cross sectional studies resulted in 3 articles; The JBI – qualitative yielded 3 articles; the JBI – Quasi experimental studies included 1 article; the JBI-narrative review was 1 article, see table 1.

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Table 1. Data Extraction Representing Unit of Analysis

Year	Author(s)	Title	Findings			
			Environmental Friendly behavior	Based on Perspective		
				Social	Economy	Environment
2014	Goonan et al.	Getting a taste for food waste: A mixed methods ethnographic study into hospital food waste before patient	• More conscious on waste from cooks and supervisors. • No re-use of bulk food left over at the tray line.	• Lack of portion control contributes to plate waste. • Dissimilar perception of portion control. • Unpredictable nature of hospital environment such as turnover patients and seasonal variability. • More training on staff. • Need for communication value	• Financial benefit for waste reduction	• Greening trend of wider food service is a concept.
2007	Tudor, T. L., Barr, S.W., Gilg. A.W.	Strategies for improving recycling behavior with the Cornwall National Health Service (NHS) in the UK	• Waste management is not viewed as a part of employee's role but other's responsibility • Employees are encouraged to buy a recycled product that affects cost saving. • Holding pro-environmental attitudes and strong belief to the benefit of recycling. • The inability of organization to integrate behavior with environmental and economic consequences, affects the environmental behavior.	• Behavior supports habit in building waste management. • Information should be provided to increase awareness. • Low motivation from the employees. • Belief influences behavior towards more sustainable practices. • low Actual recycling levels • Staff recycling behavior related culture of organization. • Sustainable practices need to be in line with policies, practices. • Management support is needed. • Employee involvement • Effective communication, • Improved waste management behaviors serve as a means to encourage employee	• Income is increased by meeting health-related targets. • Devoting money to environmental concern is difficult for managers.	• 40-50% wastes in the domestic stream are recyclable items • Major items are mixed paper, food organic materials. • 50% wastes in the clinical waste stream include paper/cover from surgery table, glove, packaging materials.
2018	Chang et al.	Identifying critical factors of sustainable healthcare institutions' indicators under Taiwan's National Health	Behavior should be included in the corporate citizenship	• Corporate governance, clinical performance, service to patients	• Supply chain • Brand management	• Environmental task should be conducted. • Energy and environmental design contributes to more efficient energy use. • Environmental improvement contributes to a more sustainable approach
2018	Gunawardana, K.D.	An analysis of medical management practices in the health care sector in Colombo	Awareness of the working staff contributes to waste management practices	Attitude of top management affects medical waste practices	NA	Technology level of organization affects medical waste treatment
2021	Carino, S., Collins, J., Malekpour, S., Porter, J.	Environmentally sustainable hospital foodservices: Drawing on staff perspective to guide change	• Packaging that involves one-time use of plastic should be considered. • Food waste digesters, chemical free kitchens are encouraged due to water technology use. • On the foodservice model menu is applied by the time between ordering and elivery.	• Food waste audit and research. • Staff vocal; organic waste recycling. • The need of media to sustainability issues. • Infection control requirements hinder the reuse of unopened individually packaged foods. • Education, knowledge and training. • Policy maker. • Repurposing untouched food for food insecurity. • Engaging more non-governmental organizations. • A systems thinking approach • A holistic vision of health	• Limited funding to drive dedicate environmental sustainability role	• Recycling of large items. • Shelf stable waste project • Innovation by waste management company to increase ease of segregation

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Year	Author(s)	Title	Environmental Friendly behavior	Findings Based on Perspective		
				Social	Economy	Environment
2017	Furukawa, P.O., Cunha, I.C.K.O., Pedreira, M.L.G.,	Characteristics of nursing professionals and the practice of ecologically sustainable actions in the medication processes	• Lack of knowledge regarding the actions that affect cost and environmental damage. • Improper practice in separating medical waste due to unawareness of rules.	• The education level affects sustainable practices. • Age and gender, working experience are found to be not correlated with sustainable practices. • Intervention, awareness and training about environmental issues. • Intervention, knowledge of waste management is affected by training presence.	• NA	• NA
2018	Baaki, T. K., Baharum, M.R., Ali A. S.	Determining a conceptual framework for safe and sustainable-health care waste management (SSHCWM) implementati-on healthcare facilities	• Behavioral change of individuals is driven by their knowledge and perception leading to intention to segregate wastes, conserve materials, reuse materials.	• Government intervention in Regulations, policies, technical guidelines direct the waste management into sustainable manners in national and international level. • Stakeholders in waste management need to recognize their roles and interact to strengthen network. • Training and education influence (SWM) implementation • Occupational health safety and public health	• Sustainable assessment is focused on finance in line with strategic focus. • Facilities are viewed as cost centers. • The commitment of financial resources and adequate finance are required to achieve the SWM. • Direct cost of supplies, training cost, operation cost, contractor services	• An environmental management system is needed as a tool to improve and implement environmental performance. • Lifecycle analysis is implemented to reduce the environmental impacts in a holistic approach starting from product selection, use, disposal, to environmental and community impact. • Environmental performance use a matrix indicator consisting of waste prevention rate, percentage of proper segregation practices, percentage of treated or disposed wastes.
2018	Bratton, A.	The role of talent development in environmentally sustainable hospitality	• The environmental behavior of employees is supported from the environmentally sustainable conference center. • The pro-environmental behavior through activities like decarbonizing efforts, discussions integrated into formal training.	• The role of organizational leaders • Work teams to develop organization's sustainability strategy. • Sustainability criteria in the decision-making process. • The environmental management training • Talent development	• Operating cost can be reduced by lower carbon consumption. • Efficiency savings are incorporated with the organization culture.	• The core environmental management area like waste and recycling support employee pro-environmental behavior.

Source: Researchers Analysis

Result and Discussion

Result

A total of 8 papers considered relevant and appropriate based on the study inclusion and exclusion criteria were taken into account in this review. Table 1 summarize these papers.

Findings on Environmentally Friendly Behavior

The healthcare institution supports its employees' environmental behavior (Bratton, 2018). The support can be in the form of training program offered by the management to increase employee's environmental behavior that affects environmental behavior. The management establishes trainings and programs. New employees and managers who have environmental knowledge in waste

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management are recruited. Environmental behavior from employees in the waste management motivates waste reduction, energy saving, recycling process and demand to be supported by policies (Bratton, 2018). The behavior is also affected by the knowledge and perception towards sustainable development (Furukawa et al., 2017).

Environmental behavior is represented from waste reduction, recycling behavior and participation that is incorporated with organizational policies. Waste management stakeholders consisting of professionals, support staff, administrative staff, management in all levels, medical staff must determine the result of performing this behavior. Organizational culture needs to reinforce all of stakeholders to hold environmental belief and attitudes toward sustainable waste management (Tudor et al., 2007). Training and development are provisional to staff as a part of reinforcement promoting environmental attitudes. The training involving learning process is viewed as a major intervention to enhance environmentally friendly behavior (Bratton, 2018). Employees and waste handling workers are encouraged to participate in sustainability programs and training for developing their motivation. The programs aim at reducing environmental burden and increasing employee's environmentally friendly behavior. The implementation of training is a vital key in promoting environmental behavior. Training is expanded to include waste management plan, risks, protective measures, role and responsibilities, and technical issues. It is offered to policy decision makers (Gunawardana, 2018).

Findings on Sustainable Waste Management

Sustainable waste management is hardly achieved due to lack of awareness, lack of resources among waste management workers toward environments (Gunawardana, 2018). Education, training, and knowledge sharing are viewed enabling factor in sustainable waste management. Waste management contractors support trainings by providing guidance and sufficient resource (Carino et al., 2021). Best practice guidelines facilitate knowledge transfer for healthcare and medical institution staff to reduce the knowledge gap. Top management requires positive attitude toward environmental issue in waste management. There is a significant relationship between the top management attitude and waste management practices. The waste management is determined by the facilities and treatments provided by each institution (Gunawardana, 2018). Sustainable waste management can be implemented by improving production efficiency and awareness on waste management. The waste management must employ waste treatment technologies that take into account environmental concern. This is strengthened by national legislation. To establish SWM people and communities are encouraged to be engaged in sustainable development practices. For example, individuals are required to properly segregate waste and carefully place wastes in a domestic or medical waste bin which may consist of large number of wastes considered domestic-type waste (Baaki et al., 2018).

For the social aspect in SWM, an integration between regulations, policies and stakeholders is needed. Every stakeholder in the SWM is aware of their roles including policy makers, healthcare officers, healthcare and medical top

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management, staff, patients, relatives, health product suppliers, academia, international and national funding bodies (Baaki et al., 2018). In the economic aspect, lack of budget becomes the vital factor affecting SWM; thus there is a strong financial resource commitment.

In the environmental aspect, life cycle waste management evaluate the environmental performance of waste management. This performance considers environmentally friendly disposal options, environmentally friendly treatment options, waste generation and segregation (Baaki et al., 2018). Sustainable practices show less environmental considerations in waste management (Goonan et al., 2014). Managers in healthcare industry are not concerned with environmental impact of waste. The focus of waste management relies more on training issues than environment. Despites non-hazardous and infectious wastes, all waste management system need to meet the measurement standard that is acknowledged waste handling workers. Medical waste management is an indicator of environmental performance in healthcare institutions incorporating waste sorting, waste reduction, waste recycling, and hazardous waste management and viewed as one criterion to evaluate sustainable healthcare institution.

Discussion

The environmentally friendly behavior are driven by stakeholders' consciousness towards environmental practices (Goonan et al., 2014), strong belief (Tudor et al., 2017), awareness (Gunawardana, 2018), knowledge and perception (Furukawa et al., 2017). The behavior needs to be reinforced by regulations and institutions (Baaki at al., 2018 and Carino et al., 2021). Training for individuals and staff affects the sustainable practices and behavior in implementing the sustainable waste management (Bratton, 2018; Carino et al., 2021; Furukawa et al., 2017; Goonan et al., 2014; Tudor et al., 2007). The financial support from institutions is considered difficult, limited and demanded to be adequate to establish the SWM (Baaki et al., 2018; Carino et al., 2021; Tudor et al. 2007).

Building the environmentally friendly behavior in the institution has to comply the environmental indicators covering life cycle analysis, environmental management system and incorporate technology innovation (Carino et al., 2021 and Baaki et al., 2018). The environmentally friendly behavior is more focused on the social dimension than the economic and environmental dimension. Recycling behavior for non-infectious wastes is encouraged in the SWM (Bratton, 2018; Carino et al., 2021; Tudor et al., 2007). The environmentally friendly behavior results in a large development in the social dimension of sustainable waste management, but a slight improvement in economic and environmental dimension.

SWM is well-implemented in the healthcare institutions if there are environmentally friendly behavior managed by government policies and rules that regulate SWM. The policies and rules should convey detailed information covering environmentally friendly behavior in supporting waste management. For the social aspects, the policies provide manuals about environmentally friendly practices for all of human resources who handle medical wastes from the beginning process to the final process. The training and skills for SWM should be listed in detail in order to make the risks of inappropriate behavior well-acknowledged by the health

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workers. The policy presents the details of costing for the SMWM that the healthcare institutions should prepare. In addition, the policies and rules are set based on the evaluation of the current waste management; they need to be improved or revised on the basis of evaluation which varies from one country to another country. The revised policies and rules are addressed to capture the lacks in managerial skill, operational skill, containers to accommodate and segregate wastes. The government should consider to arrange specific policies if healthcare institutions apply recycling process.

Conclusion

The findings of the study suggest that increasing environmentally friendly behavior of waste workers can be implemented in other medical and healthcare industries that receive greater funding from either national or international institutions to generate SWM. This study implies that improving environmentally friendly behavior enhances SWM. This study identifies stakeholders' consciousness, belief and knowledge as attributes to develop friendly behaviors and these can be used as a tool to improve SWM. The results can be applied to facilitate stakeholder participation in proper waste treatment and green practices to enhance social performance and lead to SWM.

Limitation

Some main limitations are worth addressing. First, all of studies have not presented quantitative data or statistical number regarding environmentally friendly behavior that contributes to sustainable healthcare waste management. Some discussed this behavior employing a qualitative approach. Second, less studies related the environmentally friendly behavior with the environmental aspect of sustainable waste management and more studies associated it with the social aspect. Third, the number of reviewed articles is small; thus, the results of review cannot be overgeneralized. Fourth, there is a limited number of databases covering management and health issues. However, these limitations may not have significantly affected the overall findings offered that environmentally friendly behavior contributes to the social aspect despite the economic aspect and environmental aspect. The fact that this systematic review involves 8 articles can be considered a limitation. It is expected that this paper encourages more studies in the similar area.

Sugestions

Healthcare industries such as hospitals, clinic, health funding bodies, health center and others are obviously responsible in developing their waste management that meets sustainable principles. Generally, these industries increase the number of trainings and programs for stakeholders like waste handling workers, employees, and top management. Such trainings and programs aim at enhancing the awareness toward sustainable waste management which later affects the stakeholders' environmentally friendly behavior. Healthcare industries are necessary to ensure that their employees and top management resources perform such a behavior not only at the institutions, but also at their home.

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Implications

This study contributes to the healthcare industry as it provides a systematic review that can be considered in the first stage of establishing SWM through waste workers' behavior. The healthcare industry should elicit government support for a successful implementation. In addition, SWM prevents waste and promotes the reuse of natural resources built on basic recycling, reuse and reduction principles; for instance, the government plays an important role as the top level of management in SWM through policies and rules to improve social performance. SWM manuals providing detailed information on all aspects of SWM should be created and disseminated to all stakeholders in healthcare institutions. In addition, financial support from the government is anticipated and should be prepared to initiate SWM. Incentives should be given to any medical and healthcare industry to successfully improve SWM implementation. In the current system, SWM actions can be offered that are environmentally friendly, which might reduce the disposal of hazardous materials in the environment. Participating in SWM activities and organizing conservation activities in the industry are a good remedy for environmental improvement.

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