



Experiences in Dealing with Medical Waste: A Meta-synthesis

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Abstract

Background: Health care staff may experience in dealing with medical waste in their health care activities. The experiences are various and challenging, ranging from producing the waste to disposing of it. **Objectives:** This study aimed to analyze and synthesize the findings of existing qualitative researches related to experiences of health care staff in dealing with medical waste. **Methods:** This meta-synthesis collected recent research published from 2013 up to 2019. The articles were searched using online databases: Proquest, EBSCO, CINAHL, Springer, and Pubmed. The keywords using in the search were medical waste, hospital waste, health care waste, healthcare professionals, healthcare workers, and qualitative. There were 381 articles found from the search. Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research was used to assess the articles. Six articles were finally included and synthesized using the meta-ethnographic approach. **Results:** Three themes emerged from the study: consequence of health care, ways to handle medical waste, and obstacles in managing medical waste. **Conclusion:** Medical waste is inevitable and collaboration, as well as cooperation among health care staff and stakeholders is needed to manage medical waste properly.

Keywords: Experiences, Health Care, Medical Waste, Meta-synthesis, Qualitative

1. Introduction

Medical waste or health care waste covers any waste produced from health care activities in health care facilities such as hospitals or clinics, laboratory and health care provided at-home care settings¹. Generally, medical waste consists of non-infectious and infectious waste. Non-infectious waste generated from the supporting units in a health care setting such as administrative, kitchen and housekeeping functions. The waste is also from packaging waste as well as waste generated from the maintenance of health-care facilities. Conversely, infectious waste comprises waste of body fluids (e.g., blood, vomit, feces or urine), contaminated sharp instruments (e.g., contaminated syringe, needles and surgical instruments), pathological waste (such as tumor or cancer tissues), laboratory waste (e.g., cultures media) and disposable equipment². Infectious waste is around 25% of all the waste produced in health care healthcare setting particularly hospital which must be managed carefully and cannot be disposed of with the non-infectious waste because infectious waste can be of high risk to the hospital staff and the patients, as well as environment, especially in countries where proper medical waste management are not followed strictly³.

Many parties involved in producing, collecting and disposing of medical waste. In health care facilities, infectious waste is produced by activities performed by physicians, nurses, midwives or other health care professionals. The waste is collected and handled by the cleaning staff. The waste then is disposed of using an incinerator or delivered to another party which is appointed to dispose of the waste. Policy makers of health care facilities are also involved in managing medical waste through making some policies related to it such as making regulation, financing and controlling the waste. However, the parties involved in medical waste management are responsible for medical waste management. Improper medical waste management has negative effects on the general public, patients, health care workers, waste pickers, and scavengers⁴ a new primary health care (PHC).

Existing studies related to medical waste mostly conducted quantitatively and particularly aimed to explore common topics such as variation of the waste, evaluate protocols, awareness of health care workers or practice of medical waste management⁵⁻¹⁴ waste was being segregated using color coding. Collection was timely and from all areas. Transportation in uncovered trolleys from within the hospitals 3 (50%). A few qualitative studies have been conducted related to how health care staff

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experiencing involved in dealing with medical waste^{2-4,15-17}. No study is found related to the synthesis of qualitative study related to how health care staff dealing with medical waste. Knowing the experiences of the staff involved in dealing with medical waste is important to gain an understanding of how they view medical waste in their activities. The understanding is needed to provide and improve proper medical waste management.

The objective of this meta-synthesis was to analyze and synthesize findings from existing qualitative studies about experiences of health care staff in dealing with medical waste. Meta-synthesis was chosen since it is aimed to develop a new knowledge-based on systematic methods by analyzing existing qualitative research findings of the phenomenon studied¹⁸.

2. Methods

The meta-ethnographic approach developed by¹⁹ was used this meta-synthesis. The meta-ethnographic approach was selected since it is well described and used widely among meta-synthesis¹⁸. Seven phases of the approach as following¹⁹:

Phase 1: Get started. In this phase, researchers determine an area of interest that is worthy to be synthesized.

Phase 2: Decide what is suitable for the interest which covers a literature search based on criteria.

Phase 3: Read the studies. It involves reading and rereading the articles to identify the main concepts and metaphors in each article.

Phase 4: Determine how the articles are related. In this part, researchers make a list of key phrases, concepts metaphors and ideas from the articles. The metaphors of the articles are compared and combined.

Phase 5: Translate the studies into one another. The phase involves translating the key concepts from the pool of studies into one another. These concepts or categories are synthesized into a whole.

Phase 6: Synthesize translations. In this step, the researchers make the parts of each study into a whole through the synthesis of the information.

Phase 7: Express the synthesis. The researchers write up and report the results in a publication.

In phases 1 to 3, the experiences of health care staff dealing with medical waste were selected as the area of interest. A qualitative research article search was conducted using online databases: Proquest, EBSCO, CINAHL, Springer and Pubmed. The keywords using in the search were medical waste, hospital waste, health care waste, healthcare professionals, healthcare workers and qualitative. Only recent research published from

2013 up to 2019 and in English would be collected. There were 381 articles found from the search. The authors checked abstracts of the articles and 28 articles were included in the next step. Joanna Briggs Institute Critical Appraisal Checklist for Qualitative Research²⁰ was used to assess the 28 articles. Finally, 6 articles were included and synthesized. Two articles had similar authors and year of publication but these articles were included since the articles had different study, purposes, participants, methods and results. The six studies were conducted in diverse countries, namely the United States, India, Pakistan and South Africa (see Table 1).

Phase 4 was applied by inserting all of the key metaphors, phrases, ideas, themes and concepts from the selected articles in a table (see Table 2). Those were compared and combined. Relationships among them were assessed. Phase 5 applied by translating the selected studies into one another through comparing themes and metaphors as well as key concepts into one another. Phase 6 was conducted by synthesizing the translations. In phase 7, the findings were expressed by writing this publication.

3. Results

There were 266 participants in the 6 studies. Three themes emerged from those studies: Consequence of health care, ways to handle the waste and obstacles in managing medical waste. The themes are interrelated in and between the studies.

The consequence of health care is expressed in two of the articles. Health care activities produce waste such as used gloves that are used by health care workers when delivering care to the patients, used bandages and soiled linen which is contaminated with body fluids (such as urine, sputum, pus, or blood)¹⁵ community health workers (CHWs). Furthermore, health care activities do not only produce material waste, but also waste in other forms, such as time, energy and talent, as one said:

“It’s time. It’s time. It’s our biggest wasted resource... our biggest waste of opportunity.”¹⁷

Ways to handle the waste reflect efforts of the health care workers to deal with medical waste. Four studies expressed the theme in various ways. In some government-owned health care institutions, waste management services are free and handled professionally by hospital workers or medical waste management company. A study found that medical waste was treated similar to and together with waste produced from activities at home. Another study revealed involving community members in managing medical waste was believed as an appropriate way to handle it. The selected members worked as waste management contractors.

Contractors were given instructions on how they should work:

“Yes they sign a contract document that binds them on how to work. It is a very thick document that constitutes what they are supposed to do and how and what is expected of them and their staff.”⁴ a new primary health care (PHC).

Obstacles in managing medical waste were used to depict any problems in medical waste management practice. The obstacles such as slow training, poor safety of the workers, low budgeting, supervision, monitoring, and co-ordination. Director of a hospital said:

“Needle prick injuries are the most common hazard during infectious waste management at our hospital.”²

4. Discussion

In providing health services, health care professionals use various kinds of medical equipment after health care is given will become medical waste. Almost all activities that use disposable medical devices will produce medical waste. This waste must be managed properly so that it will not cause problems for the health workers themselves and also for others or the community at large. Medical waste is different from household activity waste or other kinds of waste. Medical waste can contain various liquid products from a diseased human body that may contain germs, bacteria, or viruses that can be transmitted to others²¹. Therefore medical waste management should be viewed seriously by the management of hospitals or other health care institutions so that medical waste does not become a source of problems in the institution.

Waste management from collection to destruction must be carried out by applicable standards so that the risk of spreading the disease can be avoided²². Both wastes from services in health care facilities or health services in the community together produce medical waste that has the same risk of spreading disease²³. The participation of all parties to medical waste needs to be improved so that public health can be maintained and the spread of disease due to negligence in managing medical waste can be avoided.

The waste from health was not only in the form of solid, liquid or gas but also time, energy and talent. It can be concluded that medical waste is not only tangible such as solid, search, or gas but also intangible such as time, energy, and talent¹⁷. Wasted time is considered as the time that is wasted such as time to wait for procedures or wait for staff who haven't arrived, time to look for equipment that hasn't been found or time to move an appliance or patient. Wasted energy is also considered as waste that can be avoided such as wasted energy

because equipment that uses electric instruments is not turned off when these are not used in health care. The talent that is not utilized properly is considered as talent waste such as interventions done by health workers under their expertise. All types of waste whether tangible or intangible medical waste can be reduced by improving the management of health services, especially in the completeness and availability of facilities for health services. Besides, the effectiveness and efficiency of using resources become important so that all types of waste can be reduced or eliminated.

To manage medical waste, proper management of medical waste is needed. Every country and health care institution has medical waste management procedures from collection to destruction²⁴. Improving the management of medical waste not only requires proper management but also requires the involvement of all health care staff. The more important is continuing to improve the education and motivation of all health care staff to carry out waste management properly²⁵. Improving the management of medical waste also needs a change in the organizational culture that does not support waste management properly. Also, making policies or rules in institutions to support better medical waste management is needed so that medical waste can be minimized and the risk of spreading diseases due to the waste can be reduced. However, increasing education and motivation of health workers, changes in organizational culture and policy support, can reduce costs, time and energy wasted due to improper management of medical waste³.

Obstacles or difficulties are often encountered in managing medical waste which arises from various sides both in terms of human, equipment, policies and the environment. Obstacles from the human side are such as lack of knowledge, motivation and co-ordination in managing medical waste as well as lack of monitoring and supervision from leaders in waste management. From the policy side for example, the lack of budget policy for equipment procurement and waste management so that waste management is not handled properly. In terms of equipment, for example, the lack of equipment needed for the safety of workers who manage medical waste. Obstacles from the environmental side such as long-distance from supporting facilities for waste management, minimum supporting facilities in the environment and the other environmental conditions that do not support waste management properly and correctly². Those conditions create challenges in managing medical waste. All parties, both health service management, health staff, cleaning workers and the community must work together in overcoming these obstacles to create better medical waste management so that medical waste does not cause problems for health workers and the community^{26,27}. However, preventing problems arising from medical waste would be better than bearing the consequences of improper management of medical waste.

Table 1. Selected qualitative studies about experiences of health care staff in dealing with medical waste

Sl. No.	Authors and title of the articles	Country	Purpose and research design	Participants	Data collection and data analysis	Findings (themes and categories)
1	Hangulu, L, and Akintola, O. (2017). Health Care Waste Management in community-based care: experiences of community health workers in low resource communities in South Africa	South Africa	Purpose: explore Health Care Waste Management in Community-Based Care from the perspectives Community Health Workers Research design: qualitative study	85 Community Health Workers working in communities	Data Collection: participant observations, focus group discussions, and discussions. Data Analysis: Thematic analysis	-Activities responsible for generating medical waste -Medical waste management practices -Barriers to proper medical wastemanagement -Inadequate water, long-distance between toilets and houses.
2	Kumar, R., Babar Tasneem Shaikh, B. T., Somrongthong, R., and Chapman, R. S. (2015). Practices and challenges of infectious waste management: A qualitative descriptive study from tertiary care hospitals in Pakistan	Pakistan	Purpose: to identify issues impeding waste management. Research design: qualitative descriptive study	Director, nursing and medical supervisors, an officer.	Data Collection: in-depth interviews and observation Data Analysis: thematic content analysis	-Poor safety of the workers -Insufficient Budgeting -low training, supervision, monitoring, and coordination
3	Joshi, S. C., Diwan, V., Tamhankar, A. J., Rita Joshi, R., Shah, H., Sharma, M., Pathak, A., Macaden, R., Lundborg, C., S. (2015). Staff Perception on Biomedical or Health Care Waste Management: A Qualitative Study in a Rural Tertiary Care Hospital in India.	India	Purpose: to explore perceptions of staff teaching hospital on medical waste management Research design: qualitative study	Administrators, cleaning staff, doctors and nurses, and medical students.	Data Collection: focus group discussions Data Analysis: content analysis	-Challenges in integration of Health Care Waste Management (HCWM) in organizational practice: (I) Awareness and views, (II) Organizational practices, (III) Challenges in Implementation -Interventions improving HCWM: (I) Education and motivation (II) Organizational culture (III) Policy

4	<p>Hangulu, L, and Akintola, O. (2017) Perspectives of policy-makers and stakeholders about health care waste management in community-based care in South Africa: a qualitative study</p>	<p>South Africa</p>	<p>Purpose: explore Health Care Waste Management in Community-Based Care Research design: descriptive qualitative study</p>	<p>Officers, councilors, cleansing staffs, and managers</p>	<p>Data Collection: interviews Data Analysis: thematic analysis</p>	<p>-The perceived Health Care Waste Management -The perceived challenges -Lack of segregation -The perceived causes -Laziness and negative attitudes</p>
5	<p>Fatima, S, Z., and Asad, M. (2018). Disposal of hospital wastage in Pakistan: A qualitative research</p>	<p>Pakistan</p>	<p>Purpose: to aware about the infectious waste Research design: qualitative descriptive study</p>	<p>Executive Director, Deputy Director, Medical Superintendent, Nursing Superintendent, Medical Officer</p>	<p>Data Collection: interviews Data Analysis: thematic analysis</p>	<p>-Cleanliness of hospital and collection of waste - Low monitoring and trained staff</p>
6	<p>Goff, S. L., Kleppel, R., Lindenauer, P. K., and Rothberg, M. B. (2013). Hospital workers' perceptions of waste: a qualitative study involving photo-elicitation.</p>	<p>USA</p>	<p>Purpose: to gain sources of waste from views of workers Research design: qualitative study</p>	<p>Respiratory therapists, physicians, pharmacists, nurses, administrators</p>	<p>Data Collection: photo-elicitation and in-depth interviews. Data Analysis: selective and thematic analysis</p>	<p>- Types of waste: Time, Materials, Energy, and Talent. -Recommendations to reduce waste: recommendations deductively and inductively.</p>

Table 2. Comparing and combining metaphors, themes, categories, ideas or concepts of the selected studies

Sl. No.	The selected studies	Consequence of health care	Ways to handle the waste	Obstacles in managing medical waste
1	Hangulu, L, and Akintola, O. (2017). Health Care Waste Management in community-based care: experiences of community health workers in low resource communities in South Africa	Activities responsible for generating medical waste	Medical waste management practices	-Barriers to proper medical waste management -Inadequate water, long-distance between toilets and houses
2	Kumar, R., Babar Tasneem Shaikh, B. T., Somrongthong, R., and Chapman, R. S. (2015). Practices and challenges of infectious waste management: A qualitative descriptive study from tertiary care hospitals in Pakistan.			-Poor safety of the workers -Insufficient Budgeting -low training, supervision, monitoring and coordination
3	Joshi, S. C., Diwan, V., Tamhankar, A. J., Rita Joshi, R., Shah, H., Sharma, M., Pathak, A., Macaden, R., Lundborg, C., S. (2015). Staff Perception on Biomedical or Health Care Waste Management: A Qualitative Study in a Rural Tertiary Care Hospital in India.		-Interventions improving HCWM: (I) Education and motivation (II) Organizational culture (III) Policy	-Challenges in integration of Health Care Waste Management (HCWM) in organizational practice: (I) Awareness and views (II) Organizational practices (III) Challenges in Implementation
4	Hangulu, L, and Akintola, O. (2017) Perspectives of policy-makers and stakeholders about health care waste management in community-based care in South Africa: a qualitative study.			-The perceived Health Care Waste Management -The perceived challenges -Lack of segregation -The perceived causes -Laziness and negative attitudes
5	Fatima, S. Z., and Asad, M. (2018). Disposal of hospital wastage in Pakistan: A qualitative research.		- Cleanliness of hospital and collection of waste	- Low monitoring and trained staff
6	Goff, S. L., Kleppel, R., Lindenauer, P. K., and Rothberg, M. B. (2013). Hospital workers' perceptions of waste: a qualitative study involving photo-elicitation.	- Types of waste: Time, Materials, Energy and Talent.	Recommendations to reduce waste: recommendations deductively and inductively.	

5. Conclusion

Three themes emerged from 6 studies that were evaluated and synthesized: The consequences of health care, ways to handle the waste and obstacles in managing medical waste. The themes are interrelated in and between the studies. Medical waste is the result of health services provided to the community. Waste can be tangible objects such as solid, liquid or gas or intangible objects such as time, energy and talent. To improve the proper management of medical waste, it requires the involvement of all parties as well as increasing the knowledge and motivation of staff, changing the organizational culture that supports waste management and policy support for improving waste management. The obstacles in managing medical waste come from people, equipment, policies and the environment. Co-operation and coordination between all parties are needed in overcoming this obstacle to create a correct and appropriate medical waste management that can reduce the risk of problems arising from medical waste.

6. References

- World Health Organisation. Safe management of wastes from health-care activities. 2014; 329. http://apps.who.int/iris/bitstream/10665/85349/1/9789241548564_eng.pdf
- Kumar R, Shaikh BT, Somrongthong R, Chapman RS. Practices and challenges of infectious waste management: A qualitative descriptive study from tertiary care hospitals in Pakistan. *Pakistan J Med Sci.* 2015; 31(4):795–8. PMID: 26430405 PMCID: PMC4590381. <https://doi.org/10.12669/pjms.314.7988>
- Joshi SC, Diwan V, Tamhankar AJ, Joshi R, Shah H, Sharma M, et al. Staff perception on biomedical or health care waste management: A qualitative study in a rural tertiary care hospital in India. *PLoS One.* 2015; 10(5):1–16. PMID: 26023783 PMCID: PMC4449010. <https://doi.org/10.1371/journal.pone.0128383>
- Hangulu L, Akintola O. Perspectives of policy-makers and stakeholders about Health Care Waste Management in community-based care in South Africa: A qualitative study. *BMC Health Serv Res.* 2017; 17(1):1–13. PMID: 28424046 PMCID: PMC5395807. <https://doi.org/10.1186/s12913-017-2236-x>
- Farooq MT, Omar N, Shaid F, Khizar S, Khan A, Ashfaq N, et al. Assessment of Hospital Waste Management Protocols in Tertiary Care Hospitals of Lahore. *Biomedica [Internet].* 2017; 33(2):136–43. https://www.researchgate.net/publication/319187513_ASSESSMENT_OF_HOSPITAL_WASTE_MANAGEMENT_PROTOCOLS_IN_TERTIARY_CARE_HOSPITALS_OF_LAHORE
- Goyal KC, Goyal SKN, Goyal R. Analysis of bio-medical waste of a private hospital in Patiala city, Punjab, India. *Octa J Environ Res.* 2017; 5(1):1–5.
- Hasan MM, Rahman MH. Assessment of Healthcare Waste Management Paradigms and its suitable treatment alternative: A case study. *J Environ Public Health.* 2018; 2018. PMID: 30151013 PMCID: PMC6087569. <https://doi.org/10.1155/2018/6879751>
- Khan BA, Khan AA, Ahmed H, Shaikh SS, Peng Z, Cheng L. A study on small clinics waste management practice, rules, staff knowledge, and motivating factor in a rapidly urbanizing area. *Int J Environ Res Public Health.* 2019; 16(20):1–15. PMID: 31652534 PMCID: PMC6843947. <https://doi.org/10.3390/ijerph16204044>
- Makhura RR, Matlala SF, Kekana MP. Medical waste disposal at a hospital in Mpumalanga Province, South Africa: Implications for training of healthcare professionals. *South African Med J.* 2016; 106(11):1096–102. PMID: 27842631. <https://doi.org/10.7196/SAMJ.2016.v106i11.10689>
- Niyongaboa E, Jang Y-C, Kang D, Sung K. Analysis of treatment of solid medical waste in Bujumbura, Burundi. *Environ Eng Res.* 2018; 0-3.
- Olaifa A, Govender RD, Ross AJ. Knowledge, attitudes and practices of healthcare workers about healthcare waste management at a district hospital in KwaZulu-Natal. *South African Fam Pract [Internet].* 2018; 60(5):137–45. <http://doi.org/10.1080/20786190.2018.1432137>
- Pullishery F, Shenoy Panchmal G, Siddique S, Abraham A. Awareness, knowledge and practices on bio-medical waste management among health care professionals in Mangalore - A cross sectional study. *IAIM Int Arch Integr Med IAIM.* 2016; 3(31): 29–35.
- Singh T, Ghimire TR, Agrawal SK. Awareness of biomedical waste management in dental students in different dental colleges in Nepal. *Biomed Res Int.* 2018; PMID: 30627540 PMCID: PMC6304656. <https://doi.org/10.1155/2018/1742326>
- Yazie TD, Tebeje MG, Chufa KA. Healthcare waste management current status and potential challenges in Ethiopia: A systematic review. *BMC Res Notes [Internet].* 2019; 12(1):1–8. PMID: 31122274 PMCID: PMC6533748. <https://doi.org/10.1186/s13104-019-4316-y>
- Hangulu L, Akintola O. Health Care Waste Management in community-based care: Experiences of community health workers in low resource communities in South Africa. *BMC Public Health.* 2017; 17(1):1–10. PMID: 28506258 PMCID: PMC5432984. <https://doi.org/10.1186/s12889-017-4378-5>
- Fatima SZ, Asad M. Disposal of hospital wastage in Pakistan: A qualitative research. *Adv Soc Sci Res J.* 2018; 5(3):37–42. <https://doi.org/10.14738/assrj.53.4197>
- Goff SL, Kleppel R, Lindenauer PK, Rothberg MB. Hospital workers' perceptions of waste: A qualitative study involving photo-elicitation. *BMJ Qual Saf.* 2013; 22(10):826–35. PMID: 23748192 PMCID: PMC4553937. <https://doi.org/10.1136/bmjqs-2012-001683>
- Hammer K, Mogensen O HE. The meaning of hope in nursing research: A meta-synthesis. *Scand J Caring Sci.* 2009; 23(3):549–57. PMID: 19453659. <https://doi.org/10.1111/j.1471-6712.2008.00635.x>
- Noblit GW HR. *Meta-ethnography: Synthesizing qualitative studies.* Newbury Park: Sage; 1988. <https://doi.org/10.4135/9781412985000>

20. Institute TJB. The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews Checklist for Qualitative Research [Internet]. 2017. https://joannabriggs.org/sites/default/files/2019-05/JBI_Critical_Appraisal-Checklist_for_Qualitative_Research2017_0.pdf
21. Dzekashu LG, Akoachere JF MW. Medical waste management and disposal practices of health facilities in Kumbo east and Kumbo west health districts. *Inter J Med Med Sci*. 2017; 9(1):1–11. <https://doi.org/10.5897/IJMMS2016.1272>
22. Tadesse ML KA. Healthcare waste generation and management practice in government health centers of Addis Ababa, Ethiopia. *BMC Public Heal*. 2014; 14(1):2–9. PMID: 25424604 PMCID: PMC4258029. <https://doi.org/10.1186/1471-2458-14-1221>
23. Siregar CT, Zulkarnain, Nasution SZ, Purba JM, Karota E, Bayhakki, et al. Family concern: Facilitating self-management of patients undergoing hemodialysis. *Enferm Clin* [Internet]. 2020; 30(Icinna 2019):10–3. PMID: 32331727. <https://doi.org/10.1016/j.enfcli.2019.12.015>
24. Awodele O, Adewoye AA OA. Assessment of medical waste management in seven hospitals in Lagos Nigeria. *BMC Pub Heal*. 2016; 16(1):2–11. PMID: 26979131 PMCID: PMC4791961. <https://doi.org/10.1186/s12889-016-2916-1>
25. Botelho A. The impact of regulatory compliance behavior on hazardous waste generation in European private healthcare facilities. *Waste Manag Res*. 2012; 98(15):5–10. PMID: 22325637. <https://doi.org/10.1016/j.jenvman.2011.12.003>
26. AL-Ghabban MM, Mizzouri NS, Mahmood FR, Hassan HH, Abdulrahman KI. Assessment of Waste Generation rate of Medical Hazardous in Duhok Governorate (Proposal of alternative disposal and management methods). *Acad J Nawroz Univ*. 2018; 7(4): 139–52. <https://doi.org/10.25007/ajnu.v7n4a283>
27. Ali M, Wang W, Chaudhry N, Geng Y. Hospital waste management in developing countries: A mini review. *Waste Manag Res*. 2017; 35(6):1–12. PMID: 28566033. <https://doi.org/10.1177/0734242X17691344>