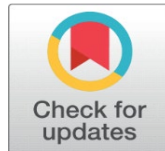


EFFECTS OF BIO-MEDICAL WASTE ON VARIOUS ILL HEALTH SYMPTOMS IN MYSURU CITY: AN ANALYTICAL STUDY

Lalitha, G. ¹, Jayashree, P. ² 

¹Research Scholar, DOS In Geography, University of Mysore, Mysuru-570 006, India

²Professor of Geography, DOS in Geography, University of Mysore, Mysuru-570 006, India



Received 26 November 2022

Accepted 27 December 2022

Published 12 January 2023

Corresponding Author

Jayashree P,
drjayashreeram@gmail.com

DOI10.29121/granthaalayah.v10.i12.2022.4929

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Copyright: © 2022 The Author(s). This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

With the license CC-BY, authors retain the copyright, allowing anyone to download, reuse, re-print, modify, distribute, and/or copy their contribution. The work must be properly attributed to its author.

ABSTRACT

Sharps, infectious, medicinal, and radioactive waste, as well as other hazardous and poisonous components of waste from healthcare facilities, pose serious risks to both human health and the environment if they are not properly handled, disposed of, or prohibited from being mixed with other municipal waste. The present study deals with analysis of health issues reported by the individuals dwelling in nearby areas. A total of 120 respondents were selected for the study and they were administered a structured checklist to assess the presence/absence of various health issues – a. aches and pains, b. cardiac related issues, c. psychological symptoms and d. other symptoms affecting effective management of BMW. Chi-square tests were employed to analyse the results and results revealed on the whole, 19.0% of the respondent's reported headaches. 29.7% of them indicated general fatigue, 34.5% of them reported eye irritation, 20.3% of them reported throat irritation and 19.3% of them reported joint pain. In the case of cardiac related ailments, 21.7% of the selected sample experienced shortness of breath, 25.2% of them reported cough, 17.9% of them indicated chest pain, 11.7% of them reported chest heaviness and 16.9% of them experienced chest tightness. In psychological issues, 20.3% of the selected sample experienced difficulty in concentrating, 24.8% of them reported irritability, and 11.0% of them indicated depression. In other symptoms, 22.1% of the respondents reported Diarrhea, 19.7% of the indicated Constipation, 18.6% of them reported rashes, 31.0% of them indicated nasal stiffness, 11.7% of them indicated nose bleeding, 37.6% of them reported nausea, and 27.2% of them reported vomiting. Age related increase in the specific health were found in the cases of headache, general fatigue, eye irritation, throat irritation, cough, chest heaviness, irritability and depression, nasal stiffness, nasal bleeding, nausea and vomiting.

Keywords: Bio Medical Waste (BMW), Aches and Pains, Cardiac Related Issues, Psychological Symptoms and Other Symptoms



1. INTRODUCTION

Medical waste contributes to the production of hazardous biological waste. The generation and disposal of medical waste is a crucial issue, particularly in nations with a high population and inadequate sanitation. Hospitals, clinics, and other places used for diagnosis and treatment are examples of medical facilities. These establishments generate exceedingly toxic wastes, which raises the possibility of fatal infections. Policies should be created that specify how waste is to be handled during generation, segregation, collection, storage, transportation, and treatment in order to prevent the spread of illnesses [WHO \(2017\)](#). In order to lessen the chance

of the health risks spreading, it is crucial to increase awareness at all societal levels through a range of communication and educational channels.

Activities related to healthcare produce waste that could have a negative impact on health. The majority of this waste isn't any riskier than standard home waste. Some forms of (medical waste, however, pose a greater threat to health. "These include infectious waste (15%–25% of total health-care waste), among which are sharps waste (1%), body part waste (1%), chemical or pharmaceutical waste (3%), and radioactive and cytotoxic waste or broken thermometers (less than 1%)." [Padmanabhan and Barik \(2019\)](#), [Pant \(2022\)](#). In Gujarat, 249 contracted hepatitis due to reuse of syringes [Seetharam \(2009\)](#).

Groundwater sources can get contaminated by the improper segregation and disposal of biomedical waste, which could then infect both people and animals. Biomedical waste must be carefully kept to keep it away from birds, rodents, and stray animals, from a hospital's garbage and storage containers to landfills (as well as humans) [Chamberlain \(2021\)](#). This improves the packing and labelling of toxins and aids in reducing the likelihood that diseases may spread among people and animals by air, land, or water.

The air we breathe can become contaminated by hazardous airborne particles if incorrect healthcare waste management is not effectively confined, separated, and burnt by on-site or off-site burning. Diagnostic technology has the potential to release radioactive particles that could wind up in a landfill or other parts of the environment, particularly the air. Numerous diseases could be brought on by air pollution that are spread over large, populated areas. [Chamberlain \(2020\)](#). Exposure to air pollution can result in a variety of illnesses, more hospital stays, and early mortality. Air pollution's detrimental effects on cardiovascular health can raise the risk of heart attack or heart failure, hypertension, angina, and arrhythmia, as well as the likelihood of stroke. Water pollution spreads pathogenic microbes through contaminated water and can cause a number of waterborne illnesses including Giardiasis, leptospirosis, neural virus, salmonella, and more [Wakelam \(2021\)](#).

The wastes produced by healthcare facilities are often divided into infectious and non-infectious categories. Hospital wastes are what are known as the infectious health care wastes and are thought to be potentially dangerous in nature. There is a risk to the environment and public health when untreated medical waste is disposed of with normal municipal waste or non-infectious hospital waste. The spread of various infectious diseases is frequently attributed to the careless dumping of untreated medical waste. Additionally, it caused hospital acquired infections, or nosocomial diseases, among the medical staff who handle these wastes at the point of creation. Few studies have highlighted the health hazards for the personnel who were directly involved in collection, storage, and disposal of BMW. As there is a scant amount of research on the health risks experienced by people who live or stay close to public and private hospitals, an analysis of these risks is attempted in the current study.

2. METHOD

2.1. SAMPLE

A total of 280 respondents residing near the government hospitals/PHCs and private hospitals who were exposed to BMW were randomly selected for the study. The 280 respondents selected for the study were belonging to different age groups from 25 to 65 years.

2.2. TOOLS EMPLOYED

Checklist to measure symptomatology

A checklist of various symptoms related to BMWM was constructed by the first author in consultation with the experts in the field. All the symptoms selected for the tool were classified under four major headings-a, aches and pains, b. cardiac related issues, c. psychological symptoms and d. other symptoms. The respondent had to answer either 'yes' or 'no' for each of the symptoms listed under aches and pains, cardiac related issues, c. psychological symptoms and other symptoms.

2.3. PROCEDURE

On the whole 280 respondents were randomly elected from the city of Mysuru who were dwelling near the government hospitals/PHCs and private hospitals. A minimum of 6 months stay in the vicinity was confirmed before the data collection process. The respondents were briefed about the study and assured of confidentiality of information were given the checklist of symptoms for which they are suffering or prone to it. To avoid unanticipated mistakes, the survey instrument was pre-tested in a non-sampled region. SPSS for windows version 25 was used to conduct the statistical analysis. The data were analysed through chi-square tests to analyse significance of differences between differences in frequencies of responses for symptoms experienced. Chi-square tests of association were done to find out the association between age groups and responses given for each of the symptoms. Results of Pearson's chi-square tests are included in Table 1 through 4, together with current answers received for each symptom overall and by age group.

3. RESULTS

3.1. GENERAL SYMPTOMS OF PAINS AND ACHES

Table 1

Table 1 Frequency and Percent Responses for Various Pains and Aches by Age Groups Due to Bio-Medical Waste and Results of Chi-Square Tests									
Symptoms of			Age groups (in years)						Test statistics
			<30	31-40	41-50	51-60	60+	Total	
1.Headache	Yes	F	2	7	10	11	25	55	X ² _(overall) =111.72; p=.001
		%	3.4%	10.9%	18.2%	20.0%	43.1%	19.0%	
	No	F	56	57	45	44	33	235	X ² _(yes/no) =33.82; p= .001
		%	96.6%	89.1%	81.8%	80.0%	56.9%	81.0%	
2.General Fatigue	Yes	F	4	13	18	21	30	86	X ² _(overall) =48.01; p=.001
		%	6.9%	20.3%	32.7%	38.2%	51.7%	29.7%	
	No	F	54	51	37	34	28	204	X ² _(yes/no) =32.79; p= .001
		%	93.1%	79.7%	67.3%	61.8%	48.3%	70.3%	
3.Eye irritation	Yes	F	9	19	20	22	30	100	X ² _(overall) =27.93; p=.001
		%	15.5%	29.7%	36.4%	40.0%	51.7%	34.5%	
	No	F	49	45	35	33	28	190	X ² _(yes/no) =18.34; P=.001
		%	84.5%	70.3%	63.6%	60.0%	48.3%	65.5%	

4.Throat irritation	Yes	F	5	11	8	14	21	59	X ² _(overall) = 102.01; p=.001 -----
		%	8.6%	17.2%	14.5%	25.5%	36.2%	20.3%	
	No	F	53	53	47	41	37	231	X ² _(yes/no) =16.35; P=.001
		%	91.4%	82.8%	85.5%	74.5%	63.8%	79.7%	
5.Joint pain	Yes	F	9	11	9	8	19	56	X ² _(overall) =109.26; p=.001 -----
		%	15.5%	17.2%	16.4%	14.5%	32.8%	19.3%	
	No	F	49	53	46	47	39	234	X ² _(yes/no) =8.56; P=.073
		%	84.5%	82.8%	83.6%	85.5%	67.2%	80.7%	

Out of 280 respondents selected for the study, 19.0% of them reported headaches. 29.7% of them indicated general fatigue, 34.5% of them reported eye irritation, 20.3% of them reported throat irritation and 19.3% of them reported joint pain. Chi-square tests revealed significant frequency differences between yes and no responses for all the symptoms of pain and aches with the significance levels of .001.

When the findings were associated with the age, it was found that significant associations were observed for headache, general fatigue, eye irritation, and throat irritation. A general observation from the table is that there were significant age-related increase in the symptoms reported for headache, general fatigue, eye irritation, and throat irritation, with the significance levels of .001, .001, .001 and .001 respectively. Only in the case of joint pain, chi-square test revealed a non-significant association between age groups and presence/absence of joint pain.

3.2. CARDIAC RELATED SYMPTOMS

Table 2

Table 2 Frequency and Percent Responses for Cardiac Related Symptoms Experienced By Age Groups and Results of Chi-Square Tests									
Symptoms of			Age groups (in years)						Test statistics
			<30	31-40	41-50	51-60	60+	Total	
1. Shortness of breath	Yes	F	9	11	11	13	19	63	X ² _(overall) =92.75; p=.001 -----
		%	15.5%	17.2%	20.0%	23.6%	32.8%	21.7%	
	No	F	49	53	44	42	39	227	X ² _(yes/no) =6.46; P=.168
		%	84.5%	82.8%	80.0%	76.4%	67.2%	78.3%	
2. Cough	Yes	F	6	8	16	17	26	73	X ² _(overall) =71.50; p=.001 -----
		%	10.3%	12.5%	29.1%	30.9%	44.8%	25.2%	
	No	F	52	56	39	38	32	217	X ² _(yes/no) =25.53; p= .001
		%	89.7%	87.5%	70.9%	69.1%	55.2%	74.8%	
3. Chest pain	Yes	F	9	11	10	8	14	52	X ² _(overall) =119.30; p=.001 -----
		%	15.5%	17.2%	18.2%	14.5%	24.1%	17.9%	
	No	F	49	53	45	47	44	238	X ² _(yes/no) =2.20; P=.699
		%	84.5%	82.8%	81.8%	85.5%	75.9%	82.1%	
4.Chest heaviness	Yes	F	5	7	4	4	14	34	X ² _(overall) =169.95;

			%	8.6%	10.9%	7.3%	7.3%	24.1%	11.7%	p=.001
	No	F	53	57	51	51	44	256		-----
			%	91.4%	89.1%	92.7%	92.7%	75.9%	88.3%	X ² _(yes/no) =11.32; P=.023
5.Chest tightness	Yes	F	9	11	7	8	14	49		X ² _(overall) =127.12; p=.001
			%	15.5%	17.2%	12.7%	14.5%	24.1%	16.9%	-----
	No	F	49	53	48	47	44	241		X ² _(yes/no) =3.15; p= .534
			%	84.5%	82.8%	87.3%	85.5%	75.9%	83.1%	

On the whole, 21.7% of the selected sample experienced shortness of breath, 25.2% of them reported cough, 17.9% of them indicated chest pain, 11.7% of them reported chest heaviness and 16.9% of them experienced chest tightness. Chi-square tests revealed significant frequency differences between yes and no responses for all the cardiac related symptoms with the significance levels of .001.

Chi-square tests were done for associations between age groups and cardiac symptoms, which revealed significant associations for cough and chest heaviness. In both the cases, more or less, results revealed age related increase in symptomatology which are significant at .001 and .023 respectively for cough and chest heaviness. However, between age groups and symptoms, non-significant associations were observed for shortness of breath, chest pain and chest tightness.

3.3. PSYCHOLOGICAL SYMPTOMS

Table 3

Table 3 Frequency and Percent Responses for Psychological Symptoms Experienced by Age Groups and Results of Chi-Square Tests

Symptoms of		Age groups (in years)							Test statistics
			<30	31-40	41-50	51-60	60+	Total	
1.Difficulty in concentration	Yes	F	9	13	9	11	17	59	X ² _(overall) =102.01; p=.001
		%	15.5%	20.3%	16.4%	20.0%	29.3%	20.3%	
	No	F	49	51	46	44	41	231	X ² _(yes/no) =4.25; P=.373
		%	84.5%	79.7%	83.6%	80.0%	70.7%	79.7%	
2. Irritability	Yes	F	9	11	9	15	28	72	X ² _(overall) =73.50; p=.001
		%	15.5%	17.2%	16.4%	27.3%	48.3%	24.8%	
	No	F	49	53	46	40	30	218	X ² _(yes/no) =24.07; P=.001
		%	84.5%	82.8%	83.6%	72.7%	51.7%	75.2%	
3. Depression	Yes	F	3	5	6	4	14	32	X ² _(overall) =176.12; p=.001
		%	5.2%	7.8%	10.9%	7.3%	24.1%	11.0%	
	No	F	55	59	49	51	44	258	X ² _(yes/no) =13.65; P=.009
		%	94.8%	92.2%	89.1%	92.7%	75.9%	89.0%	

It is clear that 20.3% of the selected sample experienced difficulty in concentrating, 24.8% of them reported irritability, and 11.0% of them indicated depression. Chi-square tests revealed significant frequency differences between yes

and no responses for all the psychological symptoms with the significance levels of .001.

When associations were analyzed between age groups and psychological symptoms, chi-square tests revealed significant associations for irritability and depression symptoms. In both the cases, results revealed age related increase in symptomatology which are significant at .001 and .009 respectively for irritability and depression. However, between age groups and symptoms, a non-significant association was observed for difficulty in concentration.

3.4. OTHER SYMPTOMS

Table 4

Table 4 Frequency and Percent Responses for Other Symptoms Experienced by Age Groups and Results of Chi-Square Tests									
Symptoms of			Age groups (in years)						Test statistics
			<30	31-40	41-50	51-60	60+	Total	
1. Diarrhea	Yes	F	9	11	14	12	18	64	X2(overall)=90.50; p=.001
		%	15.5%	17.2%	25.5%	21.8%	31.0%	22.1%	
	No	F	49	53	41	43	40	226	X2(yes/no) =5.41; p= .247
		%	84.5%	82.8%	74.5%	78.2%	69.0%	77.9%	
2. Constipation	Yes	F	9	11	11	10	16	57	X2(overall)=106.81; p=.001
		%	15.5%	17.2%	20.0%	18.2%	27.6%	19.7%	
	No	F	49	53	44	45	42	233	X2(yes/no) =3.27 p= .514
		%	84.5%	82.8%	80.0%	81.8%	72.4%	80.3%	
3. Rashes	Yes	F	9	11	7	9	18	54	X2(overall)=114.55; p=.001
		%	15.5%	17.2%	12.7%	16.4%	31.0%	18.6%	
	No	F	49	53	48	46	40	236	X2(yes/no) =7.80; P=.099
		%	84.5%	82.8%	87.3%	83.6%	69.0%	81.4%	
4. Nasal stiffness	Yes	F	7	20	17	19	27	90	X2(overall)=41.72; p=.001
		%	12.1%	31.2%	30.9%	34.5%	46.6%	31.0%	
	No	F	51	44	38	36	31	200	X2(yes/no) =16.59; P=.002
		%	87.9%	68.8%	69.1%	65.5%	53.4%	69.0%	
5. Nose bleeding,	Yes	F	4	8	3	5	14	34	X2(overall)=169.95; p=.001
		%	6.9%	12.5%	5.5%	9.1%	24.1%	11.7%	
	No	F	54	56	52	50	44	256	X2(yes/no) =12.44; P=.014
		%	93.1%	87.5%	94.5%	90.9%	75.9%	88.3%	
6. Nausea	Yes	F	9	11	25	30	34	109	X2(overall)=17.88; p=.001
		%	15.5%	17.2%	45.5%	54.5%	58.6%	37.6%	
	No	F	49	53	30	25	24	181	X2(yes/no) =42.53; P=.001
		%	84.5%	82.8%	54.5%	45.5%	41.4%	62.4%	
7. Vomiting	Yes	F	9	11	19	18	22	79	X2(overall)=60.08;

	%	15.5%	17.2%	34.5%	32.7%	37.9%	27.2%	p=.001
No	F	49	53	36	37	36	211	-----
	%	84.5%	82.8%	65.5%	67.3%	62.1%	72.8%	X2(yes/no) =12.95; P=.001

Lastly, when other symptoms were analysed, it was found that 22.1% of the respondents reported Diarrhea, 19.7% of the indicated Constipation, 18.6% of them reported rashes, 31.0% of them indicated nasal stiffness, 11.7% of them indicated nose bleeding, 37.6% of them reported nausea, and 27.2% of them reported vomiting. Chi-square tests revealed significant frequency differences between yes and no responses for all the other symptoms reported with the significance levels of .001.

Further, chi-square tests revealed significant associations between age groups and presence/absence of symptoms for nasal stiffness, nasal bleeding, nausea, and vomiting, where we find that as the age increased, all these symptoms also increased more or less linearly and significantly. The obtained P values for associations between age and symptoms of nasal stiffness, nasal bleeding, nausea, and vomiting were .002, .014, .001 and .001 respectively. However, there were no significant associations were found between age groups and symptoms of Diarrhea, Constipation and rashes.

4. DISCUSSION

Major findings of the study

- On the whole, 19.0% of the respondents reported headaches. 29.7% of them indicated general fatigue, 34.5% of them reported eye irritation, 20.3% of them reported throat irritation and 19.3% of them reported joint pain.
- In the case of cardiac related ailments, 21.7% of the selected sample experienced shortness of breath, 25.2% of them reported cough, 17.9% of them indicated chest pain, 11.7% of them reported chest heaviness and 16.9% of them experienced chest tightness.
- In psychological issues, 20.3% of the selected sample experienced difficulty in concentrating, 24.8% of them reported irritability, and 11.0% of them indicated depression
- In other symptoms, 22.1% of the respondents reported Diarrhea, 19.7% of the indicated Constipation, 18.6% of them reported rashes, 31.0% of them indicated nasal stiffness, 11.7% of them indicated nose bleeding, 37.6% of them reported nausea, and 27.2% of them reported vomiting
- Age related increase in the specific health were found in the cases of headache, general fatigue, eye irritation, throat irritation, cough, chest heaviness, irritability and depression, nasal stiffness, nasal bleeding, nausea, and vomiting

It is evident that BMW has very deleterious effect on human health conditions if not properly managed well. In the present study it was found that 34.5% of them reported eye irritation, 31.0% of them indicated nasal stiffness, 37.6% of them reported nausea and other health issues to a lesser extent. In a developing country like India, the growth of healthcare institutions has become a major source of concern for the government due to possible environmental and public health problems [Mandal and Dutta \(2009\)](#). Dioxin, a recognised carcinogen, is found after burning medical waste with plastic that contains chlorine. When dioxin is created, it

bonds to organic particles that are transported by the wind, dropped on land, and deposited in water. Dioxin's half-life is thought to be between 25 and 100 years. Nuclear DNA binds to dioxin. It has numerous harmful impacts on both human health (such as endometriosis, birth abnormalities, and low testosterone levels) and the environment, including acting as a potential cancer promoter, weakening immunological response, and potential cancer. Low doses of dioxin exposure cause all of these consequences. It is prohibited to incinerate biomedical waste that contains heavy metals. [Mastorakis et al. \(2010\)](#).

Approximately 82% of primary, 60% of secondary, and 54% of tertiary HCFs in India between 2002 and 2004 had no reliable BMW system, according to the International Clinical Epidemiology Network [INCLIN Program Evaluation Network \(IPEN\) Study Group, New Delhi, India. \(2014\)](#). In Jharkhand, the Centre for Science and Environment (CSE) studied how hospitals and nursing facilities flagrantly disregarded the state's rules for segregation, collection, storage, treatment, and disposal. This causes several health hazards to the people dwelling in the vicinity and one who visit/crosses the waste BMW places regularly. Bacteria resistant to chemical disinfectants and antibiotics may also contribute to the risks brought on by improperly handled medical waste in healthcare facilities. For instance, it has been proven that plasmids from lab strains found in medical waste were transferred to native bacteria by the waste disposal system. Additionally, it has been demonstrated that antibiotic-resistant *Escherichia coli* can live in an activated sludge plant, even if there does not appear to be a major transfer of this bacterium under typical wastewater disposal and treatment circumstances. [Padmanabhan and Barik \(2018\)](#).

Potentially hazardous microbes found in medical waste have the potential to infect hospital patients, medical personnel, and members of the general public. The introduction of drug-resistant bacteria into the environment from healthcare institutions is another possible infectious concern. The primary categories of healthcare waste as outlined in either national or municipal legislation on waste classification should be understood by all staff who deal with them. Managers who are in charge of handling medical waste should at the very least tour through the facility to identify the medical areas that produce trash, get a general idea of the types and amounts produced, and learn how the garbage is managed and disposed of. A quick assessment that combines observations with interviews and survey questions should yield enough information to pinpoint issues and start working on solutions. There is a pressing need to standardize the infrastructure requirements so that hospitals that strictly follow BMW standards do not incur additional expenditures [Rao et al. \(2004\)](#). [Singh Jamwal et al. \(2020\)](#) opines that making the right technologies, delivering expert instruction, and devoting sufficient financial resources are urgently needed for efficient and secure BMW disposal. Even the inclinators used for bio-medical waste management have to be refined to avoid pollution [Bio-Medical Waste Management Rules. \(2016\)](#). Countries like Philippines and Denmark have already banned the use of inclinators [Rivera \(2022\)](#), [Simon \(2014\)](#). BMW should be handled and disposed of properly with the assistance of public-private partnerships and top management's complete dedication. [Singh Jamwal et al. \(2020\)](#).

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

- Bio-Medical Waste Management Rules. (2016). Published In The Gazette of India, Extraordinary, Part II, Section 3, Subsection (I), Government of India Ministry of Environment, Forest and Climate Change. Notification, The. Google Scholar.
- Centre For Science and Environment (CSE). (2017). Not Handled With Care : A Survey of Biomedical Waste Practices In Jharkhand.
- Chamberlain, M. (2020). Effects of Biomedical Waste on the Environment.
- INCLIN Program Evaluation Network (IPEN) Study Group, New Delhi, India. (2014). Bio-Medical Waste Management : Situational Analysis and Predictors of Performances In 25 Districts Across 20 Indian States. Indian Journal of Medical Research, 139(1), 141–153.
- Mandal, S. K., and Dutta, J. (2009). Integrated Bio-Medical Waste Management Plan For Patna City. Institute of Town Planners.
- Mastorakis, N. E., Bulucea, C. A., Oprea, T. A., and Dondon, P. (2010). Environmental and Health Risks Associated With Biomedical Waste Management.
- Padmanabhan, K. K., and Barik, D. (2018). Health Hazards of Medical Waste and Its Disposal. Energy From Toxic Organic Waste for Heat And Power Generation, 2019, 99–118.
- Pant, N. (2022). Bio-Medical Waste.
- Rao, S. K. M., Ranyal, R. K., Bhatia, S. S., and Sharma, V. R. (2004). Biomedical Waste Management: An Infrastructural Survey of Hospitals. Medical Journal, Armed Forces India, 60(4), 379–382. [https://doi.org/10.1016/S0377-1237\(04\)80016-9](https://doi.org/10.1016/S0377-1237(04)80016-9)
- Rivera, D. (2022). Waste To Energy : Boon or Bane To Philippines.
- Seetharam, S. (2009). Hepatitis B outbreak in Gujarat: A wake-up call. Indian Journal of Medical Ethics, 6(3), 120–121. <https://doi.org/10.20529/IJME.2009.042>
- Simon, M. S. (2014). Denmark's Transition From Incineration To Zero Waste.
- Singh Jamwal, V. D., Jamwal, S., Kumar, S., and Yadav, A. K. (2020). Nuances of Human Anatomical Waste Management In A Secondary Care Government Hospital. Medical Journal of Dr. DY Patil Vidyapeeth, 13(5), 546–551. https://doi.org/10.4103/mjdrdypu.mjdrdypu_139_18
- Wakelam, L. (2021). Negative Effects of Biomedical Waste on The Environment.
- World Health Organization (WHO). (2007). Everybody's Business – Strengthening Health Systems To Improve Health Outcomes: WHO's Framework For Action. WHO.