



RESEARCH PAPER

OPEN ACCESS

Dental waste management in Cagayan de Oro City, Philippines

Rosalinda L. Ilogon^{1,2}, Janssen Blaise U. Jumau-As^{1,2}, Celestina E. Casundo¹,
Melvin Madroñal¹, Van Ryan Kristopher R. Galarpe^{*3}

¹*Department of Environmental Science & Technology, University of Science and Technology of Southern Philippines, Cagayan de Oro City, Philippines*

²*Department of Environment and Natural Resources-Environmental Management Bureau 10, Cagayan de Oro, Philippines*

³*Department of Environmental Science & Technology/Physics, University of Science and Technology of Southern Philippines, Cagayan de Oro City, Philippines*

Article published on August 24, 2017

Key words: Dental clinics, Solid waste management, Practices, Awareness

Abstract

Generation of hazardous wastes pose ecological ill effects if improperly segregated which necessitates monitoring. This study primarily evaluated the waste management practices of dental clinics in Cagayan de Oro City, Philippines. A total of fifty (50) dental clinics registered at the Department of Environment and Natural Resources-Environmental Management Bureau-10 (DENR-EMB-10) were surveyed. A modified survey questionnaire was administered covering thirty-five (35) questions on wastes identification, management, and disposal. Overall, awareness and perception on waste management guideline was adequate among dental clinic staff workers (dentists and dental technicians). However, practices and implementation of the waste management guidelines were not realized. Noticeably, dental wastes were not properly segregated, collected, and disposed. Dental wastes including hazardous wastes were often mixed with municipal solid waste except for sharps and needles which were placed in plastic bottle containers. The present findings shows the lack of proper implementation of the mandate of Republic Act (RA) 9003-Ecological Solid Waste Management (ESWM) Act of 2000 and R.A. 6969 Toxic Substances and Hazardous and Nuclear Waste (TSHNW) Act. This can be a basis for policy making for hazardous waste management in the Philippines.

***Corresponding Author:** Van Ryan Kristopher R. Galarpe ✉ vanryangalarpe@gmail.com

Introduction

The World Health Organization (WHO) defines healthcare waste (HCW) as discarded (and untreated) materials from health care activities on humans or animals that have the potential of transmitting infectious agents to humans. These wastes include equipment or materials from the diagnosis, treatment and prevention of disease that have been in contact with blood and its derivatives, including tissues, tissue fluid or excreta, or waste from infection wards (Hashim *et al.*, 2011). Although health care facilities like dental clinics may generate sparingly minimal waste as compared to large hospitals (Varey *et al.*, 2003) still the existing hazard may pose environmental ill effects.

The Republic Act (RA) 9003-Ecological Solid Waste Management (ESWM) Act of 2000 and R.A. 6969 Toxic Substances and Hazardous and Nuclear Waste (TSHNW) Act provides the mandate for waste management in the Philippines. Under these policies are frameworks for the management of infectious and dental wastes categorized as hazardous wastes. However, recent findings showed gaps on waste handling owing to disposal of hazardous waste along with municipal solid wastes in landfills or dumpsites (Galarpe and Parilla, 2014a; Galarpe and Parilla, 2014b), necessitating the conduct of this study on dental waste management.

A total of 150 dental clinics registered in the Department of Environment and Natural Resources-Environmental Management Bureau 10 (DENR-EMB 10) in Cagayan de Oro, Philippines were assessed.

The bulk of these entities present potential threat to the environment due to disposal of solid, medical, and hazardous wastes (Mackey *et al.*, 2014). Inevitably, environmental hazards may exist if these wastes are improperly managed (Hashim, *et al.*, 2011; Arora, *et al.*, 2014).

The main objective of the study was to assess the management of dental waste in selected dental clinics in Cagayan de Oro City. Specifically the study aimed to classify the wastes generated in dental clinics.

The awareness, perception, practices on waste management among surveyed dental clinics was determined. Extrapolating from these objectives were recommendations to be proposed prior to observed gaps.

Materials and methods

Study area

The study was conducted in Cagayan de Oro City, Philippines (Fig. 1).

About fifty (50) dental clinics were randomly selected from one-hundred fifty-four (154) dental clinics registered in the Department of Environment and Natural Resources - Environmental Management Bureau (DENR-EMB) of Region 10. The identification of dental clinics was employed using stratified sampling technique.

These clinics were then surveyed and assessed about their dental waste management for a period of one month. Surveyed dental clinics were located in fourteen (14) communities or barangays throughout the city. Two communities were classified as residential whereas the rest were commercial communities owing to existing business and servicing establishments.

Survey questionnaire and conduct of survey

The survey form was mainly composed of two parts. The first part identifies the kinds of wastes generated by dental clinics whereas the second part determines the dental clinics' waste management practice and disposal. A survey form was constructed which was composed of thirty five (35) questions framed to determine knowledge, attitude, and practices (e.g. disposal) of dentists or dental technicians/secretaries in dental clinics waste management. The type of wastes generated was also identified. All questions were adopted from Arora *et al.* (2014) and Narang *et al.* (2012).

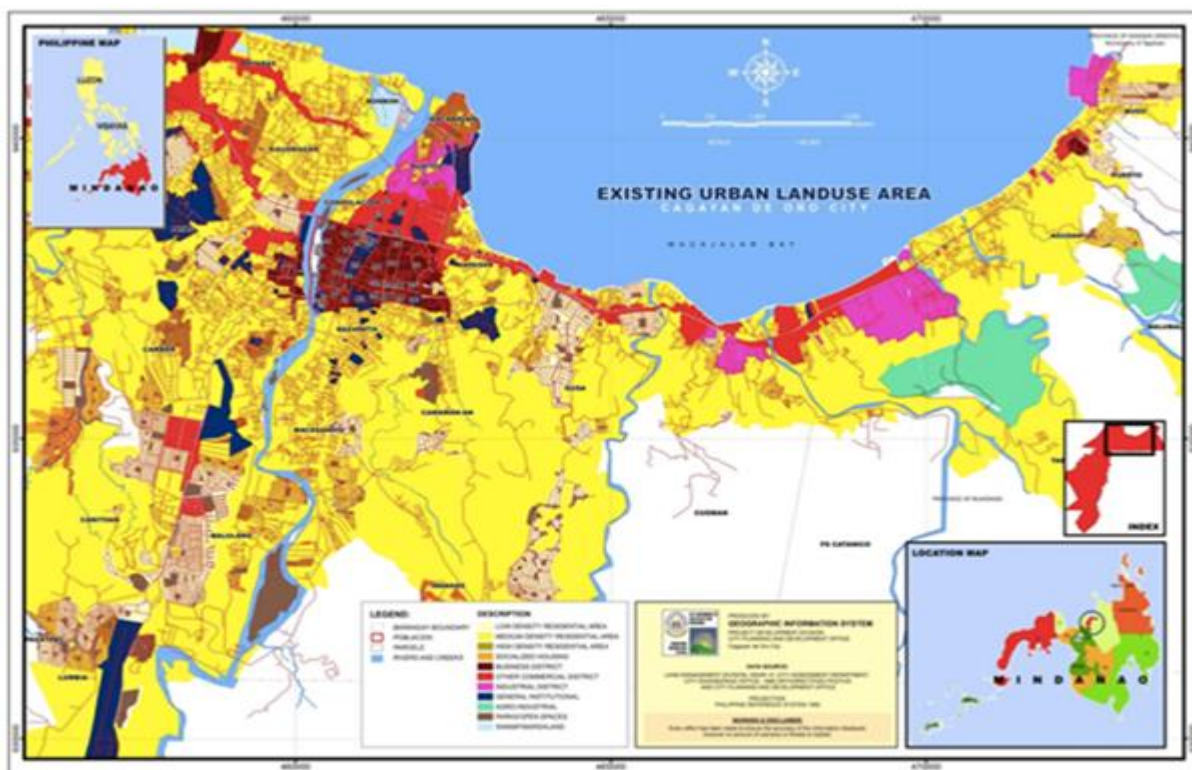


Fig. 1. Comprehensive land use plan (CLUP)-map of Cagayan de Oro, Philippines.

However, surveyed clinics were kept private and confidentiality agreement was made prior to conducting the study.

Statistical analysis

All data were assessed descriptively (Hashim *et al.*, 2011). Further test included Chi-square adopted from Arora *et al.* (2014).

Profile of surveyed dental clinics

A total of 35 questionnaires were distributed among private dental practitioners.

About 10% of the respondents were male whereas 90% were females. Most of the dental practitioners had a college degree (100%) and 60% had post graduate studies. About 80% of the respondents were practicing dentistry/dental technicians whereas the 20% for five years (Table 1).

Results and discussion

Waste classification

Table 2 depicts the types of wastes generated among dental clinics surveyed in Cagayan de Oro City.

Table 1. Demographic profile of the participating dentists.

Gender	Male	Female
	5 (10%)	45 (90%)
Education	Graduate	Post Graduate
	50 (100%)	30 (60%)
No. of years in clinical practice	1-5 years	6-10 years or more than
	10 (20%)	40 (80%)

As assessed the sharps/needle, files/reamers/burs, protective wear (gloves and masks), contaminated gauze pieces/cotton, anatomical wastes, suction tips and blood wastes ranked the highest % response of

waste generated. Present findings was in agreement with Daou *et al.* (2015) with sharp, infectious, and municipal wastes were mainly produced indicating dental clinics daily function.

Table 2. Dental Wastes Generated in Cagayan de Oro City.

Wastes identification	Number of clinic	Percentage
Amalgam	8	16
Dental Cements/Plaster of Paris	8	16
Sharps/Needle	50	100
Files/Reamers/Burs	50	100
Discarded Medicine	2	4
Protective Wears (Gloves, Masks)	50	100
Used X-ray Films & Solutions	8	16
Contaminated Gauze pieces/cotton	50	100
Anatomical Waste	50	100
Used Suction Tips	50	100
Alginate	49	98
Blood wastes	50	100
Busted fluorescent lamps	6	12
Used Batteries	1	2
Food Scraps	48	96
Plastics, Cellophanes & Bottles	50	100
Containers (e.g. chemicals)	50	100
Paper and Ball pens	1	2
Ink Cartridge (if there is computer)	8	16

Overall the waste materials can be categorized as hazardous which can be infectious (10%) like sharps or non-infectious (5%) such as chemical and pharmaceutical waste. Unmanaged dental wastes or

medical wastes maybe collected along with municipal solid wastes ending in landfills (Galarpe and Parilla, 2014a).

Table 3. Dentists reported knowledge about waste management practices.

Questions	Yes	No
Have you had any training in health care waste management?	47 (94%)	3 (6%)
Are you aware of any document outlining dental waste management policy?	50 (100%)	0 (0 %)
Do you know about colour-coding segregation of health care waste?	2 (4%)	48 (96%)
Do you follow colour-coding for health care waste?	50 (100%)	0 (0%)
Do you think it is important to know about health care waste generation, hazards and legislation?	45(90%)	5 (10%)
Does your dental clinic have a tie up with waste management companies?	2 (4%)	48 (96%)
Do you dispose all kinds of waste into general garbage?	50 (100%)	0 (0%)
Do you agree that dental waste should be segregated into different categories?	50 (100%)	0 (0 %)
Do you think safe management of health care waste is an extra burden on work?	50 (100 %)	0 (0%)
Do they use any PPE –personal protective equipment - (gloves, mask, and lab coat)?	50 (100%)	0 (0%)

Some dentists (16%) managed to use amalgam despite regulations on mercury abolishment.

From literature one unit of amalgam filling (equivalent of one small filling) is estimated to release around 0.55 g of mercury (Al-Khatib and Darwish, 2004).

Awareness

About 94% of the respondents responded to have attended trainings on health care waste management. Similarly, 100% of the dental practitioners were aware of the waste management policy (Table 3). Attending training of health care waste management practices had significant influence on

knowledge of respondents about waste management guidelines (P value= 0.02). The knowledge about waste management guidelines had also significant influence on segregation of dental and general wastes,

safe management of health care waste and use of any PPE –personal protective equipment (P value < 0.0001). Generally, knowledge on waste management guidelines is adequate in most dental clinics.

Table 4. Perceived Dental Waste Management Practice and Disposal in Cagayan de Oro City.

Waste Management & Disposal	Number of Clinic	% Percentage
Is the establishment practising waste segregation?	4	8
Is there labelling of garbage cans?	1	2
Dumpsite	0	0
Garbage Disposal through Garbage Truck Collector	50	100

However, most of the surveyed dentists/dental practitioners do not have sufficient knowledge about color coding waste segregation (96%), consequently mixing dental wastes along with general garbage types (100%) (Sharma *et al.*, 2013; Abhishek *et al.*, 2013). A similar study in India showed poor level of knowledge and awareness of biomedical waste generation hazards, legislation and management

among health care personnel (Sharma *et al.*, 2013). Further, a concern must be addressed given that surveyed dentists/dental practitioners find dental waste management (100%) as extra burden despite the approval for appropriate segregation (100%). If poorly managed and absence of disinfecting of waste materials may expose the dental workers and waste collectors to health hazards (Abhishek *et al.*, 2013).

Table 5. Color-coding Scheme for Containers.

Color of container/bag	Type of waste
Black	Non-infectious dry waste
Green	Non-infectious wet waste (kitchen, dietary etc.)
Yellow	Infectious and Pathological waste
Yellow with black band	Chemical waste including those w/ heavy metals
Orange	Radioactive waste
Red	Sharps and pressurized containers

Perception

Despite the positive level of awareness (Table 3) most dental clinics showed negative perception towards dental waste management practices (Table 4). Present finding was in agreement with the study in Chhattisgarh State, India with 8% of the dental clinics practiced waste segregation (Arora *et al.*, 2014) considered to be less. Further study showed inadequate knowledge and awareness among dental teaching institutions towards management regarding biomedical wastes (Kapoor *et al.*, 2014). Previous study among dentists showed 42.1% felt that there was a lack of waste management agency services and 16.9% felt that a lack of knowledge on waste

management as gaps on handling wastes (Rudraswamy, 2014). It can be extrapolated that awareness however may not directly reflect positive perception and practices towards dental waste management.

Practices

Generally, wastes such as sharps and needles based on the survey are not disposed to garbage cans but are segregated and stored in plastic bottles as can be seen in Fig. 2.

These findings are similar to the study on medical waste management in Metro Manila, Philippines with

plastic bottles containing discarded sharps and needles were sent to hospitals (Varey *et al.*, 2013). In the present study, there are two identified hospitals with dental clinics in the city as optional to contract

services of off-site waste treatments. Although surveyed clinics sent some waste materials to these hospitals, poor waste management practices exist.



Fig. 2. a) Bricks made of Encapsulated; b) Busted Lamps and Fluorescents Sharps and Needles.

Based on the survey, the dental wastes are separated from general wastes and sent to hospitals. Hazardous wastes which may include infectious waste, medicine vials, dextrose bottles, syringe, needles, chemotherapeutic drugs, placenta and busted lamps and fluorescent as reflected from their Hazardous Waste Generator Report (2013) were similarly

assessed. In the particular hospital (Fig. 2) the collected sharps and needles are encapsulated and are made into bricks. Busted lamps and fluorescent are stored in a proper area. Other medical wastes generated are decontaminated using an autoclave machine. These however were not entirely practiced by surveyed dental clinics.



Fig. 3. Sharps and Needles stored in Plastic bottles.

Similarly, no government inventory of sharps/needles was available since generally the number of sharps or needles disposed depend on the number of patients. Often these wastes were stored in plastic containers (Fig. 3). Anatomical wastes i.e. tooth extracted were said to be disposed to garbage cans or given to the

person being extracted with tooth. Blood wastes produced during the extraction are drained or flushed into lavatories/sinks installed in the dental chair (Fig. 4). Other wastes mentioned are directly disposed to garbage cans.



Fig. 4. Direct water flushing of blood and other liquid wastes to lavatories/sinks.

Almost all dental clinics surveyed also produce wastes such as alginate (98%), food scraps (96%), plastics, cellophanes and bottles (100%). Alginate is one of the most frequently used dental materials. It is an elastic, irreversible hydrocolloid impression material. Irreversible hydrocolloid impressions form an inseparable part of indirect restorations (Nandini *et al.*, 2011). Other dental wastes were found in minimal amounts such as dental cements/plaster of paris (16%), amalgam (16%), discarded medicine (4%) and used x-ray films and solutions (16%). Dental amalgam is a dental restorative filling material alloy that consists of approximately 50% mercury with the balance including silver, tin, copper, and zinc and other trace metals. In a report by the World Health Organization, mercury use in dental amalgam represents the most common form of human exposure to elemental mercury (recognized as a toxic substance) and along with its use in laboratory/medical devices, comprises 53% of total global mercury emissions leading to potential

environmental damage. Despite ongoing concerns about human health effects, the use of dental amalgam containing mercury continues to be widespread as reflected in this study wherein 16% of the surveyed dental clinics were still producing amalgam waste. Other generated hazardous wastes were busted fluorescent lamps (12%) and used batteries (2%). No proper disposal of these wastes was observed based on the survey conducted. Other common wastes generated are papers and ballpens (2%) and ink cartridges (16%).

Gaps and best practices to recommend

The most appropriate way of identifying the categories of health care waste is by sorting the waste into color-coded plastic bags or containers. Recommended color-coding scheme for health care waste is depicted in Table 5. According to the Department of Health that health care facilities also have the option to contract the services of off-site waste treatments. However, these off-site waste

treatments should be accredited by the government with all necessary permits.

Ideally dental wastes must be separated from other solid wastes. However in the survey, during the collection process by garbage collectors, other dental wastes except for other special wastes such as dental

cements/plaster of paris, alginate, files/reamers/burs and sharps and needles which are stored in plastic containers were often mixed with general wastes. Figure 5 similarly presents proper waste handling of medical wastes which must be adopted by dental clinics as mandated by the Department of Health.

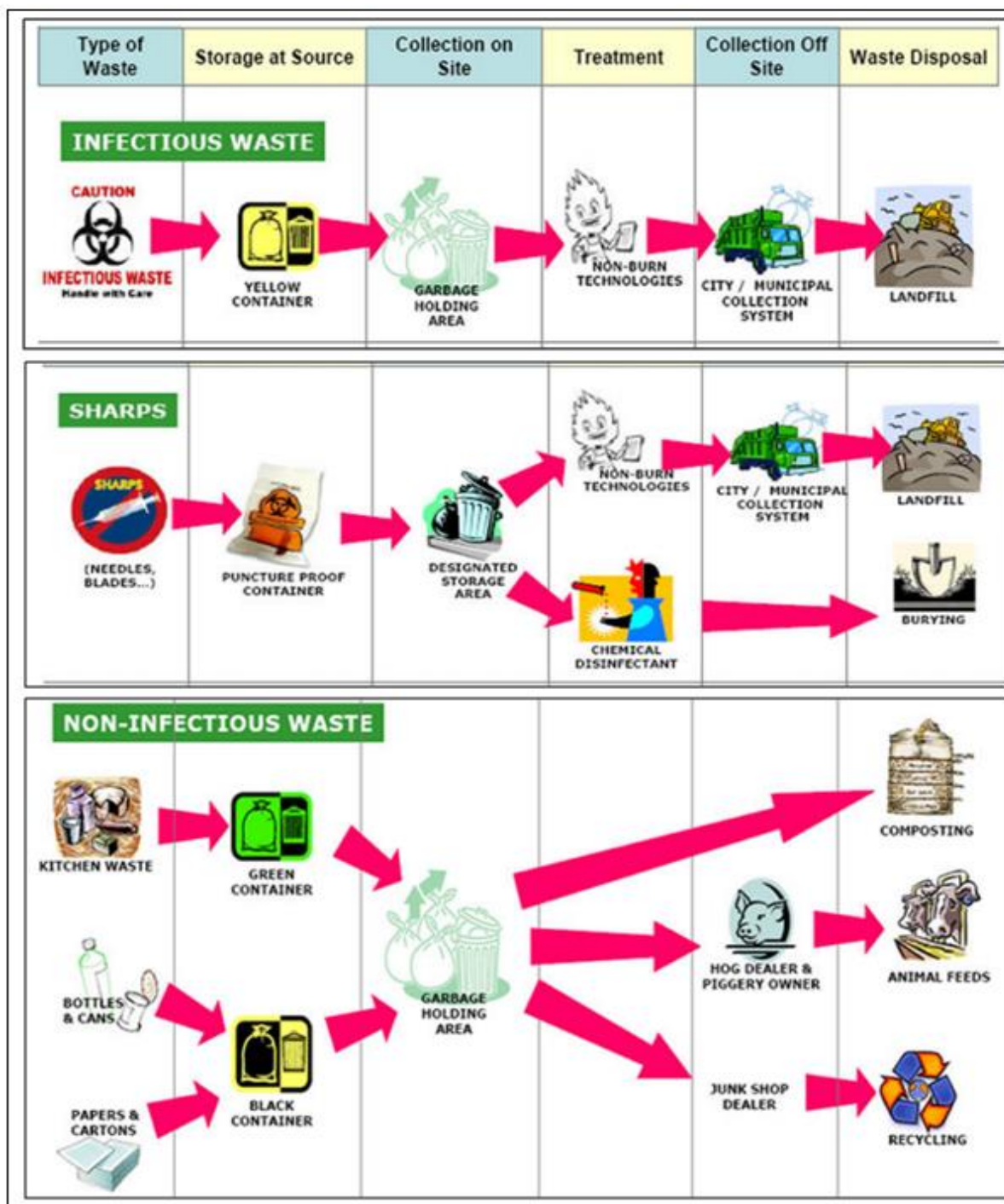


Fig. 5. Basic Steps of Health Care Wastes Handling.

Extrapolating from this, it was ideal that concerned government agencies must have coordination to provide guidelines and monitoring of dental waste management. Likewise, a provision of mandates and policies for business permits and operation inclusive of waste management must be reviewed. With regards to the dental clinics employers/employee's a training of proper waste disposal and handling of waste products.

Conclusion

Overall most dental clinics surveyed generated sharps, infectious, and non-infectious (plastics) wastes. Both dentists and dental technicians were aware of the hazardous effect of improper dental waste disposal however with poor practices towards dental waste management. Similarly, awareness and practices were significantly influenced the waste management trainings attended by dental clinic technicians/dentists. Generally, awareness and perception on waste management guidelines was adequate in most dental clinics, however, with poor practices.

References

Abhishek KN, Supreetha S, Varma P N, Sam G, Khanapure S C, Sivarajan S. 2016. Awareness-Knowledge and Practices of Dental Waste Management among Private Practitioners. Kathmandu University medical journal (KUMJ), **14(53)**, 17-21.

Al-Khatib I A, Darwish R. 2004. Assessment of waste amalgam management in dental clinics in Ramallah and al-Bireh cities in Palestine. International journal of environmental health research, **14(3)**, 179-183.
<http://dx.doi.org/10.1080/09603120420002000218>
598.

Arora R, Agrawal A, Singh D, Reddy J. 2014. Management of dental waste in private clinics in Chhattisgarh state, India—A cross sectional study. Journal of Dental and Medical Sciences, **13(1)**, 53-6.

Daou M H, Karam R, Khalil S, Mawla D. 2015. Current status of dental waste management in Lebanon. Environmental Nanotechnology, Monitoring & Management, **4**, 1-5.
<https://doi.org/10.1016/j.enmm.2015.04.002>

Department of Health (DOH). 2015. Health Care Waste Management Manual. Retrieved March 30, from
www.doh.gov.ph/Health_Care_Waste_Management_Manual-UNPRO.pdf

Galarpe VRK, Parilla RB. 2014a. Opportunities and Threats to Adjacent Community in a Sanitary Landfill, Philippines. Environment Asia, **7(1)**.
<https://doi.org/10.14456/ea.2014.15>.

Galarpe VRK, Parilla R. 2014b. Analysis of Heavy Metals in Cebu City Sanitary Landfill, Philippines. Journal of Environmental Science and Management, **17(1)**, 50-59.

Hazardous Waste Generators Quarterly Report. 2013. Acquired from DENR-EMB-10.

Hashim R, Mahrouq R, Hadi N. 2011. Evaluation of dental waste management in the Emirate of Ajman, United Arab Emirates. Journal of International Dental and Medical Research, **4(2)**, 64-9.

Kapoor D, Nirola A, Kapoor V, Gambhir RS. 2014. Knowledge and awareness regarding biomedical waste management in dental teaching institutions in India-A systematic review. Journal of clinical and experimental dentistry **6(4)**, 419-424.
<https://doi.org/10.4317/jced.51565>.

Mackey TK, Contreras JT, Liang BA. 2014. The Minamata Convention on Mercury: Attempting to address the global controversy of dental amalgam use and mercury waste disposal. Science of the total environment, **472**, 125-129.
<https://doi.org/10.1016/j.scitotenv.2013.10.115>.

Nandini VV, Venkatesh KV, Nair KC. 2011. Alginate impressions: A practical perspective. Journal of Conservative Dentistry **11(1)**, 37–41.
<https://doi.org/10.4103/0972-0707.43416>

Narang R, Manchanda A, Singh S, Verma N, Padda S. 2012. Awareness of Biomedical Waste Management Among Dental Professionals and Auxiliary Staff in Amritsar, India. Oral Health and Dental Management **11(4)**, 162-169.

Rudraswamy S. 2014. Hospital Waste Management Training Among the Staff Of Dental Teaching Hospitals in Bangalore City: Hospital Waste Management. Anchor Academic Publishing.

Sharma A, Sharma V, Sharma S, Singh P. 2013. Awareness of biomedical waste management among health care personnel in Jaipur, India. Oral Health Dental Management, **12(1)**, 32-40.

Varey N, Diaz LF, Allen N, Buenafe L, Horace C, Eggerth L, Favila G, Kahlon M, Lopez R, Palacio A, Pook R, Rollan R. 2003. Metro Manila Solid Waste Management Project (TA 4858- PHI).