ENVIRONMENTAL POLICY IN MALAYSIA: CASE STUDY OF BIOMEDICAL WASTE, STRATEGIES AND ISSUES

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ABSTRACT

Management of waste is a general acute problem around the globe. Waste management is of great concern as urbanization and economic development increase leading to generation of larger quantity of waste materials. The management of waste materials requires immediate attention of the newly emerging economy country such as Malaysia. To be more specific, biomedical wastes are becoming a topic of one cannot deny the important roles play by biomedical science and its activities on human life and fitness. However, these activities can generate some wastes that pose severe effects on human health and environment at large, especially if there is no proper management policy in place. Although some may argue that waste is generally unavoidable by-product of most human activities but the provision of expanded healthcare facilities today have added substantial quantities of biomedical waste into waste stream with severe environmental and human health consequences. This paper examines the level of biomedical waste in Malaysia. It also addresses the impacts of these biomedical wastes and the strategic measures taken by Malaysian government. Finally, it identifies some potential issues associated with policy measures and put forward some policy recommendations for precautionary measures in the future.

Key words: *Biomedical activities, biomedical waste, Management, Policies, Strategies and Issues.*

INTRODUCTION

Clinical waste resulting from healthcare establishment is growing in direct proportion with the increasing demand of medical service in Malaysia. With attractive packages, health tourism is thriving in Malaysia which sees hundreds of thousands patients from as far as Europe coming to seek various medical treatments in the country. Apart from booming health tourism, pandemics like SARS, Avian Flu as well as changing demographic lifestyles and ageing nations, means more people are seeking medical help, which sees production of biomedical increasing. By the year 2020, biomedical waste from Malaysian hospitals is

estimated to hit 33 000 tonnes annually. Currently, the capacity of incineration in this country is limited to processing 18 000 tonnes of wastes per year (Frost and Sullivan, 2010). However, as developing countries undergo economic growth, industrialization, engineering activities in biomedical science and development, the proper management of hazardous waste from those activities becomes an area of increasing concern. Responsibility for management of waste often resides with national government in any country. In fact, the control of industrial emissions was a concern for the government. To overcome this, the government enacted the Environmental Control of Toxic and Hazardous Waste Management Code and Environmental Quality Regulations related to scheduled wastes was passed in 1989. In order to bring into action, Environmental Quality Orders and Regulations (Prescribed Premises) related to Scheduled Wastes Treatment and Disposal Facilities were simultaneously introduced in 1989. In 1990, the Promotion of Investments Order (made under the Promotion of Investments Act, 1986) was introduced to regulate environmental issues in the context of investment activities that can affect any environmental resource. This was later followed by the Prohibition on the Use of Controlled Substance in Soap, Synthetic Detergent and Other Cleaning Agents Order passed in 1995. As such, this paper seeks to highlight the initiatives and course of actions taken by Malaysian government to address the negative consequences of biomedical wastes that can endanger the health of people and their environment.

CONCEPTUALIZING WASTES

According to Pruss et al (1999), the World Health Organization (WHO) defined medical waste as “any waste which consists wholly or partly of human or animal tissue, blood or other bodily fluids, excretions, drugs or other pharmaceutical products, swabs or dressings, needles or other sharps; and any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion”. Broadly defined in the context of this paper, biomedical waste is all wastes produced by hospitals, clinics, doctors' and dentists' offices, veterinary clinics, and biomedical research labs. Usually it refers to biomedical wastes that could potentially spread infectious diseases. This includes human and animal anatomical wastes, fluids and secretions from patients, contaminated syringes and other "sharps", contaminated surgical and nursing supplies, and contaminated laboratory wastes. Biomedical wastes are the infectious wastes generated from hospitals and improper management of waste from healthcare facilities that can have direct or indirect health impact on community and environment at large. A breakdown of waste types and sources results to four major categories of waste: municipal solid waste, industrial waste, agricultural waste and hazardous waste. Biomedical waste is partly belongs to hazardous waste category, which is the major focus of this paper, (WHO, 2003, p.12; and Environmental Quality Regulation, 1998).

SOURCES OF HAZARDOUS WASTE IN MALAYSIA

A clear appreciation of the quantities and characteristics of the waste being generated is a key component in the development of robust and cost-effective waste management strategies. In Malaysia, amongst other Asian countries, quantification and characterization of waste forms the basis for management and intervention by the

government and agencies and/or institutions. Priority is given to the systematic surveying of waste arising and the quantities, characteristics, seasonal variations and future trends of waste generation at large. Small- and medium-sized institutions and industries that generate hazardous wastes include hospitals and health-care centers, electroplating and metal finishing shops, textile factories, dry cleaners and pesticide users. In general, the principal sources of wastes are residential households and the agricultural, commercial, construction, industrial and institutional sectors (Agamuthu, 2001, pp.1-5).

On top of all, biomedical research facilities generate a complex array of wastes, which may be broadly grouped into two categories: biomedical research wastes that are direct products of research activities, and other conventional wastes from research support operations such as facility construction, operation, maintenance, and demolition, and administrative functions. With some exceptions, conventional wastes from biomedical research facilities are similar to or indistinguishable from wastes generated by other sources. Biomedical research wastes do contain multiple types of hazardous materials such as combinations of toxic chemicals, radioactive materials, and bio-hazardous agents. Bio-hazardous waste is usually considered by the scientific community to be a waste that could, in a susceptible host, cause infection that may develop into a disease, which could be expressed as a recognizable departure from normal. However, the public often perceives a waste to be bio-hazardous on the basis of its source and appearance. Waste appearing to originate from a hospital, clinic, or biomedical research laboratory is often assumed bio-hazardous, even if potentially infectious microorganisms or toxins are not present therein (Agamuthu, 1997, p. 5). Specifically speaking, clinical waste or biomedical waste "includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials" (World Health Organization [WHO], 2011). Without efficient infrastructure and adequate waste disposal options, large volume of these wastes may pose great danger to human health and environment. Without proper management, contaminated waste poses risk not only to public, but to those who come into contact with them namely health workers, scavengers, etc. Faulty handling and improper disposal may lead to recycling and reusing of contaminated waste such as syringes and needles (WHO, 2011). Report by WHO has shown that in the year 2000, injection with contaminated waste such as syringes and needles (categorized as "sharps") have caused millions of Hepatitis B Virus and Hepatitis C Virus and at least 26000 HIV infections. Studies have also shown that 20% of those handling "sharps" have experienced "sharp injury".

Table 1: Percentage of waste type per total waste in public health care centres

Type of waste	Quantity
Non-infectious waste	80%
Pathological waste and infectious waste	15%
Sharps waste	1%
Chemical or pharmaceutical waste	3%
Pressurized cylinders, broken thermometers etc	<1%

Source: WHO (2005), *Management of Solid Healthcare Waste at Primary Healthcare Centres - A Decision-Making Guide, Geneva*

However, in Malaysia, Private Healthcare Facilities and Services Act 1998 and Private Healthcare Facilities and Services (Private Medical Clinics or Private Dental Clinics) Regulations 2006 had been formulated to address the infectious wastes from clinics. Under these Regulations, hazardous waste includes both infectious and non-infectious waste. Infectious waste includes human, animal, biological waste or contaminated sharps and any items that may be contaminated with pathogens, whereas non-infectious waste includes

toxic chemicals, cytotoxic drugs, radioactive, flammable and explosive waste. However, according to the WHO only 20% of the healthcare wastes are considered infectious to human beings, while 80% of them are non-infectious in nature as shown in Table 1:

RATIONALE FOR WASTE CONTROL

Incineration and other medical waste treatment processes can generate secondary wastes and pollutants if the treatment facilities are not properly designed, constructed, and operated. These pollutants may have adverse environmental impacts on human health. Polychlorinated dioxins and dibenzofurans, and corrosive gases may be produced by medical waste incinerators. Varying levels of pollutants may also be emitted from alternative non-incineration treatment processes of biomedical wastes, depending on the method used for pathogen inactivation and the type and/or nature of wastes being treated. Whether these pollutants are released into the environment or contained depends on a number of operational factors and the level of technological advancement inherent in the treatment system. Phenolic disinfectants are of particular concern because they may disrupt wastewater treatment processes or result in discharges of toxic effluents that may have serious effects on human health. Many publicly owned treatment works have set allowable wastewater concentration limits for phenolic compounds at very low levels, precluding disposal of wastes containing these disinfectants via the sewerage system. Environmentally speaking, the uncontrolled dumping of biomedical wastes has the potential for transporting pathogens or disease producing organisms that can cause significant adverse impacts on human health and the environment (Prevention and Control of Infectious Diseases Act 1988, Ministry of Housing and Local Government, 1999, Section 4).

POLICIES AND REGULATIONS ON WASTE MANAGEMENT

Many groups of stakeholders, including waste producers, regulators, legislators, consultants, contractors and equipment suppliers, educators, NGOs, media and the general public, are involved in national waste management policies and strategies in Malaysia. Although each of these stakeholders plays a potential role, three groups such as municipalities, regulators and legislators provide the key to effective national waste management policies and strategies that integrate the responsibilities of all stakeholders in making waste management a successful venture in the country. Institutions and legislations at the national level generally provide the basic infrastructure for the implementation of policies, strategies and actions for waste managements in general.

In recent year, three general trends in biomedical waste management private consortia in 1993 and legislation have been evident in Malaysia. These are the creation of agents for the strengthening of environmental policies and strategies and the development of more focused environmental legislation, and the increase of manpower capabilities through education and training. There has been an upward trend in the status of the above three aspects of waste management, as government ministries and high level agencies have been established specifically to control such biomedical wastes.

(a) Guidelines Policy for Managing Biomedical Waste

More than a decade ago, serious concern has been raised regarding the potential for spreading pathogens, as well as causing environmental contamination due to the improper handling and management of clinical and biomedical waste. Whilst full regulatory programs and guidelines to control waste from such institutions have been introduced in most developed countries, in Malaysia, the Ministry of Health prepared preliminary guidelines for the management of hospital waste in 1998. The Ministry has published national guidelines for management of clinical and related wastes and similar biomedical management guidelines have also been produced at the state levels. This is to rationalize and recommend methods for the management of health care wastes within the country. In addition, guidelines were drafted for the management and safe disposal of hospital wastes and the Ministry of Health produced the "Hospital Waste Management Manual," which included detailed guidelines for handling and disposing wastes (Saw, C.B. 1994). Department of Environment (DOE) has formulated the Waste Pollution Prevention and Control Law and/or the Regulations on management of biomedical hazardous wastes. However, hospital waste is generally collected and disposed of together with other domestic wastes on the basis of the guidelines provided. In some of the larger states, individual hospitals have installed on-site incinerators for the disposal of clinical wastes (WHO/WPRO, 1998, p.12).

(b) Regulatory Measures

In Malaysia, schedule waste related to hazardous clinical or biomedical waste is categorized into a few categories according to its contents (Department of Environment [DOE], 2009). Recently, Environmental Quality (Scheduled Wastes) Regulations 2005 ("Regulations") serves as a key legal framework that deals specifically with hazardous waste. Subsidiary legislation which falls under this are (1) The Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Order 1989; and (2) The Environmental Quality (Prescribed Premises (Scheduled Wastes Treatment and Disposal Facilities) Regulations 1989. Based on the research conducted in HUKM, segregation process was highlighted as vital in managing biomedical waste. The waste is disposed of according to color coded contained or plastic bag (Zaimastura, 2005). This is in line with the Environment Quality Act (Scheduled waste) 1989 which stipulated that all healthcare establishments in Malaysia must adopt the colour coding standard in classifying biomedical waste. Blue plastic bag / container is used for wastes to be autoclaved, yellow is for wastes that are to be incinerated and black is for general household wastes (DOE, 2009). After the process of collection and storage, in central region biomedical waste will be transported to the incinerator in Teluk Panglima Garang, Selangor. Incineration is the only method in disposing of medical waste practiced by Radicare. (Zaimastura, 2005) Despite the risk of pollution, incineration is seen as the most effective way to dispose of some medical waste such as sharps and body parts and bodily fluids.

In other words, disposal of hazardous, radioactive, and medical wastes is an intensely regulated activity. A complex framework of Federal, state, regional, and local laws, licenses, and permits govern virtually all aspects of biomedical waste management from "cradle to grave," including labeling and identification, on-site storage and management, transportation, treatment, and disposal. Severe penalties were imposed against both facilities and individuals for noncompliance. These include criminal or civil actions leading to restrictions or revocations of facility operating permits, fines, and imprisonment. Academic and research facilities have recently been the focus of enhanced enforcement efforts of Environmental Quality Act (EQA) by the state agencies. Biomedical research programs conducted by Federal agencies are also subject to several Executive Orders requiring agencies to establish waste/pollution prevention programs, set waste reduction goals, and use products made from recycled materials. Pertaining to private clinics in the country, under

the Facilities and Services (Private Medical Clinics or Private Dental Clinics) Regulations 2006, it has been clealy stated that the private practitioner or owner of the private medical clinic shall take the following actions: (i) infectious and non-infectious waste shall be separated at the point of generation; (ii) infectious waste shall be discarded into clearly identifiable containers or plastic bags that are leakproof and puncture-resistant and the containers shall be marked with the universal symbol for biological hazards (three black crescents superimposed on a circle with white background and the word "INFECTIOUS SUBSTANCES (WASTE)" at the bottom); (iii) non-infectious waste shall be handled in accordance with good safety practice and any written law relating to handling of such waste; and (iv) all hazardous waste shall be packaged, transferred and disposed of in a manner accepted by the relevant authority to protect both the persons and the environment (see: Tiong, et al, 2012). However, an enabling federal regulations setting for specific source reduction and minimization requirements have not been established for most types of wastes.

(c) Hierarchy of Waste Minimization and Management Approaches

The Department of Environment in Malaysia (DOE) has set up **a** hierarchy of waste minimization and management approaches preference for hi providing the greatest protection of the environment. The DOE sought that hazardous waste from biomedical activities should be prevented or reduced at the source wherever feasible. Waste of any kinds that cannot be prevented should be recycled in an environmentally safe manner whenever feasible; and waste that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. The DOE provides guidance for selecting general approaches to waste minimization solely on the basis of environmental considerations. For biomedical research facilities, it is of paramount importance to ensure that the approaches used will not have adverse effects on patients, laboratory animals, and scientific productivity, (CAP's Report, 2001, p.2).

STRATEGIES WASTE MANAGEMENT IN MALAYSIA

(a) *Adoption of Incineration for Waste Treatment*

In Malaysia, the Bukit Nanas Integrated Waste Treatment Facility is the country's first comprehensive treatment plant possessing various facilities including high-temperature incineration, physical and chemical treatment. Thus, hazardous waste incinerators have been developed in Malaysia. Since privatization of Malaysian clinical waste management and hospital support services in 1995, regional and on-site medical waste incinerators were developed. According to Consumers' Association of Penang (CAP), five regional medical waste incinerators with capacity of 20 to 500kg per hour were built to manage biomedical wastes of all types. In addition, other regional of higher capacity of about 200kg per hour are underway but yet to be built due to siting problems and resistance from local authorities. In addition, the government had spent RM17 million to establish another seven mini-incinerators with a capacity of 5-20 ton per day in the resort Islands in Langkawi, Labuan, Tioman and Pangkor, (CAP's Malaysia Country Report, 2001, p.1).

(b) Waste Collection Strategy

Malaysia also adopts the "Cradle to Grave" concept where waste is managed from the point of generation to the final stage of disposal by the concessionaires, which are put in place. Healthcare providers on the other hand, manage the segregation and storage process (Frost and Sullivan, 2010). Other strategies adopted in Malaysia is control through legislative and non- legislative means, building suitable infrastructures in treating and disposing of waste as well as through the support for any effort to reduce and recover wastes. There are a few regulations that are in place to ensure the protection and safety as far as the biomedical waste is concerned (Zaimastura Ibrahim, 2005). In many cities of the country, municipal biomedical waste is gathered in a variety of containers ranging from cans and rattan baskets to the used grocery bags and plastic drums or bins. In some cities, dumping areas have been designated (formally or informally) on roadsides from which bagged and loose waste is collected. A wide variety of collection systems are used including hospital to-hospital or medical centers collection and indirect collection, by which containers, skips or communal bins are placed near medical/health centers.

Collection and transfer services are capital-intensive and highly mechanized employing standardized collection vehicles, compactors and containers and providing collection rates in the range of 90 per cent and collection services to most urban and even rural medical areas. Source separation and subsequent collection of recyclables is governed by regulation and is facilitated by the provision of colour-coded bins or bags or by the establishment of area recycling centers. Whilst a significant number of big cities in Malaysia continue to retain parts of the collection process within their direct municipal control, many others have contracted to private sector waste collection firms and have made private sector trade and industrial establishments responsible for the collection and disposal of their own solid waste including those from health facilities. In some of the cities, biomedical waste collection and transfer tend to be labour-intensive and are undertaken by personnel directly employed by the municipal authorities. Waste collection is undertaken using low-levels of mechanization with handcarts and tractor-trailers being used to collect waste from communal bins and dumping areas (CAP's Malaysia Country Report, 2001, p.1).

In some cities, decentralized pre-collection has proven effective in achieving increased collection rates. In large urban cities such as Kuala Lumpur, transfer stations are used as a means of gathering waste from a sub-division of the city in order to compact the waste for maximizing transportation efficiency and then transferring the waste to larger haulage vehicles for delivery to the disposal sites. In addition, transfer stations often serve as material recovery centers where recyclables are separated for reuse/recycling. Increasingly, collection services are being privatized. In most of the states in Malaysia, collection services are now contracted out to private waste collection companies and the practice is gaining momentum. In Malaysia, as elsewhere, the main motivation for privatization of waste collection of any types is cost saving.

(c) *Private Sector Initiative*

In Malaysia, the privatization of waste management commenced in 1997 with a privatization policy oriented towards reducing the Government's financial and administrative burden; promoting competition, increasing the role of the private sector in nation building and providing opportunities to meeting the targeted new economic policy. The rationale for the privatization of biomedical waste management services and all other types is mainly economic. Evidence seems to indicate that public provision is more costly and frequently unsatisfactory due to the inefficiency and rigidity of public bodies. Privatization basically involves the transfer of management responsibility and/or ownership from the public to the private sector and has proven to be a powerful means of improving the efficiency of some biomedical waste management services such as collection, haulage, and disposal. Such

initiatives have been led by direct partnerships between the local community and the private sector in the management of wastes from all sources. Privatization is seen as an effective and efficient way to improve the quality of biomedical waste management (United Nations Commission for Asia and The Pacific [UNESCAP], 2000). Three concessionaires namely Radicare (M) Sdn Bhd, Faber Medi Serve (M) and Pantai Medivest Ddn Bhd have been appointed by the Ministry of Health to help improve the management and of public health care service (Malaysia Environmental Industry, 2010) in terms of waste collection, transportation and disposal system. They have generated almost RM 200 million by managing almost 16 000 tonnes of biomedical waste in the year 2009 (see: Malaysia Environmental Industry, 2010).

The Government is also expanding the participation of the private sector through the intended placing of contracts for the collection and treatment of medical waste, the storage of low-level radioactive waste and the remediation of its closed landfills. Thus, this strategy has also resulted in the growth of private companies specializing in the waste business to complement the services that are supposed to be mainly provided by the Local Authorities. Several municipalities in Malaysia have let smaller-scale general biomedical waste collection contracts. For example, the states of Selangor and Penang are currently using private sector landfill arrangements and the Federal Government is planning to extend these schemes nationally. These two states are extremely useful model for cities that have reached the point at which they were ready to improve their waste management arrangements and which carefully considered why and how contracting-out to the private sector was the best means of accomplishing their objectives. The results, in terms of environmental improvement and financial savings, are amply documented in these two cities (Abdul Raufu, 2000, p.45; The Eight Malaysia Plan 2001-2005, p.188; Mid-Term Review of the Eight Malaysian Plan, p.446).

(d) *Material Recovery and Recycling*

Material recovery and recycling are encouraged to reduce the net amount of wastes requiring treatment and disposal. In many of the states the rate of recovery of recyclable materials from biomedical wastes has improved significantly in recent years (Maruthai, et al, pp. 360-61). Hence, minimizing the quantities of waste requiring disposal, through source reduction, material recovery and reuse and recycling, is increasingly being realized as the central basis of an integrated approach to biomedical waste management.

The informal sector plays a significant role in waste recycling in Malaysia. Waste pickers perform the recycling operations in many cities of the states. Material recovery and recycling assume particular economic significance. Recycling not only reduces the volume of biomedical wastes to be disposed, but also saves the country valuable foreign exchange which would otherwise be used to import raw materials. Waste reduction through recycling and reuse in Malaysia has emerged recently as an environmental priority. The governments' goal is to increase recycling of waste from present 10 per cent to 25 per cent in 2007 (DOE, 2006). Thus, recycling in the country has improved dramatically over the last decade and such improvements are likely to continue in the foreseeable future. The government has relaunched its recycling campaign on December 2000 with target of 22% of all wastes, including biomedical types, to be recycled by the year 2020, (CAP, 2001, p.1).

(e) *Landfilling Facilities*

The disposal of waste at a semi-engineered or full sanitary landfill has been adopted by cities from both low and high-income states as the most attractive of disposal options. Cities in Malaysia have adopted controlled tipping or sanitary land filling for waste disposal. Kuala Lumpur employs disused tin mines for waste landfills around the city. The generation of landfill gas has been turned to advantageous use at a number of landfills through the development of electricity generation facilities. Severe land constraints have led to complex engineering infrastructure solutions being developed to ensure high standards of operational and maintenance control and have enabled the development of acceptable landfill solutions in some of the states. In other words, purpose-built sanitary landfills have been developed to receive hazardous waste in Malaysia (Tiong, et al, 2012). In the densely populated cities and towns of the states, the land availability for landfill site is a major constraint. Between 1995 and 2000, the Federal government had spent RM 20.9 million to build 9 sanitary landfills and upgrade other twenty-seven existing landfills in 34 local authorities (CAP's Report, 2001, p.1).

(f) *Economic and Financial Strategies*

In Malaysia, a number of different economic tools have been integrated into their strategic waste management plan or policy strategy to ensure that waste in all its forms is minimized. As a matter of fact, different stages of the production and consumption process have produced different forms of waste in the country. The challenge has been to choose the right economic tool given the stage at which the waste has been produced. For example: licences, permits and extraction charges have been used to ensure that excessive use and waste of natural resources inputs does not occur; tax deductions, pollution taxes, and input and product taxes have been used to ensure that clean environmental practices are encouraged and rewarded. Refundable deposits for private hospitals and private medical healthcare have been used to ensure the recycling of end materials when they are economically viable; and performance bonds have been used as an incentive for hospitals to manage their affairs in an environmentally sound manner (Abdul Raufu, 2007). However, the use of economic measures to assist in biomedical waste management in the country is minimal and sparsely spread throughout a limited number of sectors. A number of criteria/options have been used in choosing between various policy instruments and strategy alternatives with respect to economic and financial aspects of waste management services in the country (Abdul Raufu, 2007, pp.15-19; Section 30 (B) of EQA Amendment 1996). The chosen criteria/options have been compatible with the national regulatory objectives and existing legislation as well as the long term plans of the national environmental protection plan. In addition, this approach has ensured that selected policies are credible substitutes for, or supplements to regulatory legislation, and that they conform to the principle of institutional concordance.

(g) *Awareness and Campaign Strategy*

Although, greater emphasis was on source reduction practices or reduce biomedical waste generation and its hazards. However, awareness and campaigning is another minimization practices in Malaysia to reduce the volume and toxicity of unavoidable biomedical wastes, and improvements in transportation, storage, treatment, and disposal of wastes by ensuring containment of hazardous materials and prompt removal of these materials from the teaching hospitals and medical centers. Thus, public cooperation is the key to achieving a successful and sustainable biomedical waste management practice in various medical and health-care centers of each city. A good waste management practice presupposes the involvement of the local community in day-to-day processes and other

NGOs as well as international programs jointly organized with Malaysian government (Johannesburg Summit 2002-Malaysia's Country Profile, p.35; Mid-term Review of the Eight Malaysia Plan, p.446, Periasmy, Ambikavathi, 2003, pp.129-132).

ISSUES IN BIOMEDICAL WASTE MANAGEMENT

Although, the findings have shown that the management of biomedical waste management in HUKM is generally good based from observation, interview and site visit (HUKM). However, according to a research conducted by Chong, (2007) in Tengku Ampuan Rahimah, the results show that the hospital is practicing a good clinical management and the staffs generally have a good awareness in clinical management system (Chong, 2007), but there has not been extensive research done on the effectiveness of the management of clinical wastes in preventing infectious diseases.

Generally speaking, waste collection systems are relatively inefficient as the collection vehicles and containers are not fitted with compactors, necessitating the transportation of loose waste and, hence, imposing a constraint on the capacity of the collection system. The lack of efficient transfer facilities represents a weak link in the waste collection and transportation system. In general, financial constraints and the lack of technical expertise severely limit the effectiveness of waste management in the cities and towns of the states. Shortages of storage, collection vehicles, non-existent and/or inadequate transfer stations, traffic congestion and a lack of public compliance are factors affecting collection efficiency, resulting in low waste collection rates. The lack of coordination and overlapping of responsibilities among various government agencies and different levels of local government also contribute to the problem (CAP, 1996, p.332).

Biomedical facilities typically generate hundreds and thousands of different wastes, usually in small volumes as the result of a one-time experiment. These properties significantly increase the complexity of biomedical waste management. Unit costs of analyzing, processing, record keeping, shipping, treating, and disposing of biomedical waste in orders of magnitude is higher than for conventional wastes. Biomedical research wastes may contain multiple types of hazardous materials--combinations of toxic chemicals, radioactive materials, and bio-hazardous agents. Therefore, selecting treatment methods for these multi-hazardous wastes and determining the most appropriate sequence of treatment procedures is often a complicated and problematic task. The presence of multiple types of hazardous materials also reduce or eliminate access to disposal facilities, as most of these facilities can usually process only a single type of waste. The hazardous properties of many materials used in research may not be known or are described incompletely. Therefore, biomedical research wastes, particularly those from medical procedures have aesthetically objectionable characteristics affecting how they must be managed. For example, pathological wastes may have to be processed in a manner that renders them unrecognizable before they are disposed (Ferry, 1998, p.197). There are no routine surveys or national reporting requirements for biomedical wastes except for certain hazardous wastes regulated by Environmental Quality Act, 1974 (EQA). Biomedical hazardous waste-generation data are not reported by facilities on an annual basis. Even for these wastes, it is difficult to determine the amount generated by biomedical research activities as well as all hazardous wastes are combined in reports.

A significant short-term and long-term liability is associated with generation of all types of wastes, particularly hazardous from biomedical wastes. Liability for costs relating to remediation of environmental damage from these wastes (environmental impairment liability) may be catastrophic. Generators never escape liability for their wastes. Even if biomedical wastes are managed and disposed of in accordance with all regulatory requirements by fully licensed and permitted contractors, the generator retains liability and may be responsible for

damages found years later. Liability is also joint and several. Generators responsible for a relativity small amount of waste at a contaminated site may incur liability for clean up of a disproportionately large fraction of the total costs. Though, it may be claimed that the amount of toxic wastes from biomedical wastes produced by local clinics and hospitals are considerably low and they are being treated separately, especially through landfill. Nevertheless, landfill or dumping site strategy lends to air pollution and attract vermin and other disease causing germs. Landfill fires, a common incident, releases heavy metals and other toxic substances such as dioxins and furans into atmosphere. The poisons from dumping sites can leak out in the form of a smelly black toxic liquid called "leachate" and escapes into the ground surrounding dumping site and contaminate the nearby underground water source (WHO, 2005).

The lack of funds impedes implementation and enforcement actions and sometimes a lack of community involvement and community participation is a major constraint on improving the standard of waste management services. In some countries, there is an encouraging trend in increased budgetary resources and manpower capabilities for the waste management sector. However, despite these advances, waste management in many countries including Malaysia remains diffused due to parallel and over lapping responsibilities (Tiong, et al, 2012).

Incineration although has been hailed as effective method and adopted in Malaysia, it carries with it potential threat to the environment as it emits toxic byproducts such as dioxins, furans and others when plastic that is made from PVC are burned. Long term exposure poses various health complications to humans and animal such as liver failure and cancer (WHO, 2011). Other common problem related to incinerators is performance below its optimum level (Mohd Rozainee Taib, 2008), which may lead to high emission of dioxing. World Health Organization outlined 800 degree Celcius as the acceptable level, which is very difficult to be achieved by incinerator. The Department of Environment of Malaysia is drafting a new legislation on dioxin as the regulation on standard dioxin emission was nonexistent (DOE, 2009). Studies by Agarwal (1998) supports this finding by stating that incinerator encourages more waste as waste is thought as easily disposed off with incinerator. More importantly, incinerators are unable to mitigate contamination problems that take place during the pre- incineration process.

In addition, the incineration of waste remains an expensive and technically inappropriate waste disposal solution. The development of waste incineration facilities has been constrained by the high capital, operating and maintenance costs and by increasingly stringent air pollution control regulations. In addition, the combustible fraction of much of any type of the biomedical waste s generated in the low and middle-income cities of some states is relatively low, with high organic and moisture contents. In addition, waste management practices are seemed to be effective where they form part of a robust and integrated approach to the collection and disposal of all generated wastes. However, at present, biomedical waste management is given relatively low priority in many cities despite increasing loads that stretch the already limited resources of waste collection and disposal agencies.

RECOMMENDATION

Special requirements are needed to handle destruction of wastes that contain confidential or protected information and items that must be protected from diversion to unauthorized uses. Such kind of wastes may include (*a*) medical records, clinical specimens and other items labeled with patient identification information; (*b*) research data and samples; and (*c*) controlled substances. Wastes and pollutants from biomedical research activities can directly cause damage to the environment if released in an uncontrolled manner or treated improperly before disposal, or if treated wastes are discharged into inappropriate environmental area. Even if medical wastes are managed properly, the secondary wastes pollutants from their transportation, recycling and treatment are an inevitable consequence of waste generation. Since waste management issues are a major source of public concern, misinformation on biomedical waste management can create misperceptions about research facility operations. Therefore, facilities with open, well-managed waste prevention and waste management programs should be in place to help maintain public confidence in biomedical research programs.

Although the amounts of wastes and pollutants generated by individual biomedical research procedures are usually small, value of laboratory wastes as a teaching tool is an important measure for biomedical waste minimization. The value outcome would provide an excellent opportunity for investigators and/or researchers to learn, practice, and teach the principles of environmental stewardship in the laboratory. These lessons outcome can then be applied to ensure that the products of biomedical research and development such as drugs will not become major sources of pollution as they are subsequently used on a large scale in the healthcare system.

In addition, there is an urgent need of properly regulated dumping site/s in every settlement, and must be away from water source. In other words, there is also an urgent need of a system in place that would check the amount of wastes going to the landfill. These landfill or dumping sites should be properly fenced and the wastes in the landfill should be properly treated by covering with the soil so as to check leachate particularly during heavy rain period. There should be no open burning of biomedical wastes, even at the disposal site. Open burning of biomedical wastes is the most inefficient way of waste management with heavy environmental and health impacts. Burning of biomedical plastic wastes is very closely associated with the cause of cancer, heart diseases and respiratory disorder etc. This is because in the process of indiscriminate burning, resources that could be conserved for further use will go up in flame, which has far-reaching environmental impacts causing air pollution and adding to the global warming. So there should be a strict instruction to stop burning them and efforts need to be made to educate people about it.

In some states of Malaysia, a reduction in the quantities of waste generated at source has been promoted through the regulation of medical industry and economic instruments to encourage plant modification in the benefits of environment-friendly products. However, the ultimate success of waste minimization depends on cleaner production, which is increasingly being advocated in many developed and developing countries in the region as a more efficient and modern practice than conventional waste management practices (Kamaria, 1998; Ferry, 1998, p.197). In some countries, the adoption of cleaner production programs has reduced the need for end-of-pipe investments in waste treatment in industries and has therefore provided both financial and economic net benefits (Kumarasivam, 1998, pp.19-24). Therefore, it is recommended that Malaysian government should look into such programs and their economic net benefits.

Finally, cost-effectiveness and feasibility should also be considered. With these considerations, it is suggested that many of the same pollution prevention and waste

minimization strategies used in industry can be successfully applied to biomedical research operations. These strategies include (*a*) avoiding over-ordering of hazardous materials; (*b*) substitution of hazardous materials with less hazardous or non-hazardous materials in biomedical research operations; (c) improved waste segregation to maximize recovery of materials and treatment of wastes; and *(d*) ensuring that all staff members are aware of the need to minimize wastes and are trained on minimization methods applicable to their job duties and responsibilities.

CONCLUSION

Malaysian government approaches the management of biomedical hazardous and non hazardous wastes in an integrated manner, involving various actors and agencies. These include the national task forces, especially Department of Environment, Ministry of Health, private sector as well as NGOs. Three regulatory policies have been placed to control the generation, distribution, treatment and disposal of hazardous wastes and the like since 1989. In addition, the Ministry of Health has formalized a system for the disposal of pathologically hazardous wastes from hospitals, medical centers and biomedical research institutions through the country. Among the strategies are awareness campaigns and community participation as well as private-government collaborations. Under the privatization program, the government has appointed three private consortia since 1993 to provide storage, collection, transportation, treatment and disposal services for biomedical and/or clinical wastes from hospitals. Technologically, incinerators and other facilities were in place in various biomedical centers, hospitals for treatment and segregation of biomedical wastes generation at the sources. With the establishment of the central hazardous waste treatment and disposal facility, new technologies for biomedical engineering wastes are continuing to be developed. In addition, private companies are also playing a role to develop technological answers for storing toxic and biomedical waste materials.

A reduction in the quantities of biomedical waste generated at source has been promoted through the regulation of medical industry and economic instruments to encourage plant modification in the benefits of environment-friendly products. However, there are various policy issues highlighted in the paper, which should be urgently addressed by the government. These include cost effectiveness of each strategy, especially incinerators. Above all, environmental impact of landfill strategy of biomedical waste management must be taken into consideration with stringent policy to tackle the future occurrence of diseases that may affect the surrounding environment and human health. Finally, it is hoped that Malaysian government in particular and government elsewhere would pay attention to various recommendations given in this paper.

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