PERFORMANCE AUDIT REPORT

HEALTHCARE WASTE MANAGEMENT IN REGIONAL HOSPITALS

MINISTRY OF HEALTH AND QUALITY OF LIFE

DECEMBER 2015

ABBREVIATIONS AND ACRONYMS

CSD	Central Supplies Division
EHEU	Environmental Health Engineering Unit
EIA	Environment Impact Assessment
EPA	Environment Protection Act
HCW	Healthcare Waste
JNH	Jawaharlal Nehru Hospital
MEPU	Ministry of Energy and Public Utilities
MoHQL	Ministry of Health and Quality of Life
MoESD	Ministry of Environment, Sustainable Development, Disaster and Beach Management
SSRNH	Sir Seewoosagur Ramgoolam National Hospital
WHO	World Health Organisation

EXECUTIVE SUMMARY

The Ministry of Health and Quality of Life (MoHQL) provides free health services to the population. In so doing, healthcare waste (HCW)[1] is generated at the Public Health Institutions. Inappropriate management of HCW may have serious health consequences on the waste handlers, Incinerator Operators, Medical staff and the community. In 2014, MoHQL has estimated that some 1.7 million kg of HCW are generated and disposed of by incineration annually. Currently, there are seven incinerators at the Public Health Institutions. One of them started operation in 2001, four in 2003, and the remaining two in 2006 or after. Due to their advanced age, they experienced frequent breakdowns. According to the World Health Organisation (WHO), HCW incinerators may emit black smoke that contains pollutants, such as dioxins and furans in the environment. Thus, the Ministry has to ensure that HCW is properly collected, segregated, transported, stored and disposed of.

The objective of this Performance Audit Report is to assess whether MoHQL has appropriate mechanisms for ensuring that HCW is properly managed to mitigate health and environmental risks.

Key Findings

- Since October 2006, Regulations under the Environment Protection Act (EPA) require all medical and clinical wastes incinerators to have an Environment Impact Assessment (EIA) prior to their operations. As mentioned above, six of the incinerators at the Public Health Institutions started operations prior to that date and therefore did not require an EIA. Except for the incinerator at Jawaharlal Nehru Hospital (JNH), the Ministry did not carry out any health and environmental risk assessment for the others, although there were several complaints, such as bad smell, and emission of black smoke, against some of them.

- As of October 2015, MoHQL had some 3,500 beds at the Public Health Institutions. They were generating some 1.7 million kg of HCW annually, that is, some 1.33 kg per bed per day. According to WHO, high income countries generate on average 0.5 kg of HCW per bed per day, while for low income countries, the average is 0.2 kg. The Public Health Institutions are currently generating an average quantity of HCW per bed per day which is higher than the average for high income countries. Currently, the Ministry does not have any strategy towards HCW minimization and there is no specific law regulating management of HCW.

- The hazardous and harmful nature of HCW requires that the different activities from collection to disposal need to be carefully planned. WHO recommends that each Healthcare Facility should have a management plan for efficient and effective management of HCW. Since 2009, MoHQL has taken several initiatives to develop a management plan. However, as of October 2015, these initiatives have not been successful.

[1] "Health Care Waste" is used interchangeably with "Biomedical Waste", "Clinical Waste," "Medical Waste" and "Hospital Waste". As per the "Environment Protection (Standards for Hazardous Wastes) Regulations 2001", HCW is categorized as hazardous waste

- The activities involved in HCW management from collection to disposal require that the Hospital personnel, such as Ward Managers, Charge Nurses, waste handlers and Incinerator Operators are adequately trained. WHO recommends that a training programme in HCW management should cover, among others, information on risks, health and safety, and handling procedures, including the management of incidents and use of safety equipment.

  However, the Ministry did not have a formal and structured training programme. It is a practice at the Regional Hospitals to provide those who have been assigned the duties of waste handlers and Incinerator Operators on the job training on the practical applications of waste handling and disposal. Inadequate training makes it difficult for them to be conversant with processes and hazards involved in the HCW management stream.

- WHO recommends that parameters such as waste generated each month, by waste category in each Ward and Department and the treatment and disposal methods, and incidents resulting in injury or failures in the handling, segregation, storage, transport or disposal system has to be reported. This information has to be used to decide on the preventive measures to avoid recurrences. Regional Hospitals, such as Flacq, Victoria and Jawaharlal Nehru Hospitals, did not have a system to record and monitor these parameters. At A.G. Jeetoo Hospital, an inspection team was set up to monitor the segregation of HCW, and ensure that it is done according to standard practice. The other activities, such as transportation, storage and disposal were not monitored. The absence of quantitative information may severely hamper efforts to control problems associated with the management of HCW.

- The process of HCW management involves a number of steps, such as segregation, transportation, storage, and disposal. In order to minimize the hazardous effects, all the steps have to be strictly followed. However, a number of shortcomings were noted as follows:

  - *Collection and Segregation* Sharps were at times found in general wastes bags, thus causing injury to the waste handlers.

  - *Transportation* *S*ome waste trolleys were not covered with a lid to prevent accidental spillage of waste. There were also cases where general and infectious wastes were transported on the same waste trolleys.

  - *Storage* All the storage facilities are not marked with biohazard symbol and are not fenced to prevent public access. They are also not well lit, equipped with a freezer and designed to prevent rodents, insects and birds from entering. Large quantities of expired pharmaceuticals were still kept in stores and were awaiting disposal since 2006.

  - *Disposal* Incineration is the main method used by MoHQL to dispose of HCW. There are no emission standards for incinerators. Furthermore, for the period June 2012 to October 2015, some 409 tons of HCW (excluding anatomical wastes) have been disposed of at landfill without treatment.

Conclusion

The system in place at the Ministry has not always been adequate to ensure that HCW is properly managed to mitigate health and environmental risks. The absence of a HCW management plan and insufficient provisions in the existing legislations do not promote an efficient and effective management of HCW. Moreover, current practices at the Public Health Institutions are not uniform and are not in accordance with the minimum requirements recommended by WHO and the MoHQL Guideline.

There is no appropriate monitoring and control system for effective management of HCW, particularly with regard to handling, storage, transportation, and disposal of HCW. Weaknesses included insufficient training of waste handlers and Incinerator Operators, insufficient record keeping system, and inadequate segregation.

Key Recommendations

- MoHQL should consider evaluating the risks to health and environment arising from the current operation of the incinerators. This will help MoHQL to recognize their potential harmful impact on human health and environment. The Ministry should then take appropriate corrective actions to address any problem. Moreover, it should seek the expertise of MoESD to come up with emission standards for incinerators.

- MoHQL should review the adequacy of existing legislations in comparison with international standards with the view to identifying any regulatory gap which should be bridged with appropriate regulatory requirement to achieve an acceptable level of HCW management practices. Moreover, it should seek the expertise of Ministry of Environment and Sustainable Development, Disaster and Beach Management (MoESD) to come up with emission standards for incinerators, and develop a waste minimisation strategy with a view to reducing handling and disposal costs.

- MoHQL should develop a HCW management plan which provides a road map to introduce safe HCW management practices in all Public Health Institutions. The plan should include all relevant details, including staff responsibilities, waste generated, operational and monitoring procedures, training programs for all categories of staff, contingency and emergency procedures.

- MoHQL should design a training plan specifically tailored for HCW management activities. The training plan should contain separate training programs for each category of Hospital personnel. Furthermore, the training plan should indicate refresher courses to be administered and clearly state the frequency of delivering these trainings.

- Regional Hospitals should maintain records on waste generated per category and department. This will enable MoHQL to make reliable projections and effectively manage waste based on factual information regarding the quantity and nature of waste generated.

- MoHQL should improve its HCW management activities so as to meet the requirements of WHO Guideline. Each Hospital should put in place a system to ensure that segregation of HCW is properly carried out. All waste trolleys should have tightly fitting lids to prevent spillage of waste during transportation to the point of disposal. The storage facilities should have good lighting and ventilation, lockable to restrict public access and designed to prevent rodents, insects or birds from entering. Management should organize for timely destruction of expired pharmaceuticals, or should alternatively develop a schedule of incinerating small quantities at a time until they are all completely disposed of.

CHAPTER ONE

INTRODUCTION

This Chapter provides a brief background of the topic and describes the approach used in the conduct of this Performance Audit.

1.1 Background

Every year, Government invests significant resources in the provision of good quality health care services for the population through the different Public Health Institutions, such as Regional Hospitals, Mediclinics, Community Hospitals, Area Health Centres and Community Health Centres. Hence, healthcare waste (HCW) is generated for which the Ministry of Health and Quality of Life (MoHQL) is responsible to safely manage. Inadequate and inappropriate handling of HCW may have serious public health consequences and a significant impact on the environment. Over the years, with the development in the Health Sector, there has been growing concern on the management of HCW.

1.2 Motivation

In Mauritius, HCW is stored in sheds within the compound of the Regional Hospitals and incinerated on site. During incineration of HCW, pollutants, such as dioxins and furans are released. As most of the Hospital incinerators are located near residential areas, several complaints from inhabitants against nuisances, such as bad smell from the wastes, as well as noise and smoke emissions from the incinerators have been received. The media have also adversely reported on the pollution caused by the operation of the incinerators. The matter has even been debated on private radios and at the National Assembly. Several studies on environment status in Mauritius have also highlighted the importance to properly manage HCW. Hence, it is against this background that the National Audit Office carried out this Performance Audit.

1.3 Audit Objective

The audit objective is to assess whether MoHQL has appropriate mechanisms for ensuring that HCW is properly managed to mitigate health and environmental risks.

1.4 Audit Questions

In order to address the set objective, the Performance Audit answered the following questions:-

- Is there any regulatory framework for the management of HCW? Does MoHQL have a HCW management plan?
- Are the collection, segregation, transportation, storage and disposal of HCW properly carried out?
- Are there training on HCW management to ensure safety of waste handlers, Incinerator Operators, Medical staff and the community? Are the HCW management processes monitored?

1.5 Scope of Audit

The audit assessed the HCW management practices at four Regional Hospitals from planning to final disposal. The examination excluded management of general wastes, radioactive wastes, and the HCW management practices at Private Health Institutions. The audit covered the period January 2009 to October 2015.

1.6 Assessment Criteria

The audit assessed the HCW management against criteria from the World Health Organisation (WHO) Guideline and MoHQL Guideline, as well as good practices in the area.

1.7 Audit Methodology

The audit was conducted in accordance with relevant standards of the International Standards of Supreme Audit Institutions. Different methodologies were used to understand the audit area, along with gathering sufficient, relevant and reliable audit evidence to support the conclusions and recommendations. The data collection methods used included interviews, document reviews and site visits as described below:-

1.7.1 *Interviews*

Primary data were collected through interviews carried out with key players to obtain information about management of HCW. Details of the key players interviewed are provided in the Appendix. The aims of the interviews were to capture information from interviewees through their personal experiences, particular references, opinions, and also obtaining their knowledge by the interpretation of internal documents and reports. Interviews were also used to confirm that facts are correctly understood.

1.7.2 *Documents Reviewed*

The audit team collected data mainly through document reviews to have a comprehensive picture of HCW management practices at MoHQL. The reviews helped to confirm information obtained from other sources. Documents reviewed included WHO and MoHQL Guideline for proper collection, segregation, transportation, storage and disposal of HCW.

1.7.3 *Sampling and Site Visits*

Four of the five Regional Hospitals, namely Victoria, Flacq, A.G Jeetoo, and Jawaharlal Nehru were selected for site visits. The processes involved in managing HCW from generation to disposal were observed and assessed against criteria in the two Guidelines mentioned above. Regional Hospitals were selected as they treat more patients and generate more HCW.

CHAPTER TWO

DESCRIPTION OF THE AUDITED ACTIVITY

This Chapter describes the nature of HCW, roles and responsibilities of the different key players and the current practice in the management of HCW.

2.1 Definition and Classification of Healthcare Waste

Public Healthcare Institutions are responsible for the delivery of patient care services, and during this process, HCW is generated. According to WHO, HCW considered as hazardous includes all the wastes generated within healthcare institutions, research centres and laboratories related to medical procedures. The hazardous HCW is further classified as described in Table I.

Table I – Categories of Hazardous Healthcare Waste

Waste Category	Description and Examples
Infectious	Biomedical and HCW known or clinically assessed to have the potential of transmitting infectious agents to humans or animals. It includes all microbiological cultures in which a multiplication of pathogens of any kind has occurred.
Human anatomical	It comprises non-infectious human body parts, organs and tissues and body bags.
Sharps	They are objects and materials that are closely linked with healthcare activities and pose a potential risk of injury and infection due to their puncture or cut property. Examples include needles, infusion sets, scalpels, knives, blades, lancets, and broken glasses.
Pharmaceutical	It consists of expired pharmaceuticals or pharmaceuticals that are unusable for other reasons, such as call back campaign. Pharmaceutical waste is divided into solid, semi-liquid and liquid wastes.
Liquid (Highly infectious)	It is generated in the field of medical laboratories and medical practices
Radioactive	It includes liquids, gases and solids contaminated with radionuclide generated from in vitro analysis of body tissue and fluid, in vivo body organ imaging and tumor localization, and investigative and therapeutic procedures

Source: MoHQL Guideline

2.2 Role of the Ministry of Health and Quality of Life

As per Section 4 of the Environment Protection (Standards for Hazardous Wastes) Regulations 2001, a waste generator shall minimize the generation of a hazardous waste by using the best practicable means, and it shall ensure that hazardous waste is properly stored, treated on site or disposed of as approved by the appropriate enforcing agency. MoHQL thus segregates, collects, stores and disposes of all HCW produced. Except for general wastes which are collected in black plastic bags and dumped at the landfill, all the other categories of HCW are collected in yellow bags.

2.3 Healthcare Waste Management at the Public Health Institutions

2.3.1 *Segregation, Transportation, Storage and Disposal of Health Care Waste*

A closed waste carrier van collects the HCW from the outstations and transfers them to the respective Regional Hospitals. The protocols for collecting and segregating HCW are affixed at each point of waste generation. After collection, all the bags are closed, sealed and labelled and are temporarily kept in a Dirty Utility Room. Hospital Attendants collect the wastes from the Room twice daily on trolleys and transport them to their respective sheds. Yellow bags are incinerated. Expired drugs from the Pharmacies are returned to Central Supplies Division (CSD) for their ultimate disposal.

2.3.2 *Disposal Methods of Waste Water and Ash*

- Waste water generated at Jawaharlal Nehru Hospital (JNH), Sir Seewoosagur Ramgoolam National (SSRN) and Flacq Hospitals are treated on-site. As regards waste water generated at Victoria and A.G Jeetoo Hospitals, they are discharged in the sewerage system of the Wastewater Management Authority.

- Ash from incineration is conventionally considered as hazardous by virtue of its likely heavy metal content, and is disposed of in designed cells at the landfill.

2.3.3 *Incineration of Healthcare Waste*

The HCW incinerators are mainly operated by staff members from the Minor Grade Cadre who are normally given training by the suppliers and the Energy Service Division. Monthly servicing of the incinerator is done as per a maintenance agreement with the suppliers, under the supervision of the Division.

2.3.4 *Monitoring Segregation of Healthcare Waste*

Segregation of HCW is monitored by the Ward Managers and Charge Nurses of the Regional Hospitals. In addition, as from October 2014, a team comprising the Nursing Administrator, a Hospital Administrative Assistant and a Hospital Executive Assistant has been set up at the A.G

Jeetoo Hospital to ensure that segregation of HCW is done correctly. Any deviations are reported to the Regional Health Director and actions are taken promptly.

2.4 Risks Associated with Healthcare Waste management

HCW is potentially dangerous because it may contain infectious materials and sharps, and hence, can transmit disease and cause cuts and needle-stick injuries. If improperly handled, HCW is hazardous to waste handlers, Incinerator Operators and Medical Staff. The risks are as follows:

- Infections caused by exposure to HCW and causative organisms, such as bacteria and viruses
- Sharps may not only cause cuts and punctures, but also infect the wounds by agents which have previously contaminated sharps, and
- Pathogens may also be distributed by rodents and insects that come in contact with unsafely stored waste

2.5 Key Players

Several key players are involved in the management of HCW. Their roles and responsibilities are described below:

2.5.1 *Solid Waste Management Division*

As per the Environment Protection (Standards for Hazardous Wastes) Regulations 2001, wastes from diagnosis, treatment or prevention of disease and natal care are categorized as Hazardous Wastes. Accordingly, the enforcing agency is the Solid Waste Management Division under the Environment Protection Act (EPA). The Division provides for the disposal of HCW, excluding anatomical wastes, at the landfill whenever cases of incinerator breakdown are reported. As regards pharmaceutical wastes, the mode of disposal is also recommended by the Division.

2.5.2 *Ministry of Environment, Sustainable Development, Disaster and Beach Management*

The Ministry of Environment, Sustainable Development, Disaster and Beach Management (MoESD) is the enforcing agency for air quality. In this regard, the Pollution Prevention and Control Division ensures compliance with environmental legislation and standards under the EPA. The Division registers complaints and attends to emergencies through established protocol in collaboration with the enforcing agencies.

2.5.3 *Ministry of Energy and Public Utilities*

The Ministry is the enforcing agency for water and waste water. It enforces regulations made under EPA. It also has the responsibility to formulate and implement policies on water and waste

water sectors through agencies, such as the Central Water Authority, Wastewater Management Authority and Water Resources Unit falling under its purview.

2.5.4 *Environmental Health Engineering Unit at MoHQL*

MoHQL is the enforcing agency with respect to Drinking Water Quality, Noise and Odour under EPA. The monitoring, as well as enforcement pertaining to same, is undertaken by the Environmental Health Engineering Unit (EHEU) of the MoHQL. The Unit also makes recommendations in terms of proper environmental sanitation which may affect the physical development and health.

2.6 **Relevant Documents and Acts**

2.6.1 *WHO Guideline and Guideline prepared by MoHQL*

WHO Guideline is a source of information and guidance on safe HCW management practices. MoHQL Guideline for the management of HCW in the Public Health Institutions was prepared for healthcare personnel directly or indirectly involved in the collection, segregation, transportation, and storage of HCW.

2.6.2 *Environment Protection (Amendment) Act 2008*

According to Part B of the revised First Schedule of the EPA 2008, the activities requiring an Environment Impact Assessment include incineration of medical and clinical wastes.

2.6.3 *Environment Protection (Standards for Air) Regulations 1998*

The Environment Protection (Standards for Air) Regulations 1998 prescribe the national standards for the emission of pollutants in the atmosphere. Since the incineration of HCW results in the release of air pollutants, the standards for air are relevant.

2.6.4 *Environment Protection (Standards for Hazardous Wastes) Regulations 2001*

These Regulations are equally important as HCW is one of the several types of hazardous wastes which necessitate proper management. As per Section 3 of the Regulations, no person shall dispose of a hazardous waste at any place except at a disposal site, and according to Section 4, a waste generator shall minimize the generation of a hazardous waste by using the best practical means, and it shall ensure that it is properly stored, treated on site or disposed of as approved by the relevant enforcing agency.

2.6.5 *Environment Protection (Standards for Effluent Discharge) (Amendment) Regulations 2004*

These Regulations provide that no person shall discharge effluent onto land, into a watercourse or into a water body unless he ensures that the parameters of the effluent do not exceed the permissible limits set out in the Second Schedule of the Regulations. The enforcing agency is the Ministry of Energy and Public Utilities.

CHAPTER THREE

FINDINGS

This Chapter describes the findings related to management of HCW at MoHQL

3.1 Healthcare Waste at Public Health Institutions

MoHQL operates seven gas incinerators in the Public Health Institutions across the island. In 2014, the Ministry has estimated that some 1.7 million kg of HCW are generated and disposed of annually. As of October 2015, there were some 3,500 beds at the Public Health Institutions. Details are as shown in Table II.

Table II: Healthcare Waste Incinerated at Public Health Institutions

Hospital	In Operation Since	No of Beds	Annual Estimated Quantity (kg)	Average per Bed per Day (kg)
A.G Jeetoo	2001	550	260,000	1.30
Flacq	2003	435	260,000	1.64
SSRN	2003	460	416,000	2.48
Victoria	2003	715	416,000	1.59
Poudre D'Or	2003	60	13,520	0.61
Brown Sequard	2006	680	72,800	0.29
Jawaharlal Nehru	2013	588	260,000	1.21
Total		**3,488**	**1,698,320**	**1.33**

Source: MoHQL Records

According to WHO, high income countries generate on average up to 0.5 kg of HCW per bed per day, while for low income countries, the average is 0.2 kg. However, the Public Health Institutions, while providing a good quality level of healthcare service, are generating an average quantity of HCW per bed per day which is higher than the average for high income countries. Further, MoHQL currently does not have any strategy towards waste minimization. The disposal of a larger quantity of HCW put much strain on the operation of incinerators. Moreover, during the process, black smoke that may contain pollutants, such as dioxins and furans are released. These wastes, along with inappropriate management practices, increase health and environmental risks.

The Ministry stated that following a survey carried out by the Solid Waste Management Division over a period of four weeks in 2015, it was found that the quantity of HCW generated at the Public Health Institutions was some 17,000 kg per week, that is, some 0.69 kg per bed per day.

The average quantity of HCW generated per bed per day is still on the high side.

3.2 **Regulatory Framework**

WHO advocates that for a comprehensive HCW management system to be implemented effectively, it is important that the basic requirements are regulated. A framework can then be established for a minimum approach to the management of HCW.

Currently, the HCW management issues are not adequately regulated. The current EPA sets a general framework on the management of wastes. It does not make specific and detailed provisions for HCW management. The regulations under the Act highlight that pollution from any such sources entering air, water or land should not exceed the prescribed limits. However, they do not address some of the following issues related to HCW. For example

- A clear and properly categorized definition of hazardous HCW
- Types of wastes to be regulated
- A "cradle-to-grave" tracking system
- Standards for segregation, labelling, transportation, storage, treatment and disposal of HCW
- Methodology for record keeping and reporting
- Monitoring and enforcement mechanism and penalties to be imposed for mismanagement

This situation has made it difficult for Public Health Institutions to efficiently monitor HCW management practices. This has encouraged different practices in HCW management at the Public Health Institutions.

3.3 **Health Care Waste Management Plan**

The hazardous and harmful nature of HCW requires that the different activities in the management thereof need to be carefully planned. WHO recommends that each Healthcare Facility should have a management plan for efficient and effective management of HCW. Since 2009, MoHQL has taken several initiatives, such as recruitment of a Consultant to develop a management plan. However, as at October 2015, these initiatives have not been successful.

In the same year, MoHQL prepared a guideline for the safe management of HCW adapted from the WHO Guideline. The guideline is being used by the Public Health Institutions to manage HCW, but it does not cater for management of same at Private Health Institutions. Moreover, in 2014, another Guideline on Infection Prevention and Control was prepared to address some of the issues on HCW management.

3.4 Current Healthcare Waste Management Practices

3.4.1 *Healthcare Waste Collection and Segregation*

According to WHO, sharps have to be collected in puncture and leak proof containers immediately after use, and then incinerated so as to eliminate the risk of injury or infection. It is the responsibility of Ward Managers and the Charge Nurses to ascertain that segregation is carried out accordingly.

During the past two years, several cases of injuries caused by sharps found in the general wastes bags, have been reported by the Solid Waste Management Division to MoHQL. This implied that collection and segregation of HCW were not adequately carried out and monitored properly. The unsafe disposal of contaminated syringes and needles poses public health risks. A few examples of cases of injuries are given in Table III.

Table III - Cases of Injuries Reported to MoHQL

Date	Details	Hospital
07.12.2012	A Refuse Collector has sustained injury from sharps	Victoria
29.04.2013	One Refuse Collector was injured by a syringe needle	Victoria
21.03.2014	Clinical wastes and needles were found deposited in the Municipal trailer along with other wastes	A.G Jeetoo
08.07.2014	One Scavenger alleged having a needle prick while attending the dumping shed to remove wastes	Flacq

Source: MoHQL Records

3.4.1.1 *Good Practice at A.G Jeetoo Hospital*

The management of A.G Jeetoo Hospital has set up an Inspection Team to ascertain that segregation of waste is carried out according to the MoHQL Guideline. The Team reported several cases of non-compliance, such as yellow bags contained both general waste and clinical waste**.** Actions were then taken to remedy the situation**.**

Though this is a laudable initiative, this practice has not been replicated in other Regional Hospitals.

3.4.2 ***Healthcare Waste Transportation***

3.4.2.1 *Waste Route*

WHO recommends that Public Health Institutions should plan and use a fixed and reliable waste route for the transportation of HCW based on the principle "from clean to dirty" to minimize health risks.
Currently, Regional Hospitals do not have waste routes as no provision was made in the design of the buildings. For example, at A.G Jeetoo Hospital, HCW was transported from Wards to incinerator using the same elevator and same route commonly used by the Medical Staff, patients and the general public.

3.4.2.2 *On-site Transport - Trolleys*

According to WHO, infectious and non-infectious HCW should be transported on separate wheeled trolleys, containers or carts that are properly labelled and which are not used for any other purposes. The waste containers and the trolleys should also be closed with lids to isolate wastes from patients, staff and the general public.

However, at Flacq Hospital, the same trolleys were used to transport infectious and non-infectious HCW. Further, at Jawaharlal Nehru, Victoria and Flacq Hospitals, trolleys were not labelled and closed with lids.

3.4.3 ***Healthcare Waste Storage***

WHO recommends that space for storing wastes should be incorporated into a building design when new construction of Public Health Institution is undertaken. The facility should be easy to clean, have good lighting and ventilation, be equipped with a freezer and designed to prevent rodents, insects or birds from entering. The Public Health Institutions must provide an enclosed structure, such as a shed, fenced area or separate loading bay to store waste and should be marked with a biohazard symbol.

However, no provision was made for the storing of HCW in the design and construction of new A.G Jeetoo Hospital. HCW is temporarily stored in a 20 feet container. At Victoria and Flacq Hospitals, the storage facilities are made up of concrete blocks with iron sheets on the top. All the facilities are not marked with biohazard symbol and are not fenced to prevent public access. They are also not well lit, equipped with a freezer and designed to prevent rodents, insects and birds from entering. Inhabitants living near A.G Jeetoo and Flacq Hospitals have been recurrently complaining on bad smell emanating from storage of HCW.

3.4.4 ***Disposal of Healthcare Waste***

3.4.4.1 *Incineration of Healthcare Waste*

Incineration is the main method used by MoHQL to dispose of HCW. The operation of the incinerators was assessed.

- *Environment Impact Assessment*

Since October 2006, Regulations under EPA require all medical and clinical wastes incinerators to have an EIA prior to their operations. Six of the seven incinerators started operations prior to that date and therefore did not require an EIA. Except for the incinerator at JNH, the Ministry did not carry out any health and environmental risk assessment for the others, although there were several complaints, such as bad smell, and emission of black smoke, against some of them.

- *Location*

Good practices on siting of incinerator have the objective of finding a location that minimizes potential risks to public health and the environment. This can be achieved by minimizing ambient air concentrations and deposition of pollutants to soils, foods, and other surfaces and minimizing the number of people potentially exposed.

Currently, three of the incinerators are located near residential areas. MoHQL has been receiving several complaints from inhabitants nearby Flacq, Victoria and A.G Jeetoo Hospitals regarding noise and smoke emissions from the incinerators.

- *Emission Standards for Incinerators*

Incinerators are major releasers of air pollutants, such as dioxins and furans, heavy metals, oxides of nitrogen, sulphur oxides, particulate matter, and numerous volatile organic compounds. Good practices advocate standards for quantitative emission limits for each type of pollutants. However, there are no emission standards for incinerators. The existing incinerators are also not equipped with air pollution control devices.

- *Incinerator Operators*

WHO recommends that incinerators be operated by qualified personnel. If no qualified operators are available, Managers of healthcare facilities should arrange to train an adequate number of personnel. They should be trained in general functioning of the treatment facility, including heat recovery and flue-gas, technical procedures for operating the plant, emergency response in case of equipment failures, and maintenance of records.

At the Regional Hospitals, staff members from the Minor Grade Cadre have been assigned the duties of Incinerator Operators. They received only minimum training on the operation of incinerators by the supplier of the equipment. They were not trained on the tasks recommended by WHO, such as emergency procedures, emission control, maintenance and record keeping. When they were on leave, other Workers from the same Cadre, without appropriate knowhow on the operation of incinerators, replaced them. EHEU had reported that frequent breakdowns of incinerators were due to untrained operators.

- *Incinerator Breakdowns*

Most of the incinerators are over 10 years old and experience frequent breakdowns. For example the incinerator at the A.G Jeetoo Hospital was reported to be out of service from 10 to 27 October 2014 and that of JNH from 12 to 27 September 2015.

During breakdown, HCW is either incinerated at other Regional Hospitals or is disposed of at landfill by MoHQL after approval from the Solid Waste Management Division. In other countries, it is a good practice to treat HCW prior to disposal at landfill. However, for the period June 2012 to October 2015, some 409 tons of HCW (excluding anatomical wastes), have been disposed of at landfill without treatment.

3.4.5 ***Disposal of Healthcare Waste Water***

The basic principle of effective waste water management is a strict limit on the discharge of hazardous liquids to sewers. Chemical waste should be collected and treated separately. Discharging wastewater generated from a health-care facility into the sewerage system, after adequate treatment is a preferred method.

3.4.5.1 *Use of Treatment Plant*

At JNH, the treatment plant has not been operating efficiently and effectively. Since 2010, the plant has overflow problem, and every month, some 80,000 litres of waste water had to be carted away at an average monthly cost of Rs 22,000.

WHO recommends that the inflow of waste water and the outflow of treated effluent should be tested regularly to monitor how effectively the treatment plant reduces the concentration of contaminants. Since September 2009, MoHQL has not performed any tests on the effluent flowing out of the plant. Hence, the effectiveness of the treatment could not be ascertained.

3.4.5.2 *Discharge into the Public Sewerage System*

At Victoria Hospital and the Central Health Laboratory, it is a practice to discharge liquid hazardous waste into public sewerage via the sink without treatment. A few examples are shown in Table IV.

Table IV: Hazardous Waste Water Discharged into Public Sewer

Department	Type of Hazardous Waste
Medical Laboratories	• Bacteriology – reagent mixed with blood stain • Biochemistry - reagent mixed with blood stain • Hispathology – Xylene, Alcohol 90
X-Ray Department / Nuclear Medicine	• Photographic fixing and developing solutions • Unused liquids from Radiotherapy • Urine and excreta from patients treated or tested with unsealed radionuclides
Operation Theatres and Intensive-Care Units	Generate wastewater with high contents of disinfectants, detergents and pharmaceuticals. Additionally, the organic content can be high due to the disposal of body fluids and rinsing liquids (such as those from suction containers).

Source: MoHQL Records

3.4.5.3 *Maintenance of On-site Sewerage System*

An effective and efficient disposal of healthcare waste water should be accompanied by a good, well-maintained sewerage system within the Hospital. Leakage of waste water is common during collection and transportation due to, for example, broken sewer pipes and non-watertight access holes. Maintenance and leakage problems can often be identified through regular comparison of water consumption and discharged waste water quantities. Inspection of the sewerage system has not been carried out since the operation of the Treatment Plant at JNH.

3.4.6 ***Disposal of Pharmaceutical Waste***

According to WHO Guideline, the disposal of pharmaceutical waste should take place in an appropriate waste disposal facility. The disposal options available depend on quantities of pharmaceutical waste. For small quantities, the waste is encapsulated, returned to suppliers or chemically decomposed according to manufacturers' requirements. For large quantities, the waste is incinerated or encapsulated.

MoHQL spends some Rs 600 million annually on the acquisition of pharmaceuticals. Most of them have a shelf life of 18 months. As of December 2014, MoHQL had stored some Rs 109 million worth of pharmaceutical waste. These wastes have been accumulated since 2006 and were awaiting disposal. It was only in August 2015, that authority for the incineration of some Rs 46 million of the waste was obtained. As of end of October 2015, no action has been taken regarding the remaining wastes. MoHQL was not disposing its pharmaceutical waste in a systematic way.

At the Regional Hospitals level, the expired pharmaceuticals should be returned to CSD for their ultimate disposal. However, large quantities of expired pharmaceuticals were stored in Regional Hospitals, such as Victoria Hospital. These wastes could not be returned to CSD, as the latter was experiencing storage problem.

Keeping of pharmaceutical waste for a long period of time is unnecessarily occupying valuable storage space. The hazardous nature of these wastes may increase the risk of adversely affecting human health and the environment.

3.5 **Monitoring and Recording**

HCW management activities are carried out on a daily basis at the Regional Hospitals. Each one needs a monitoring and record keeping system to keep decision makers informed and enables them to take appropriate actions. According to WHO, the following parameters have to be monitored:

- Waste generated each month, by waste category in each Ward and Department and the treatment and disposal methods

- Waste handled safely and in accordance with the safety operation procedures:

    - Occupational safety (for example personal protective equipment)
    - Use of proper and clean equipment
    - Proper segregation at source
    - Internal safe transport, storage, treatment and disposal methods

- Public health aspects, such as incidents resulting in injury or failures in the handling, segregation, storage, transport or disposal system has to be reported. This information has to be used to decide on the preventive measures to avoid recurrences.

Regional Hospitals, such as Flacq, Victoria and Jawaharlal Nehru Hospitals, did not have a system to record and monitor the above parameters. At A.G. Jeetoo Hospital, an inspection team was set up to monitor the segregation of HCW, and ensure that it is done according to standard practice. However, the other activities, such as transportation, storage and disposal were not monitored. The absence of quantitative information may severely hamper efforts to control problems associated with the management of HCW.

3.6 **Personnel Protective Equipment and Training**

According to WHO and MoHQL Guidelines, Incinerator Operators and waste handlers are required to wear personnel protective equipment including, overalls or industrial aprons, boots and heavy duty gloves. The thick soles of the boots offer protection in the storage area, as a

precaution from spilt sharps, especially where the segregation process is weak and where floors are slippery. In some cases, leg protectors should also be worn.

They should also be adequately trained on the basic principles and practical applications of the different activities from transportation to disposal to minimize exposure to health risks.

3.6.1 *Personnel Protective Equipment*

At the Public Health Institutions, the personnel protective equipment provided to the employees has not always been to the required standard. For example, at Flacq, Victoria and Jawaharlal Nehru Hospitals, Incinerator Operators were given rubber boots and leather gloves instead of heavy duty gloves and industrial boots. In October 2014, the Health and Safety Unit made the same observations at A.G Jeetoo Hospital and recommended that Incinerator Operators, who are regularly exposed to biological, physical and chemical hazards, be provided with adequate protective equipment to reduce the risk of exposure to heat, fires, and carbon monoxide poisoning.

Those who do not wear standard protective equipment run the risk of, for example, skin burns, and inhaling organic solvents that can injure their lungs, livers and other organs.

3.6.2 *Training*

The activities involved in HCW management from collection to disposal require that the Hospital personnel, such as Ward Managers, Charge Nurses, waste handlers and Incinerator Operators are adequately trained. WHO recommends that a training programme in HCW management should cover some of the following aspects:

- Information on risks, and health and safety advice
- Competence based training on all handling procedures, including the management of incidents
- Wearing of protective clothing
- Use of safety equipment
- Documentation and record keeping

However, the Ministry did not have a training programme that covers the above. Training provided was informal and unstructured. It is a practice at the Regional Hospitals to provide those who have been assigned the duties of waste handlers and Incinerator Operators on the job training on the practical applications of waste handling and disposal. Inadequate training makes it difficult for them to be conversant with processes and hazards involved in the HCW management stream.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

MoHQL is responsible to safely manage HCW generated at Public Health Institutions. Currently, HCW per bed per day generated is higher than the average for high income countries. The system in place at the Ministry has not always been adequate to ensure that HCW is properly managed to mitigate health and environmental risks. The absence of a HCW management plan and insufficient provisions in the existing legislations do not promote an efficient and effective management of HCW. Moreover, current practices at the Public Health Institutions are not uniform and are not in accordance with the minimum requirements recommended by WHO and the MoHQL Guidelines.

There is no appropriate monitoring and control system for effective management of HCW, particularly with regard to handling, storage, off-site transportation, treatment/incineration and disposal of HCW. Weaknesses included insufficient training of waste handlers and Incinerator Operators, insufficient record keeping system, and inadequate segregation.

In the light of the audit findings and conclusions, hereunder are the recommendations

4.1 *Waste Minimisation*

MoHQL should adopt a waste minimisation strategy with a view to reducing health and environmental risks. This approach offers several benefits, such as, reducing material use, HCW collection, transportation, storage and disposal costs, and decreased pollution control. The following practices could be considered.

- *Material/Device Substitution*

Proper procurement practices, for example changing the products and materials can help to reduce the harm. Products should be assessed prior to purchase in terms of their potential to generate HCW, to result in toxic emissions, or to be detrimental to the operation and maintenance of treatment facilities. There are some viable substitutes for many products that contain PVC plastic.

- *Product Modifications*

Simple product modifications to minimize waste streams include requesting the supplier to reduce unnecessary packaging or replace polystyrene foam with recyclable or biodegradable fillers.

- *Increasing Awareness of Employees*

Increase awareness of hospital staff in hazardous materials management and waste minimization.

4.2 ***Review of Legislation***

MoHQL should review the adequacy of existing legislations in comparison with international standards with the view to identifying any regulatory gap in the safe management of HCW. Thereafter, any gap should be bridged with appropriate regulatory requirement to achieve an acceptable level of HCW management practices. The expertise of MoESD may be sought for this purpose.

4.3 ***Developing a HCW Management Plan***

The weaknesses identified in the present system for managing HCW call for an urgent need to develop a management plan which is intended to address them and provide a road map to introduce safe HCW management practices in all Public Health Institutions. The plan should include all relevant details, including staff responsibilities, estimates for waste generated, operational and monitoring procedures, training programmes for all categories of staff, contingency and emergency procedures.

4.4 ***Improving Current Healthcare Waste Management Practices***

- *Segregation*

MoHQL should ensure that HCW generated is properly segregated. The enforcement mechanism set up at A.G Jeetoo Hospital should be replicated in other Regional Hospitals.

- *Transportation*

Waste carriers should have tightly fitting lids to prevent spillage of waste during transportation from the collection point to the point of disposal. For HCW on-site transportation, wheeled trolleys should be provided. The bags containing HCW should be labelled to identify the source, type and quantities of waste produced in each area, and the date the waste was generated so as to allow problems relating to waste segregation to be traced back.

- *Storage*

HCW storage facilities should comply with the norms required by WHO Guideline. The room should be ventilated, well lit and equipped with a freezer for storage of accumulated HCW. This applies mainly to anatomical parts which need to be kept in freezer if stored for longer periods to avoid environmental and health risks. Appropriate warning signs should be displayed at entrances of storage areas. Access to the storage facility should be restricted to authorized personnel.

- *Incineration of Healthcare Waste*

MoHQL should consider evaluating the risks to health and environment arising from the current operation of the incinerators. This will help MoHQL to recognize their potential harmful impact on human health and environment. The Ministry should then take appropriate corrective actions to address any problem. Moreover, it should seek the expertise of MoESD to come up with emission standards for incinerators.

Any new incinerators to be acquired should be equipped with air pollution control devices.

- *Disposal of Healthcare Waste at Landfill*

HCW not incinerated should be treated. MoHQL could consider autoclaving as a method of treatment.

- *Records*

Regional Hospitals should maintain records on waste generated per category and department. They should also provide information on the quantity of HCW disposed of. This will enable management to make reliable projections and effectively manage waste based on factual information regarding the quantity and nature of waste generated.

- *Protective Equipment*

Appropriate personal protective equipment should be provided to waste handlers and Incinerator Operators. Management should also monitor to ensure that the waste handlers and Incinerator Operators actually wear the clothing and equipment provided to them and that they are entirely covered and protected when operating the incinerators.

- *Training*

MoHQL should design a training plan specifically tailored for HCW management activities. The training plan should contain separate training programs for each category of Hospital staff. Furthermore, the plan should indicate refresher courses to be administered and clearly state the frequency of delivering these trainings.

- *Alternative Treatment and Disposal Technologies*

To reduce exposure to toxic pollutants associated with the combustion process, such as dioxins, and furans, as well as, particulate matter and to minimise occupational and public health risks, it is important to consider the following treatment and disposal technologies listed in Table V.

Table V: Other Treatment and Disposal Technologies

Treatment/Disposal	Advantages	Disadvantages
Incineration	• Good disinfection efficiency • Drastic reduction of weight and volume	• Toxic emission to air if there are no control devices • Maintaining temperature levels is difficult • High costs for high temperature
Chemical Disinfection	• Simple • Relatively cheap • Disinfectants widely available	• Involve handling of dangerous chemicals • Waste volume is not reduced • Requires shredding prior to treatment with chemicals
Autoclaving	• Is safe household wastes after autoclaving • Ecological • Low operating costs	• Unsuitable for chemical or pharmaceutical wastes • Shredding is essential to avoid re-use • Unpleasant odours
Encapsulation	• Simple and safe • Low costs • can be applied to pharmaceuticals	Not recommended for non-sharp infectious wastes
Inertisation	• Relatively inexpensive	Not applicable to infectious wastes

Source: WHO Guideline

- *Quality Control Test*

JNH should carry out routine quality control tests on the treated waste water in line with the regulations in order to provide assurance that the effluents are safe for discharging into the environment. Further, the MoHQL should ensure that hazardous liquid wastes are pre-treated before they are disposed of regular inspections on the on-site sewerage system should be carried out.

4.5 *Disposal of Pharmaceutical Waste*

MoHQL should set up a mechanism that will allow the periodic disposal of pharmaceutical waste. This could include either organising for timely destruction of the waste or alternatively developing a schedule of incinerating small quantities at a time until they are all completely disposed of.

4.6 *Setting up of Monitoring Mechanism*

MoHQL should set up a monitoring mechanism for all activities from collection to disposal of HCW at each Regional Hospital to detect incorrect practices, identifying risk and investigating factors contributing to unsafe practices.

Appendix

Key Players Interviewed

Rank	Organisation
Regional Health Director	Hospital (A.G Jeetoo Hospital)
Deputy permanent Secretary	MoHQL
Chief Hospital Administrator	MoHQL
Hospital Administrators	Hospitals (Flacq, A.G Jeetoo, JNH, Victoria)
Hospital administrative Assistant	Hospitals (Flacq, A.G Jeetoo, JNH, Victoria)
Charge Nurses	Hospitals (Flacq, A.G Jeetoo, JNH, Victoria)
Pharmacists	Hospitals (Flacq, A.G Jeetoo, JNH,Victoria)
Incinerator Operators	Hospitals (Flacq, A.G Jeetoo, JNH, Victoria)
Chief Sanitary Engineer	Environment Health Engineering unit (MoHQL)
Charge Nurses/Nursing administrators	Hospitals (Flacq, A.G Jeetoo, JNH, Victoria)
Director	Solid Waste Management Division
Divisional Environment Officer	MoESD
Senior Chief Executive	Ministry of Energy and Public Utilities