

CHAPTER 7 WASTE PREVENTION AND RECYCLING

7.1 Waste Prevention

Waste prevention is an essential method of minimizing environmental pollution.

There are four types of waste prevention.

1. Waste reduction at source
 - (1) Shift to cleaner processes
 - (2) Use of safer materials
2. Changes in products
 - (3) Production of recyclable products
 - (4) Extending the durable period of products

1) Waste Reduction at Source

There are two methods to reduce waste generation at source; shifting to cleaner processes and using safer materials. Two types of clean process, which are technological conversion and process management, are currently used in many enterprises. Since there is too much information on clean process to cover, this section will only refer to processes that are relevant for Morocco.

a. Changing Production Processes for Caustic Soda

The mercury method (Amalgam method) is employed to produce caustic soda in Morocco. This method was used in Japan and resulted in Minamata disease. After the disease occurred, the mercury method was replaced by the diaphragm method, which was later shifted to the ion-exchange method (the Membrane method). In 1986, the mercury method was no longer used. The ion-exchange method is a method to obtain NaOH by moving Na ion to cathode in brine where a diaphragm is located between cathode and anode. Morocco will be able to solve mercury waste issues by using this method.

b. Phosphoric Acid Production

Phosphoric acid can be obtained in the process of producing phosphoric acid and gypsum by adding sulfuric acid to phosphorous ore. Although the phosphoric acid production process is not completely studied, the fact that gypsum is generated possibly means that the above mentioned process is used. Gypsum is no use when it contains hydrated phosphate. A new method using very pure phosphoric acid is now used worldwide in order to secure pure gypsum. Gypsum is used for construction materials in Japan.

c. Electroplating Process

Waste generation in electroplating processes should be controlled by reducing electroplating wastewater and collecting metals with waste treatment. This is to control generation of polluted waste and also to minimize wasteful use of resources.

Wastewater generation can be reduced by removing electroplating water and using counter current multistage rinsing equipment (cascade rinsing equipment). This method will reduce released electroplating water from the process and control wastewater generation. As waste water generation decreases, use of chemicals for wastewater treatment will be reduced, and sludge generation will be minimized. When electroplating processes use copper or nickel, ion-exchange can be used to collect the materials.

d. Shift to "Clean" Materials

Shift to use of safe materials in production processes is a worldwide trend. Avoiding use of cadmium or mercury for dry batteries is an example. Another example is use of non-hazardous solutions rather than hazardous ones. Water is used instead of solutions in paint production.

2) Changes in Products

Changes in products do not necessarily reduce industrial waste generation but can control waste generation of society. It is well known that auto manufacturers Volvo and Mercedes Benz have shifted to use of recyclable materials so that when their products are abandoned, each component can be recycled.

Research and development has resulted in plastic products that are easy to recycle. It is difficult to recycle mixed plastic waste of different kinds.

7.2 Recycling

Waste generated in factories can be recycled in factories first. Material slag can be recycled to a considerable degree if it is sorted out from waste, oil, and other impurities.

Concerning recycling within production processes, there is equipment to prevent solution evaporation and to cool it down for collection. There is also equipment to condense hydrochloric acid and sulfuric acid. Filtration of waste oil is also used commonly worldwide. Dust in iron making factories can be recycled as iron materials. Dust in cement factories can be fully recycled.

Concerning recycling outside factories, gypsum recycling is well known. Sludge containing dross or metals can be reused in refining factories. There are many opportunities for recycling widely used PET bottles in Morocco.

The existing recycling situation has not been well studied. Therefore, it is necessary to conduct research on recyclable waste generation and discuss possible business opportunities for recycling.



CHAPTER 8 DEVELOPING PRIVATE SERVICE PROVIDERS

In principle, industrial waste management should be conducted by business establishments that generate the waste. It is, however, not effective for all businesses to do so on their own. In industrial countries, large businesses that generate a large amount of waste are generally equipped with their own treatment and disposal facilities. Small businesses with small amount of waste generation do not find it effective to install their own facilities and generally contract out treatment and disposal to private service providers.

Private service providers, however, do not exist in Morocco. This is because there are no strict legal regulations governing disposal activities by businesses. When regulations are tightened for proper SWM, demands for private contractors will increase.

Although regulations cannot yet be enforced since no laws define them, inadequate SWM by businesses should be improved by governmental instructions. In other words, the government itself must promote development of treatment facilities.

There will be only a few options for achieving such a development. What the government should do first is to create business opportunities for private service providers.

Transport companies will be able to enter the SWM market first. Transport companies that can offer disposal service have a competitive edge in the market since there are many factories that cannot dispose of waste on-site.

As demands for waste transport service increase, disposal service providers will develop.

In order to increase demands for disposal, the government should first promote proper SWM by businesses. Priority should be given to enterprises around Casablanca and Mohammedia.

Consensus among businesses should be formed then concerning use of private contractors for proper SWM. At the same time, the government can request proposals from private businesses that intend to offer SWM service.

The government should have to approve disposal site construction by the private sector. Concessions should only be approved when the businesses fulfill requirements for proper disposal operation.

The government should encourage businesses to make use of approved disposal sites. Governmental monitoring should be intensified for businesses that do not use the disposal sites.



CHAPTER 9 PROMOTING INVESTMENT IN ENVIRONMENTAL CONTROL

As discussed elsewhere in this report, investment in environmental control on the part of industry can be promoted by various means, including educational and training campaigns, regulations, and market based (economic and financial) instruments. This section refers to the latter category.

Various types of economic and financial instruments are used in other countries to manage industrial solid waste. The following may be identified as particularly relevant in the Moroccan context:

- user charges
- product charges
- subsidies

9.1 User Charges

Both user charges and regulations aimed at the discharge of industrial waste should be designed to encourage cost-effective means of achieving waste management targets. The case for user charges based upon the social cost of discharging waste is that they give enterprises a choice between paying for the social cost of such waste or dealing with it themselves. For those types of solid waste which industry may prefer to be handled by municipal authorities (restricted to that which can be mixed with household waste), the municipality may charge tipping fees and collection fees based upon the cost of handling the volume of waste discharged. In principle the freedom of industry to choose between alternative ways of responding to the social cost of the waste discharged should result in cost-effective solutions to the problem.

In practice of course, user charges levied at the point of discharge are subject to the large administrative difficulties in monitoring and measurement. In such cases rough approximations may be used to determine the liability of individual industries, with random checks being used. Also, it will normally be the case that hazardous and toxic wastes should be subject to administrative regulation or outright bans rather than reliance upon economic instruments.

9.2 Product Charges

Due to administrative difficulties of monitoring large numbers of individual waste discharges, an alternative approach is becoming increasingly popular in many countries. This approach makes use of blunter instruments which are based on the presumed environmental damage or disposal costs involved in the use of certain materials in

production or consumption. These instruments are known as product charges (or presumptive charges), in which there is a presumed relationship between the use of a resource and its eventual contribution to pollution. These blunter instruments should normally be implemented at the national, rather than the local level.

Product charges are related to investment in pollution control not only because they may reduce the volume of specially damaging waste, but may also stimulate investment in more environmentally friendly alternatives. However, as in the case of user charges, where a product is highly toxic and its use should be completely eliminated or substantially reduced, a partial or total ban will be preferable to the use of economic instruments. In principle, charges should be based upon the total cost (including environmental cost) of disposing of the waste material after the product has been utilized. Product charges satisfy the criteria of promoting cost-effective investment in pollution control only if the technical linkages between the use of certain materials and their transformation into environmentally damaging outputs can be established with some degree of certainty. The potential use of such instruments in the Moroccan context deserves further research, including study of the environmental damage caused by different materials, the point at which fees or taxes should be levied, and the administrative costs involved.

9.3 Subsidies

In many countries, industrial investment in environmental controls or recycling has been encouraged by a variety of government subsidies, primarily by means of tax relief and low interest loans. Such inducements have typically been found necessary to obtain the co-operation of powerful industrial groups. It has also been used where the social costs of requiring an industry to improve its environmental performance (perhaps due to unemployment created if a firm has to curtail its operations) are deemed to be excessive.

While the potential contribution of such measures in the Moroccan context should be examined, it should be noted that such subsidies are in direct contravention of the widely accepted "polluter-pays" principle, and that administration of such a system to avoid possible abuses is extremely complex. Moreover, although in the long term some savings might be achieved due to reduction in waste discharge, the net impact would place an additional burden on public revenues, which in Morocco are already under great pressure.

Guidelines for National Level Policies and Actions for Solid Waste Management

Part 4 Infectious Waste

Exchange Rate (as of July 1997)

1 Dirham = 0.115 US dollars = 13 yen

Abbreviation List

BMH	Municipal Health Service
CNE	National Council for Environment (Conseil National de l'Environnement)
CRE	Regional Council for Environment (Conseil Régional de l'Environnement)
DAHIR	Law, Decree, or other legal document signed by the King
DH	Dirham
EU	European Union, E.E.C
FEC	Fond D'Equipement Communal Communal Fund for Equipment
GDLC	General Department of the Local Government, MoI
HCS	Haul Container System
MoA	Ministry of Agriculture
MoC&I	Ministry of Commerce and Industry
MoE	Ministry of Environment
MoEM	Ministry of Energy and Mines
MoH	Ministry of Health
MoI	Ministry of Interior
MoPW	Ministry of Public Works
NP	National Promotion
ONEP	National Office for Drinking Water
SWM	Solid Waste Management
USE	Under Secretariat for Environment, MoI
Veh.	Vehicle

Final Report

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Current Book and Part are marked with “*”.

***Book 1 Guidelines for National Level Policies and Actions
for Solid Waste Management**

- Part 1 National Strategy
- Part 2 Laws, Institutions, and Finance
- Part 3 Industrial and Hazardous Waste
- *Part 4 Infectious Waste

**Book 2 Guidelines for Improvement of Solid Waste
Management for Urban Communes and
Communities**

- Part 1 Management and Institutions
- Part 2 Technical Guidelines

**Book 3 National Action Programs for Solid Waste
Management**

**Book 4 Solid Waste Management Plans for Safi and El
Jadida**

- Part 1 Solid Waste Management Plan for Safi
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Current Conditions of Solid Waste Management in
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THE STUDY ON THE NATIONAL GUIDELINES FOR SOLID WASTE MANAGEMENT FOR THE KINGDOM OF MOROCCO

INTRODUCTION

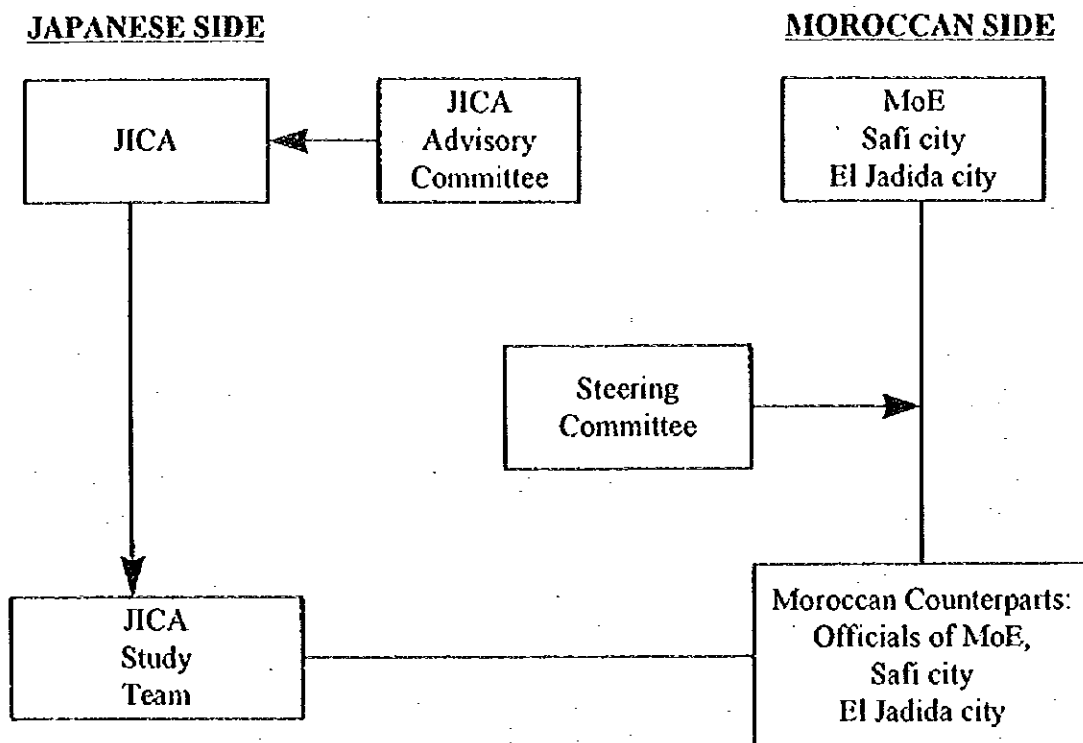
1. Objectives of the Study

The objective of the Study is to strengthen the capacity of solid waste management at both national and local levels. This study has been executed by Japan International Cooperation Agency (JICA) based on the request from the Government of Morocco. JICA commissioned the study to a joint venture comprising EX Corporation and Yachiyo Engineering Co., Ltd. The joint venture has organized a study team comprising of 11 specialists. The Study has been conducted jointly by Japanese consultants and their Moroccan counterparts.

The study period was about 18 months from January 1996 to July 1997. The Study is divided into two phases, the first phase being from the beginning up to September 1996, and the second phase being from October 1996 till the end. The objective of the first phase study is to formulate the guidelines and action plan for solid waste management at both national and local levels. The objective of the second phase is to apply the guidelines formulated and check their applicability. Two cities, i.e. Safi and El Jadida were selected for the second phase. The Study team in collaboration with the counterparts in Safi city have formulated a plan for improvement of solid waste management. In addition, we have implemented a public education campaign (demonstration project) aiming at strengthening citizens' understanding and cooperation concerning city cleansing. We have also formulated a plan for improvement of disposal of solid waste for El Jadida. It is expected that the plans will serve as a model for other local authorities in Morocco.

2. Study Organization

The study organization is shown in the figure below. This study has been conducted jointly by the Study Team led by Mr. Ohno and the Moroccan counterparts, i.e. officials of Ministry of Environment, Safi city and El Jadida city. A key counterpart agency on the Moroccan side is the Ministry of Environment. For the smooth execution of the study, the Moroccan side formed a steering committee comprising of representatives of the Ministry of Environment, Ministry of Interior, Ministry of Health, Ministry of Public Works, and Ministry of Commerce and Industry. Mrs. Layachi, Director, Department of Observation, Study and Coordination, Ministry of Environment served as chairman of the steering committee. On the Japanese side, an advisory committee was formed for the study. Dr. Masaru Tanaka, Director, Department of Waste Management Engineering, the National Institute of Health, served as chairman of the Advisory Committee.



MoE: Ministry of Environment

3. Reports

This study has produced the following reports:

1. Inception report
2. Progress report (1)
3. Interim report
4. Progress report (2)
5. Draft final report
6. Final report

The final report consists of the following Books:

- Book 1** Guidelines for National Level Policies and Actions for Solid Waste Management
 - Part 1 National Strategy
 - Part 2 Laws, Institutions, and Finance
 - Part 3 Industrial and Hazardous Waste
 - Part 4 Infectious Waste
- Book 2** Guidelines for Improvement of Solid Waste Management for Urban Communes and Communities
 - Part 1 Management and Institutions
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- Book 3** National Action Programs for Solid Waste Management
- Book 4** Solid Waste Management Plans for Safi and El Jadida
 - Part 1 Solid Waste Management Plan for Safi
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- Book 5** Summary
- Book 6** Supporting Report :
Current Conditions of Solid Waste Management in Morocco
- Book 7** Data Book:
Appendices to Solid Waste Management Plan for Safi
- Book 8** Japanese Summary

All the Book except for Book 8 has been prepared in English and French.

4. Guidelines for National Policies and Actions for Solid Waste Management (Book 1)

The Guidelines consists of the following four parts:

- Part 1** National Strategy
- Part 2** Laws, Institutions, and Finance
- Part 3** Industrial and Hazardous Waste
- Part 4** Infectious Waste

1

2

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CHAPTER 1 INTRODUCTION

1.1 Background

Treatment of hospital waste, especially infectious waste, is currently at a very poor level in Morocco. No one who belongs to hospitals (namely generators), communes and communities (disposers) deny this fact; however, they do recognize the necessity for handling this matter.

Then, why has Morocco allowed waste to be left untreated? There is a simple answer to this question. Doctors believe that they are meant to cure sick people but not to manage medical waste. Although hospitals may have a mature management system for medical treatment, they do not have any full-fledged system for waste management due partially to the absence of explicit objectives for waste management.

The solution of this problem, however, is not necessarily the doctors, who understand the necessity for waste treatment. Doctors should still be concentrating on medical treatment. It is essential for hospitals to employ managers specifically for infectious waste management and to make necessary arrangements in the hospitals.

Since Morocco has almost no administrative regulations over waste, the existence of such managers will not necessarily lead to successful waste management. Pressure regarding their social responsibility should be placed on the shoulders of hospital staff, private contractors, and others responsible for SWM. Such pressure requires creation of an administrative system for SWM supervision and monitoring.

1.2 Objectives of the Guidelines and Scope of their Application

Medical institutions are responsible for medical and infectious waste. Proper SWM by the institutions is the principal objective, their role being a decisive factor in improving Morocco's infectious waste management.

Little result can be expected from what hospital-related people do spontaneously according to past experience of the Ministry of Health. This experience has proved that strong leadership must be taken by the government to conduct SWM. The government must be a guide for hospital employees to properly conduct infectious waste management.

What are the steps that the government must take in the field of medical waste management? These guidelines are intended to identify these steps.

There are three areas where expertise must be developed:

1. Administration of infectious waste
2. Management of infectious waste
3. Development of treatment facilities for infectious waste

These guidelines are for the readership of the government's SWM personnel who administer medical and municipal waste. It is written to support efforts to establish a national administration for medical (infectious) waste.

Part 4 of these guidelines is created for persons responsible for hospitals and other medical institutions.

The guidelines, however, do not specify exactly what should be done by hospital employees. This information will be presented in action programs at the national level. The guidelines also do not present enough case studies or reference material; these should be gathered.

1.3 Structure of the Guidelines

The guidelines consist of an introduction and the succeeding five Chapters. Chapter 2 summarizes the present situation of governmental (MoH) actions toward infectious waste in Morocco and also issues relating to management. The guidelines should be developed based on what the MoH has successfully done so far.

In Chapter 3, basic aspects of infectious waste will be explained for readers who are not familiar with it. General principles of infectious waste treatment, which have been established by the MoH, will be presented, too. This chapter is the starting point for the main part of the Guidelines.

In Chapter 4, necessary actions for the government to establish effective administration of waste will be explained. A desirable administration under the current situation, in which there are no SWM laws, will be introduced.

In Chapter 5, the basics of SWM in medical institutions will be explained. These basics are prepared as guidelines for the government to encourage establishment of an SWM system in medical institutions. The chapter will show SWM actions required in medical institutions and serve as an important reference for hospital-related personnel. It will not however serve as a manual for SWM of infectious waste, and elaboration of detailed actions remains the government's task.

Chapter 6 contains discussions of how the government should direct development of waste treatment facilities. It is not the purpose of this chapter to provide complete answers for this development. This Chapter is to present the guidelines-based actions that the government should carry out.

Much more could be included in the Guidelines, so they do not precisely state the actual steps to be taken to establishing a new administrative structure. This is only a step towards the goal. For making further and wider steps, the government, at the top level, must go further than issuing decree documents, and must prepare concrete actions to direct medical institutions. Once the government undertakes these actions, it will soon understand that the guideline is just to indicate where to start establishing an SWM administration.

CHAPTER 2 PAST EFFORTS AND CURRENT ISSUES CONCERNING HOSPITAL WASTE

2.1 Past Efforts of MoH

MoH has understood hospital waste issues for some years, and has been handling the waste as follows.

1982-83	Consultation on hospital waste by a WHO expert, which ended up with recommendations on an action strategy
1989	A day of reflection on urban waste (and hospital waste in particular) in collaboration with the Local Communities' Department
1991-1992	Document on hygiene in hospitals created by the Division of the Environment's Hygiene Section, including records of hospital waste collection
1992	Report concerning the estimation of equipment needs and safety measures against nosocomial (nasal) infections, particularly in regard to hospital waste.
November 1992	Circular note No. 40236DE/10 on hospital waste collection, and cleanliness and hygiene of hospitals
Early 1993	Presentation of a project for hospital and industrial waste treatment by a centralized incineration unit, organized by a Spanish company Technical de Protection Ambiental SA(TPA)-Madrid
1993	Action plan No. 2 for the improvement of hospitals, section Hospital Hygiene, chapter on hospital waste
1994	Consultation on hospital waste by a WHO consultant, organized by the Division of the Environment, Hygiene Section
July 17, 1995	Establishment of a national committee in charge of hospital waste

In November, 1992, MoH issued a document on proper treatment of hospital waste, but satisfactory actions were not taken by the hospitals. In 1993 an action plan for hospital improvement was launched, involving waste, but so far there have been few results. In 1994, with the help of a WHO expert, MoH discussed hospital waste treatment.

In July, 1995, MoH set up a national committee for hospital waste management to take some special actions. This committee has four working groups. The first working group studies regulations for hospital waste treatment. The second working group prepares training programs, education, and information for hospital personnel. The third working group works on developing the collection of sorted waste. The fourth working group deals with technical and financial measures, and the feasibility of hospital waste treatment.

2.2 Problems and Issues at Present

MoH's analysis found the following five reasons for failure of their action plan

1. The lack of follow-through consultation actions
2. Projects without accompanying budgetary estimates or sources
3. Projects exceeding the intrinsic capacities and resources of the Ministry of Public Works
4. The lack of awareness of and involvement of decision-makers and workers in the field of public health
5. The lack of any principles for hospital waste management based upon a national consensus

The following paragraphs summarize present hospital waste treatment studies by MoH and present hospital waste management studies by MoE and JICA

1. Sorting

Hospitals are instructed to sort waste by type and to discharge it at designated locations. However, this instruction is not followed at present. While hospital staff understand the instruction, operating staff lack training in SWM.

2. Collection and Storing

Waste bags and containers are not used for collection. The lack of collection trucks is confirmed. Infectious waste is collected without being separated from other waste and is dumped in open spaces. The waste is left uncovered for over 24 hours before dumping.

3. Transport

Collection workers in Communes have to handle unsorted hospital waste without protection from accidental infection.

4. Treatment

No stabilizing treatment for hospital waste is conducted. There are incineration facilities, but they are not properly operated.

The above paragraphs have mentioned the main aspects of hospital waste treatment. The most important aspect relates to the institutions that manage the treatment. For example, although doctors working with infectious diseases understand the danger of infectious waste, managers of hospitals do not convey a clear definition of waste to hospital staff. Also, training for judging infectious waste is lacking. Even if dangerous infectious waste is sorted out in each room of the hospital, control of the sorted waste is not sufficient afterward. Adequate arrangements for collection, storage, and supervision of waste activities do not exist.

2.3 Action Plans of MoH

MoH has future action plans as follows.

1. Organizational Plans

- Forming a multidisciplinary national committee to reflect on and elaborate a hospital waste management policy
- Placing necessary means at the disposal of the Hospital Department in order to implement this policy
- Involving all the structures of the Ministry and the other departments in the process of coordination and follow-up execution

2. Operational Plans

- Elaborating a technical guidebook on hospital waste management and disposal
- Drawing up plans for staff training and to increase increasing the awareness of health workers
- Collecting the existing documents at the national and international level
- Identifying necessary actions for hospital staff, possibilities of subcontracting, and efforts to coordinate with the concerned departments.
- Investigating possibilities for bilateral and multilateral cooperation in this field

CHAPTER 3 BASICS OF INFECTIOUS WASTE TREATMENT

3.1 What is Infectious Waste?

Infectious waste is waste that is contaminated with pathogens, whose quantity is enough to cause an infection. Measuring pathogens quantitatively is impossible; therefore, it is widely acknowledged that the definition of the waste includes potentially infectious waste.

Potentially infectious waste includes materials contaminated with blood and body fluid of even uninfected parents.

The list below shows various definitions of infectious waste :

Table 3.1-1 Various Definitions of Infectious Waste

Guidelines for Medical Waste Management, WHO 1983	<ul style="list-style-type: none">• Culture materials and germ stocks of infectious pathogens• Waste generated from medical operations of infected patients• Waste from infected patients in isolated wards• Waste from infected patients under dialysis treatment• Waste containing pathogens, and infected animals
Guidelines for Infectious Waste Management, EPA, USA, 1986	<ul style="list-style-type: none">• Isolated waste as defined by Center of Disease Control• Culture media and germ stocks related to infectious pathogens• Blood, etc.• Pathogenic waste• Impairment waste• Waste related to test animals
Manual for Medical Waste, Ministry of Health and Welfare, Japan, 1992	<ul style="list-style-type: none">• Blood, serum, plasmas, body fluid, blood derivatives• Pathogenic waste generated from medical operations• Sharp-edged materials contact that have been in contact with blood• Materials used for testing and examination of pathogenic micro-organism• Any materials stained with blood• Waste from infected patients of legally-defined contagious diseases, such as TB

There are no acknowledged data on the generation of infectious waste. Commonly used are data on the quantity of the hospital waste for each bed. Based on a survey

conducted with the help of WHO, it is estimated that 3 kg of hospital waste is generated per bed in Morocco.

The same type of data acquired around the world show different results ranging from 1.2 kg/bed to 6.5 kg/bed (USA). In Japan, it is estimated at 1.5 kg/bed. Therefore, the figure of 3 kg/bed in Morocco is not small and this is because the number of beds is small in the country.

The numbers of hospital beds per 1000 citizens in some countries are as follows.

- Morocco 1.2
- Algeria 2.6
- Tunisia 2.0
- France 9.3
- Spain 4.8
- Germany 8.7
- Netherlands 5.9
- Japan 15.9

As seen above, the number of beds in Morocco is small. This means a number of patients receive inadequate medical treatment. As Morocco's medical situation is projected to improve, the generation of hospital waste will increase:

MoH has estimated the amount of hospital waste generated as follows.

$$3 \text{ kg/bed/day} \times 35,000 \text{ beds} = 105 \text{ ton/day}$$

Among the waste generated, it is estimated that risky waste accounts for 5% to 10 %, and contaminated specific waste 35% to 40%. (Risky wastes are pathogenic waste and radioactive waste.)

Data obtained around the world present the ratio of infectious waste to total hospital waste as 20 % to 40 %.

A conservative estimate of the amount of infectious waste in Morocco will be 20t/day, and it will not exceed 50t/day.

The following can be listed as infectious waste.

- | | |
|---|---|
| 1. Blood | Blood, plasmas, serum, body fluid (sperm), blood derivatives |
| 2. Pathogenic waste | Body organs and tissues discharged |
| 3. Sharp-edged materials and needles contaminated with blood, etc. | Used injection needles, scalpels, test tubes, petri dishes, and small pieces of glass, etc. |
| 4. Materials used for examination of pathogenic micro-organism | Culture media, germ stocks, test equipment, and test animals |
| 5. Other blood-contacted materials | Gauze stained with blood |
| 6. Materials contacted with human waste of patients of contagious disease | Papers, textiles, paper diapers, etc. |

Disposable medical equipment is rare in Morocco; especially tubes and containers used for liquid transfer and injection cylinders.

Used infection needles and scalpels require extra caution during transport since they are potentially harmful to collection workers.

3.2 How Dangerous is Infectious Waste?

Possible diseases caused by infectious waste are as follows.

1. Pathogenic Infection

TB, skin infection (tetanus, staphylococcus aureus infection), sexual disease (syphilis, gonorrhea), gastroenteritis, (dysentery, cholera), other disease (brucellosis disease, pasteurella disease, plague)

2. Virus Infection

Hepatitis (type B and C), AIDS, viral haemorrhagic fever (Lassa fever, Ebola haemorrhagic fever, Marburg disease, Crimea haemorrhagic fever, Congo haemorrhagic fever), other disease (adult T-cell leukemia, herpes, rubella, cytomegalovirus infection)

3. Chlamydia infection

4. Rickettsial disease

Most importantly, care must be taken to avoid infection through contacts with blood and body fluid. Diseases caused by such infection include hepatitis, viral haemorrhagic fever, adult T-cell leukemia, syphilis, and malaria. Pathogens that contaminate through blood contact are weak and easily die away outside the human body, and the risk of infection to humans is very low unless actual contacts are made. Virus and germs dwelling in the blood and body fluid are also weak outside the human body, and for average citizens, the risks of infection by blood-contacted waste are low. There are, however, risks to hospital personnel and cleaning staff when they are hurt by used injection needles.

There are some particular germs that can cause infection only by skin contact. They do not cause infection on healthy skin but only when injured. Waste collectors may get infected when they are cut by sharp-edged waste.

Tuberculosis is more difficult to handle since infection is airborne. TB pathogens are not easily destroyed even in the air, and waste from TB patients calls for extra caution.

Average citizens have only a small chance to get infected with these pathogens since the germs die away in time. Infection to scavengers working at disposal sites, however, may cause the spread of germs, and so caution is necessary.

It should be emphasized that care should be taken when handling used injection needles and scalpels. Secondary infection, which may take place in hospitals, is possible, and measures should be taken to avoid this.

Cleaning crews and collectors need to be careful about their contact with waste during work. Contacts made by scavengers should be avoided since they can pass the pathogens to others. Vermin control is also important for this reason.

3.3 Basics of Medical Waste Treatment

MoH has basic instructions for hospital management and outside-hospital treatment, as shown in the following paragraphs.

The most important is that infectious waste should not be disposed of untreated in landfills, and it needs sterilization or incineration treatment.

Therefore, the MoH's instruction requires the separation of infectious and pathogenic waste from other hospital waste. This sorting should be done at hospitals. Whether the waste is infectious or not is to be judged at hospitals.

The sorting involves pathogenic waste because no other means than incineration properly treats the waste. Infectious waste, even sorted out from pathogenic waste, should be stored correctly in prepared containers. Hospitals must sterilize or incinerate the waste before it is taken outside their sites. It is possible to dispose of the sterilized waste at landfill sites and mixed with other waste.

Incineration ash can be treated in the same way as sterilized waste. A hospital must look for an available incineration facility in case it cannot incinerate the waste on-site.

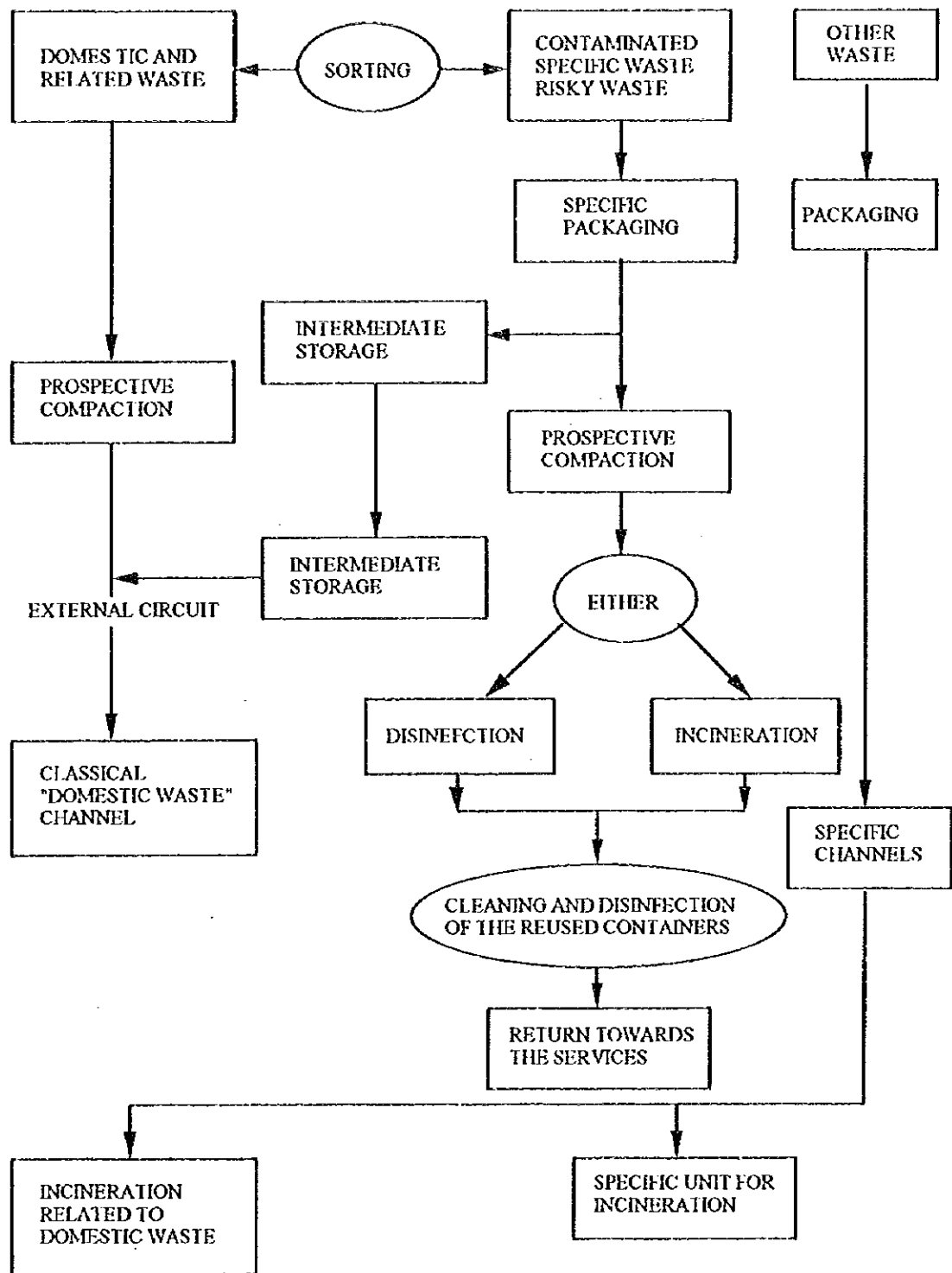


Figure 3.3-1 Infectious Waste Management Procedures



CHAPTER 4 GOVERNMENTAL ROLES AND ARRANGEMENTS FOR INFECTIOUS WASTE

4.1 Governmental Roles

Administrative regulation and monitoring of medical institutions are necessary to encourage their proper treatment of hospital waste. When treatment is done by an external institution, the same administrative activities should be conducted.

To achieve the above, the government should make the following efforts.

1. Developing laws concerning SWM
2. Formulating arrangements for regulation and monitoring
3. Formulating a national policy for infectious waste management
4. Preparing technical standards for collection, storage, and treatment
5. Providing updated technological information
6. Discussing a promotion policy for developing treatment facilities (including economic aspects)
7. Understanding the present status of nationwide infectious waste management
8. Offering training for staff in infectious waste management
9. Building cooperative relationships with foreign institutions

4.2 Improvement of Legal Arrangements

1) Items for Improving Legal Arrangements for Infectious Waste

What it takes to establish an administrative system for medical waste are laws, enforcement procedures, and executive arrangements.

It is not practical to set laws solely for medical waste or infectious waste. They should be included in legislation that covers all types of waste. Yet, infectious waste has special characteristics, so the government should issue orders and regulations concerning details of its management.

Legal aspects other than specific consideration of infectious waste, as shown above, should be the same as for other wastes and hazardous wastes.

Following are items to be covered in legislation on the proper treatment of infectious waste.

1. Definition of infectious waste
2. Responsibility for hospital waste treatment
3. Obligatory treatment of hospital waste
4. Methods of hospital waste treatment
5. Administrative system of treatment in hospitals
6. Installation and operation of treatment facilities

7. Permissions, reporting, and recording
8. Licensing the treatment service
9. Monitoring and evaluation
10. Administrative power and regulatory arrangements
11. Penalties

2) Items for Improving Laws

a. Definition of Infectious Waste

The definition of infectious waste should be made in the decree on infectious waste management. The definition has already been prepared by MoH with the help of WHO.

The governmental guideline is necessary when hospital crews sort out infectious waste.

“Normal” hospital waste is all waste other than infectious waste. Apart from hospital waste, radioactive waste will be generated in hospitals. Although SWM should comprehensively manage all the waste generated in hospitals, radioactive waste is usually managed by separate legislation covering radioactive materials.

b. Responsibility for Hospital Waste Management

It is necessary to legally define the responsibility for hospital waste management. The necessary definition will include the following.

Waste that medical institutions generate belongs to the managers responsible for the management of the institutions; therefore, hospital personnel hold responsibility for the waste.

Non-infectious waste can be handled with household waste, and local governments (communes and communities) can be allowed to take over the responsibility for its collection and disposal.

Responsibility for hospital waste management remains with the hospitals when local governments do not accept the waste, for example, infectious waste. Private contractors authorized by local regulatory agencies should be allowed to offer collection, transport, and treatment services.

Responsibility for infectious waste management is eventually attributed to medical institutions. Therefore, even when the private contractor commits a breach of contract, the responsibility for treatment is, strictly speaking, still with the medical institutions.

Contracting out does not mean relinquishing responsibility.

c. Obligation for Hospital Waste Treatment

Legislation should clearly state that hospitals are responsible for properly treating medical and infectious waste.

Medical institutions are obliged to properly discharge non-infectious medical waste according to local government requirements.

d. Methods of Infectious Waste Treatment

Legislation should definitely cover two things, namely, that infectious waste must be treated only at licensed facilities, and transport of the waste can be contracted out only to licensed operators.

Decrees concerning infectious waste should definitely rule out landfilling of any untreated infectious waste. The government should examine decrees to define; the proper treatment of waste, permission for contracted treatment, and necessary appointment of contractors to be hired by medical institutions.

e. Management System for Infectious Waste Treatment in Hospitals

The obligations of managers of medical institutions should be defined in law. They should be obliged to appoint personnel in charge of infectious waste management and of the operation of the treatment facility, to build up an internal SWM system; and to inform the regulatory agency of the people appointed for these duties.

A decree should determine the qualifications of the personnel in charge of infectious waste management and their obligations.

f. Installation and Operation of Treatment Facilities

Legislation should clearly define the obligations of institutions operating facilities for treating infectious waste. They should be obliged to satisfy the technical and operational standards for such facilities.

In order to promote these facilities, the responsible ministry should also be obliged to prepare development plans for local governments' facilities. The ministry should be authorized to set up technical and operational standards for the facilities.

g. Permissions, Reporting, and Recording

Permission to be obtained from local regulatory agencies for installing or improving treatment facilities should be required by law. The following should be obligatory: Reporting on the performance of operational managers, and keeping operating records.

The ministry should determine the types of facilities to be reported. Facilities such as a high-pressure steam sterilizer (autoclave) may not have to be reported.

h. Licensing the Treatment Service

Legislation should require private providers of treatment to be licensed. Where the amount of infectious waste is small, the law should allow providers to have a regional concession.

i. Monitoring and Evaluation

In order to achieve proper management of infectious waste in a region, the local regulatory agency should be legally obliged to fulfill tasks such as monitoring and evaluating medical institutions; and informing central ministries and agencies of the obtained information.

j. Administrative Power and Regulatory Institutions

The local regulatory agencies and their tasks should be defined in law. Rights of on-site inspection and power to stop the operation of a violating facility should be defined by law.

k. Penalties

Definition of violations should be made by law. It is necessary to apply the same type and severity of penalties to violations concerning hospital waste as to other waste.

Activities to be penalized can be listed as follows.

1. Unauthorized installation of a treatment facility for infectious waste
2. Unauthorized alteration of a facility
3. Violation of an order to halt the operation of the facility
4. Unauthorized collection, transport, and treatment of the waste
5. Violation of contract standards by clients or contractors
6. Negligent operation, recording, or filing of records
7. Violations concerning reporting by hospitals or treatment service providers (forgery of reports or refusal to report)
8. Violation of administrative orders for improvement committed by hospitals or treatment service providers
9. Negligence of managers responsible for infectious waste management
10. Negligence of operation managers of infectious waste treatment facilities
11. Negligence of managers responsible for administrative management (manager of hospital)
12. Interrupting site inspection
13. Violation of prohibited discharge of waste, etc.

4.3 Establishment of Administrative Institutions

1) Coordination at the National Level

Tasks that the government should fulfill for hospital waste are listed as follows. It is necessary to have a coordinated approach when determining the ministry responsible for each task.

1. Legal and regulatory steps

- Enactment of legislation
 - Defining infectious waste and preparing standards by which this definition may be judged
 - Preparing standards for collection, storage and treatment of infectious waste
 - Preparing technical standards for infectious waste treatment facilities
 - Preparing inspection standards for approving facility placement
 - Preparing operation standards for the facilities
2. Introducing updated technical information on infectious waste management to hospital-related people
 3. Creating a national policy for infectious waste management
 4. Discussing policies to promote the development of treatment facilities
 5. Understanding the state of infectious waste management currently conducted in the country
 6. Training supervisors of administration and medical personnel in infectious waste management
 7. Building relationships with foreign institutions for technical cooperation
 8. Preparing management standards for infectious waste treatment at municipal disposal sites under emergency circumstances

Main ministries responsible for above tasks will be the Ministry of Health, Ministry of Environment, Ministry of Public Works, and Ministry of Internal Affairs

MoH supervises medical institutions. MoE prevents air, water, soil, and ocean pollution, and excessive noise and odor caused by business activities. MoPW supervises the management of construction in municipalities with regard to pollution of river and ground water. MoI supervises municipalities.

MoH, which supervises medical institutions, should be responsible for SWM in hospitals. The ministry should be involved in issues relating to infectious waste, such as setting standards by which infectious waste may be defined. MoH, however, should share with MoE responsibility for the following tasks: setting standards for infectious waste treatment, placing treatment facilities in hospitals, and preparing technical standards for the operation of facilities, in view of environmental objectives.

MoE should be mainly responsible for preparing environmental standards for approving storage, transport and treatment facilities when out-of-hospital treatment of hospital waste, especially infectious waste is carried out.

MoPW should supervise the issuance of construction permits for installation of treatment facilities. Management by MoH of construction should be limited to its technical and environmental aspects.

Hospital waste other than infectious waste can sometimes be treated in a local government facility. In this case, the local government should issue standards for acceptable waste and issue regulations and instructions concerning the hospital's discharge of the waste. Although the local government should be empowered to introduce such regulations and instructions, MoIA should retain the responsibility for supervision over what the local governments do.

Local administrative regulatory agencies (Prefectures and Wilayas) and the local regulatory agency of the central government (which does not yet exist) should be responsible for preparing plans to promote the development of treatment facilities for infectious waste. MoH and MoE should share authority to approve this plan. Until the local regulatory system is developed, responsibility for nation-wide development of treatment facilities will be almost entirely with the central government.

MoH and MoE should share responsibility for sharing technical information, training, and cooperative relationships with foreign institutions. This responsibility should be shared by MoH relating to hospital waste management; and by MoE relating to prevention of damage to the environment by properly treating infectious waste.

2) Establishment of Legal Framework for Local Regulations

The central ministries and agencies should not regulate infectious waste management at the local level. The government should create local regulatory agencies to undertake the task.

Regulations that will be needed at the local level are as follows.

1. Regulation and monitoring of hospital waste management as one aspect of hospital management
2. Regulation of environmental aspects of planning, licensing, and operation of waste treatment facilities in hospitals
3. Regulation of environmental aspects of planning, licensing, and operation of waste treatment facilities outside hospitals

Local regulatory agencies can be communes, prefectures, Wilayas, regional health centers, or new local regulatory agencies.

The Decentralization Law of 1976 authorizes a commune to participate in any local activities. Communes do not seem to have many staff available for regulating infectious waste since the task calls for very specialized expertise. It is actually inefficient for communes to have staff for that purpose only. With regard to the disposal of non-infectious hospital waste at communal or community disposal sites, local governments should be authorized to issue instructions and impose regulations.

Many methods can be devised for strengthening Prefectures and Wilayas. Coordination will be needed to secure administrative channels of MoH and MoE, which are mainly responsible for regulating infectious waste.

Regional Health Centers are the appropriate administrative channel since they currently represent the MoH in their regions. Regional branches of MoH should regulate arrangements and systems for infectious waste management in hospitals. The centers are expected to directly instruct hospitals and offer education and training for managers responsible for infectious waste management.

An environment-related regulatory agency should be authorized to give permission for the installation of infectious waste treatment facilities and regulation of their operations. An important issue emerges here in strengthening the nation's environmental management, namely whether the government should improve Prefectures and Wilayas to take on these tasks, or whether a new local environmental regulatory agency should be established. One possibility is that the government might place an environmental agency in each region.

4.4 Priority Administrative Improvements

1) Administration Prior to the Development of New Legislation

New legislation and regulatory arrangements will take some time to be ready, even though infectious waste is already being generated. The government should address this urgent problem now.

The government should take care of the following six items to strengthen infectious waste administration in order to implement proper treatment of waste.

1. Preparation of management guidelines for medical waste
2. Instruction on establishing infectious waste management systems in medical institutions
3. Quality training for hospital employees
4. Auditing of collection, disposal, and treatment conducted by hospitals and non-medical institutions
5. Discussion on promoting treatment facilities, and establishment of a national policy for developing the facilities
6. Detailed instruction on proper treatment of medical waste at municipal disposal sites

2) Administrative Actions

a. Preparation of Guidelines for Hospital Waste Management in Medical Institutions

The government should prepare SWM guidelines for medical institutions and have them distributed to concerned institutions. These guidelines should include items that will support legal developments in the future. The guidelines will be explained in

Chapter 3 and 5 of the JICA Guidelines. These chapters should be supplemented by adding detailed information and case studies.

The government needs to issue the guidelines as a MoH notification to medical institutions.

b. Instructions for Establishing Management Systems in Medical Institutions for Hospital and Infectious Waste

The government, namely MoH, should instruct medical institutions to be cooperative in assigning responsibility for proper disposal of hospital and infectious waste.

The government should encourage medical institutions to implement SWM properly, and require the institutions to appoint persons responsible for infectious waste management. The government should instruct institutions on the development of operation systems for collection, storage, and treatment; and require them to report names of responsible persons to regional health centers.

The government should instruct large hospitals to set up internal committees for coordination concerning hospital waste, supervision of operations, and evaluation of performance.

c. Offering Training to Hospital Personnel

The government should fulfill the following tasks: holding seminars on hospital management for directors in charge of medical institutions; explaining guidelines for infectious waste at meetings and conferences; and providing training to personnel responsible for infectious waste management in each region.

For this task, MoH and MoE should appoint traveling instructors and periodically hold joint instruction meetings and training programs.

d. Auditing Management

Until the concerned laws are developed, the traveling instructors should check hospitals' infectious waste management according to the guidelines for the management. This check should be included in auditing the management of medical institutions.

The traveling instructors will evaluate how management is done by questioning, on-site inspection, and interviewing medical personnel and cleaning staff. These checks should be based on prepared check lists.

The instructors will present their evaluation and propose improvement items at meetings with the personnel of the institution.

e. Discussion on Development of Treatment Facilities and Promotion of Private Participation

The government should discuss how to promote treatment facilities in accordance with its policy for infectious waste treatment. Also, the government must set up a basic policy for developing facilities including criteria for whether or not the waste should be treated in hospitals.

The government should discuss how to attract capital investment from the private sector and create favorable conditions for such investment.

There will be some regions where incineration and other proper treatment facilities are unlikely to be developed for the time being. In this case the government should promote the use of sterilization treatment. When this is not enough, details of other acceptable methods should be stipulated.

f. Strengthening Control of Disposal of Hospital Waste at Municipal Disposal Sites

A governmental order should be issued to the chairpersons of local governments regarding safety of collection workers and the management of collection and disposal of hospital waste, in order to reduce the risks of infection.

Training programs should be given to SWM staff of local governments concerning the management of infectious and non-infectious hospital waste in all the regions.

Local government and medical institutions should agree on the obligatory management of hospital waste discharges. This agreement can be regarded as a contract that binds hospitals not to discharge infectious waste and obliges local governments to collect and dispose of non-infectious hospital waste.

The number of such agreements will be used as progress indicators regarding the national management of infectious waste.

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CHAPTER 5 HOW TO IMPLEMENT INFECTIOUS WASTE MANAGEMENT

5.1 SWM Systems, Internal Rules, and Training in Medical Institutions

1) Institutions

- a. Directors of medical institutions should appoint managers specifically for infectious waste management.**

The person in charge of each medical institution should appoint a manager for infectious waste management in order to ensure proper treatment of the waste.

This manager must satisfy certain qualification requirements. Only doctors and nurses and individuals who have passed the relevant tests after receiving MoH's training programs can be qualified.

The appointed manager will fulfill the following tasks in accordance with internal management rules for hospital and infectious waste.

- 1. Preparation of operational norms for sorting, storage, collection, packaging , and treatment**
- 2. Formulation of a management plan**
- 3. Complete circulation of necessary information to doctors, nurses, and cleaning crews**
- 4. Supervision of operations**
- 5. Documentation of operational records, record-keeping, and reports to hospital directors.**

b. Establishment of an Operational Organization and an Internal Committee

Medical institutions must build up an organization for operating the tasks as follows: preparation of containers for sorting infectious waste, collection, storage, treatment, and transport to the outside. Hospital staff must appoint a leader who supervises the sorted discharge of infectious waste .

It is desirable to appoint an operations supervisor when a hospital has more than 4 or 5 cleaning crews for infectious waste.

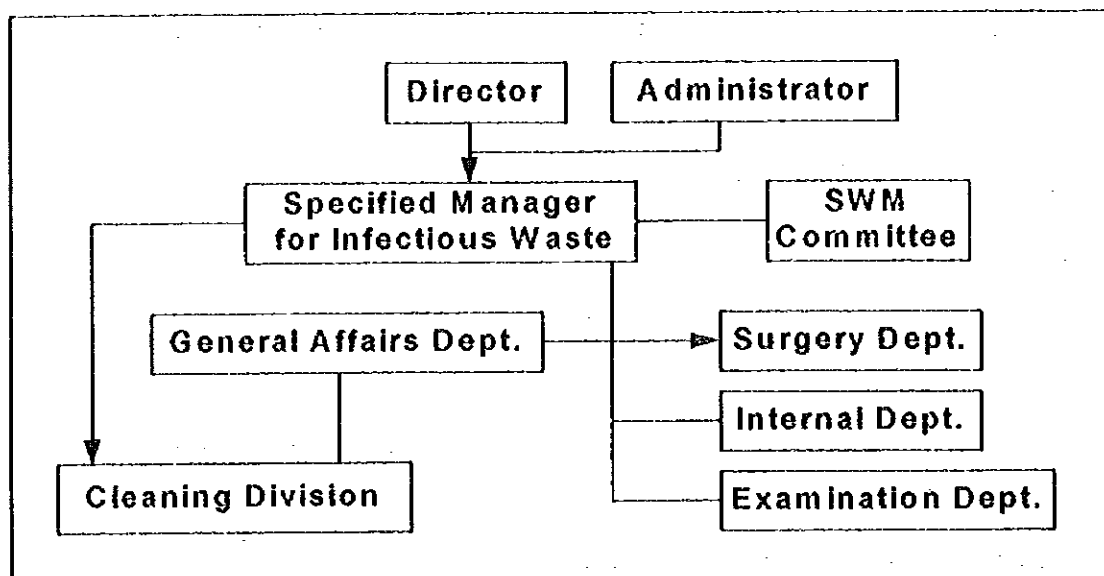


Figure 5.1-1 Institutional Arrangements for Infectious Waste Management in Hospital

It is recommended that general hospitals with many sections should have a SWM committee consisting of directors from each section. The committee should be able to evaluate and audit operational performance of the treatment. The secretariat of the committee should be headed by the manager of infectious waste in the hospital

2) Preparation of a Waste Management Plan and Management Regulations in the Hospital

a. The directors should formulate a hospital waste management plan.

Managers of medical institutions should specify the infectious waste generated and be familiar with its amount. Hospital personnel should prepare plans for collection, transport, sterilization, packaging, storing, and treatment to be carried out in the hospital.

Such plans should include the following items regardless of the size of the hospital.

1. Creating charts and tables depicting the source and amount of medical and infectious waste, and, for sorting purposes, the types of waste and containers.
2. Setting SWM norms regarding sorting, containers (types and color, storage inside the hospital, collection frequency, outside-hospital treatment, and hauling-out frequency
3. Determining the types and colors of waste containers
4. Deciding conditions and procedures for contracting out
5. Drawing a map exhibiting locations of waste storage
6. Preparing an organization chart and defining the roles of each component of the organization

b. The directors should establish internal SWM rules.

The directors should set up internal rules for infectious waste management.

The rules should cover the following items.

1. Definitions of medical and infectious waste
2. Appointment of specified managers, and definition of their responsibilities
3. Tasks of an internal SWM committee
4. Internal organization for SWM operations
5. Management principles for handling medical and infectious waste, sorting, packaging, labeling, in-house collection, storing, and internal treatment
6. Definition of obligation to prepare a treatment plan
7. Contracting out

3) Education of Hospital Staff

A director of a hospital should order its specified manager for infectious waste management to offer education and training programs to hospital staff and cleaning crews on how to handle the waste.

The first step in proper infectious waste treatment is the correct sorting of the waste by the hospital staff, who must be knowledgeable in handling the waste including collection, storage, packaging, and treatment.

When new staff are introduced, the specified manager should present the rules and a management plan and provide on-site demonstration to show what should be done. When the manager finds unsatisfactory sorting during periodical inspection, the manager must educate the personnel who are responsible for it.

The manager should also provide training to operating staff to prevent accidents.

4) Auditing

Hospital-related institutions are expected to self-audit their infectious waste management.

Auditing of medical institutions can be conducted by a third party, such as the region's public medical authority with the help of the institution accepting the auditing.

5.2 SWM within Medical Institutions

1) Sorting Receptacles

In hospitals, infectious and other wastes must be sorted out completely and be discharged in designated and separate receptacles.

It is desirable that infectious waste is sorted out again 1) as fragile waste and 2) used needles, blood, pathogenic waste, and 3) other waste. These wastes should be placed in separate designated containers. The containers should be easy to distinguish by their shapes and colors.

These containers, which are generally disposable, are not produced in Morocco, so for the time being re-use of containers is unavoidable. It is thus necessary to develop a standard container and the creation of a facility for sterilizing the products.

It is recommended that the government discusses standardization with medical associations, and rosin and cardboard manufacturers.

Until standard containers appear, each hospital must make its own effort to differentiate between receptacles.

2) Collection and Transport

The waste must be transported in containers that cause no waste scattering or spillage.

The following measures should be taken to avoid such accidents.

- 1. Avoiding waste scattering and spillage during transport**
- 2. Avoiding non-separate transport of infectious and non-infectious waste; separated hauling equipment should be used especially in large hospitals**
- 3. Prohibiting waste transfer in collection and transport**

Infectious waste should not be removed from its containers when transported. This however is not yet possible in Morocco, where the costs of containers is very high. As an interim measure, plastic bags purposefully colored and readily distinguishable can be substituted for the containers. Effort should be put into making containers free from spillage of disposed blood.

3) Storage

Infectious waste must be stored properly until it is treated; therefore, the following actions are necessary:

- 1. Restricting entrance to storage only to authorized personnel**
- 2. Storing infectious waste separately from other waste**
- 3. Placing a sign warning of the presence of infectious waste (possibly a bio-hazard sign)**
- 4. Avoiding storage for unnecessarily long periods**

5. Using a refrigerator for storing pathology test waste that may otherwise rot

A storage facility must be located where the managers can easily work. Mice and mosquitoes should not be present.

Discharges should be checked when accepting waste at the storage site. The specified managers must prepare a record, in which workers are required to fill in the types and amount of accepted infectious waste.

4) **Packaging and Labeling**

Infectious waste must be transported in containers when hauled by vehicles from hospitals to internal or external treatment facilities.

In Japan the government recommends that containers should be differentiated to separately receive sharp-edged waste, blood, and other solid waste. Blood waste should be transported in a sealed closed containers. Used needles and scalpels should be transported in containers that will not allow the waste material inside to break. Solid waste can be put in a plastic bag. At present, these containers are not produced domestically, therefore, the government should develop standard containers in cooperation with other parties.

The standard containers should be labeled with a bio-hazard mark to indicate that the infectious waste is kept there. The Japanese government recommends that three different colors should be applied so that containers can be distinguished from each other.

5) **Hospital's Management of Treatment and Operation**

- a. **Hospitals should treat infectious waste with their internal equipment as much as possible.**

Treatment methods will be;

1. Incineration,
2. Steam sterilization,
3. Thermal inactivation, and
4. Chemical disinfection.

Landfilling at hospital locations should be prohibited.

Incineration is the most expensive treatment. International conferences on infectious waste, however, have concluded that this method is still desirable in terms of sterilization, and waste reduction.

Autoclave can be valid for all the infectious waste save for pathogenic waste. The method, however, is not suitable when treating a large quantity of waste. Neither is thermal inactivation. Chemical disinfection should be employed to treat blood, pathogenic cultures, and germ stocks.

b. Selection of Treatment Methods

Medical institutions are advised to use an autoclave equipped in the hospitals to treat their waste by themselves unless the amount of the waste overwhelms the capacity of the equipment.

Steam sterilization by autoclave is widely used in hospitals. Infectious waste pathogenic waste can be sterilized in this way. This method, however, has some fundamental disadvantages. There are no ways to confirm if sterilization is completely done. It requires a limited amount of waste to be processed at one time. Some advantages that can be listed are that it costs rather less and does not require special knowledge for its operation, when compared to incineration.

Incineration is recommended in hospitals whose amount of infectious waste is large. Pathogenic waste should be also incinerated.

Incinerators are very expensive and create air pollution issues. They should not be located close to residential areas. Measures to prevent air pollution must be examined since Morocco will face an increased amount of waste of disposable medical equipment made from polyvinyl chloride.

Dry distillation gasification can be substituted for incineration. It has not yet been used widely in the world. (It is not commonly used in Japan either.)

The types of incineration are fixed grade batch combustion, rotary kiln incinerator, and fluidized bed incinerator. Among the above methods, only the fixed grade batch combustion can generally be employed in hospitals.

Technical standards for incineration facilities in Japan are as follows.

1. Furnace temperature of 800 degrees centigrade must be maintained at the exit of combustion chambers.
2. Facilities must be equipped with auxiliary fuel firing to maintain a temperature of 800 degrees centigrade.
3. An air conditioner must be installed to control air intake of a combustion chamber

When using a batch furnace of fixed grade batch combustion type, a secondary incinerator is necessary to treat incompletely combusted gas generated while feeding the waste into the furnace.

There are no legal regulations measures for preventing air pollution in Morocco. Best affordable prevention should be taken, and hospitals should consult MoE when locating batch furnaces.

Equipment to collect particulate matters are multicyclone (MC), bag filters, and electric dust collectors. Multicyclone is commonly used in small institutions such as hospitals. Japan's standard for the emission of the matter is at least, 0.7 g/Nm^3 . Hel may not be problematic now because plastic disposal equipment is used only a little at present in

Morocco. It is, however, necessary to consider this when locating the facility, and may be a problem in the future. In Japan, dry scrubbers with slaked lime are widely used.

SOx and NOx are also emitted. SOx does not present much problem for it is not a major component of waste. Treatment for NOx is generally not required when the incineration facility is small. Pathogenic germs will not be emitted after complete incineration of the germs.

Installing an incineration facility is a hard task. Medical institutions in different regions should get together to discuss private sector involvement and the joint setup of the facility. Coordination between institutions and the national government is necessary.

c. Application for Installing an Intermediate Treatment Facility

Medical institutions must apply for a governmental permission to set up an incineration facility.

There are no legal requirements for permission to establish an incineration facility. To ensure proper installation of the facility and to reduce its environmental impact, the government should require the directors of hospitals to consult concerned ministries and agencies.

Documents that medical institutions should submit to the government are as follows.

- Structural drawings of a facility
- Process charts proposed for treatment
- Conditions of operation
- The local environment surrounding the site where the facility will be constructed

The governmental regulatory agency should issue permission after assessing the structure, capacity, and impact on the environment around the site. Regional health centers should consult MoH and MoE for permission until the local regulatory agencies are set up.

d. Setting Operational Norms

Medical institutions are required to operate their treatment facilities properly; therefore, directors of the institutions must order the managers of infectious waste management to set up operational norms. The directors are responsible for assigning operation managers to their facilities.

Operation records for infectious waste management should be kept daily for management purposes.

In operating an incinerator, the following must be understood. Infectious waste must be put in the incinerator when its inside temperature reaches the designated level. The

amount of waste should not exceed the capacity of the incinerator. A thermometer and a temperature recorder must be installed in the incinerator to allow control of the heat of its furnace.

When using an autoclave, excessive amounts of waste should be avoided. Containers and bags must be opened so that the steam can sterilize the waste. Japan's norm requires total sterilization; therefore, the containers and bags must be opened and the waste must be crushed into pieces before treatment. The waste must be sterilized for more than 20 minutes by steam at a temperature of 121 degrees centigrade.

When sterilization is done by boiling, the process must take more than 15 minutes according to Japan's operational norm. Chemical disinfection will follow the process of soaking the waste in hypochlorite solutions of 1000 PPM or stronger for 60 minutes and in glutal-aldehyde for another 60 minutes.

e. Recording Operational Performance and Filing Records

Operational performance must be recorded and kept for a certain period of time.

5.3 Waste Treatment outside Hospitals

1) Collection and Transport

When medical institutions contract infectious waste management out to a third party, the waste must be hauled by the institutions themselves or by authorized private contractors. This authorization can be given by the government's regional regulatory agency. (The system for authorization has not yet been established.)

Hauling containers must be safe from any accidents. Containers should be carefully labeled and state that they contain infectious waste. (See section 5.2)

2) Subcontracting Treatment

Medical institutions must contract infectious waste management out when they cannot handle it themselves. The subcontractor's facility must be approved by MoE.

A medical institution may not have a proper treatment facility, in which case the waste can be treated at a municipal disposal site after the hospital has sterilized it by autoclave. Pathogenic waste is impossible to treat in hospitals. Separate landfilling can be applied for this waste at a municipal disposal site as a temporary measure. This should require some discussion by personnel of the local government and of the hospitals in the region.

When transporting waste outside the hospital, the service providers should be aware of the contents of the waste. The hospital must obtain a documented report proving that the contract has been properly completed by the contractor.

This reporting system is called "tracking system" in the USA and "manifest system" in Japan. In this system, a hospital issues several documents to go with the waste, and the documents come back to the hospital, confirming that the proper treatment was conducted.

Morocco should introduce this system even before the relevant law comes into force.

CHAPTER 6 HOW SHOULD THE GOVERNMENT DEVELOP TREATMENT FACILITIES FOR INFECTIOUS WASTE?

The government should ensure the following tasks are completed in order to promote the development of treatment facilities for infectious waste.

1. Preparation of instructional guidelines for development of waste treatment facilities
2. Instructions on preparing a development plan for regional facilities
3. Instructions on identifying a region's central hospitals and locating small-size incinerators
4. Promotion of private companies that can treat infectious waste

6.1 Preparation of an Instruction Plan for Developing Treatment Facilities for Infectious Waste

First of all, the government must prepare an instruction plan for hospital-related institutions and private contractors in order to promote investment in treatment facilities for infectious waste.

a. Principles of Infectious Waste Treatment

Infectious waste must be sterilized or incinerated. In principle, pathogenic waste, especially, should be incinerated. The incineration ash can be discharged at landfill sites

Waste treatment can be achieved with incineration, high-pressure steam sterilization, chemical disinfection, and boiling. High-pressure steam sterilization is highly recommended when the amount of waste is small. An incinerator, however, is highly recommended in some difficult situations; namely, where the hospital generates an excessively large amount of infectious waste, and for pathogenic waste.

There are no ways to check if sterilization is completely done. Some risk is thus involved and an incinerator is basically recommended to treat a large quantity of infectious waste at one time.

b. Principles for Development of Treatment Facilities for Infectious Waste

The government must convey to medical institutions certain principles for developing treatment facilities for infectious waste.

A distinction should be made between large cities where private treatment providers will appear, and rural areas and towns where such business is unlikely to spread. How to develop the facilities will be different in each area. Therefore, the principles must reflect this difference.

Figure 6.1.1 shows a flow chart of decision making with this consideration taken into account. Following this chart, the government can set up the principles as follows.

- Principle No. 1 Infectious waste except pathogenic waste should be sterilized in hospitals with their own sterilizing equipment.
- Principle No. 2 Large hospitals should install a small incinerator when they cannot use a private treatment provider to treat the large quantity of the waste.
- Principle No. 3 Hospitals should be encouraged to use private treatment providers when it is reasonable.
- Principle No. 4 A small size incinerator of a large hospital should be available for small hospitals' use when they cannot find any other facility for treating pathogenic waste.

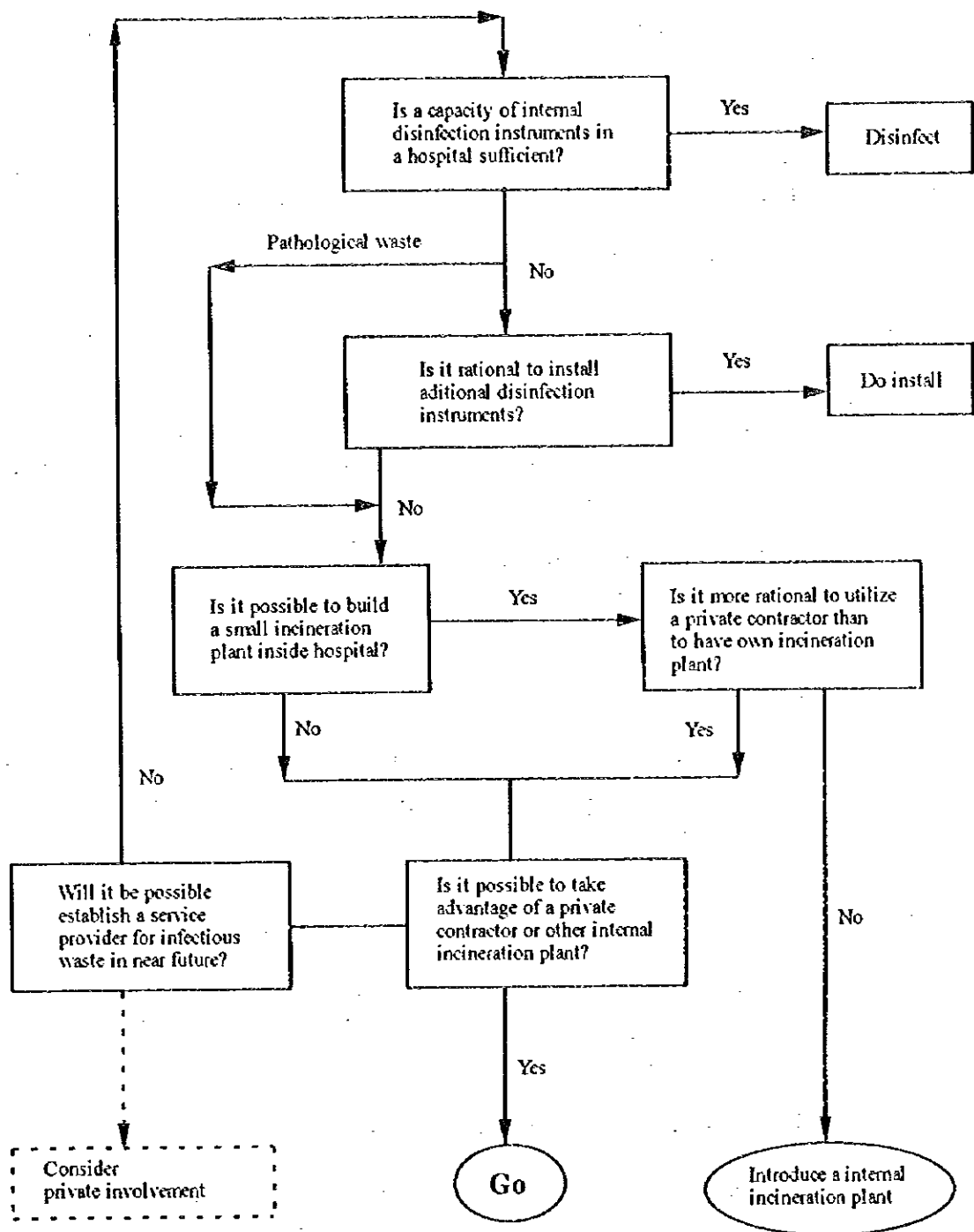


Figure 6.1-1 Flow Chart of Decision Making

c. National Instructions for the Development of Treatment Facilities for Infectious Waste

After developing a instruction plan for developing treatment facilities for infectious waste, the government must discuss the instructions themselves with medical staff, and introduce methods to utilize private providers.

For example, the following plans can be listed.

1. Plan for rural areas where it is not likely to be possible to use private contractors for infectious waste treatment

The government should instruct hospitals to sterilize infectious waste on-site. Where necessary equipment is lacking, it should be procured according to governmental regulations.

A large hospital of a region should be equipped with a small-size incinerator. The government should instruct this hospital to treat the pathogenic waste of small hospitals in the region.

2. Plan for urban areas where private contractors are available

In large city areas, it is efficient to have private treatment service. The government should encourage private businesses to develop the facilities and should instruct medical staff to utilize their services.

6.2 Preparation of Plans for Developing Treatment Facilities

The government should instruct local regulatory agencies to prepare plans for each region to implement development of the facilities. The government should begin by preparing a pilot plan for specified regions.

a. Development Plan for Treatment Facilities

Morocco must promote the installation of treatment facilities for infectious waste. Local regulatory agencies of the Prefecture and Wilayas should prepare plans for developing treatment facilities in accordance with governmental guidelines. At present, however, there are no such agencies in Morocco, so the supervising ministry or agency should launch a pilot plan in selected regions where infectious waste issues are most problematic.

This plan will be regarded as an instructional guideline for medical institutions to promote treatment facilities for hospital and infectious waste generated in the agency's jurisdiction.

The plan should include the following.

1. The amount of hospital and infectious waste
2. Treatment methods for hospital and infectious waste
3. Plans for locating a sterilization or incineration facility within an institution
4. The amount of infectious waste that requires outside-hospital treatment, and the methods of treatment
5. Plans for promoting development of the facility

b. Institutional Responsibility for Preparing Plans, and Preparation Procedures

The government should instruct local regulatory agencies in preparation of plans. The question will emerge for local regulatory agencies as to who should prepare this plan. Normally, it should be the agency's supervisors who oversee environmental and medical institutions, who should work on this task in cooperation with each other.

In order to create the plan, the government (MoH and MoE) must issue guidelines for planning and offer training programs to the agency's supervisors.

The following tasks should be carried out :

1. Offering training programs to infectious waste managers of medical institutions regarding hospital waste issues (such as research methods)
2. Research in medical institutions and reporting the results
3. Recording the total amount of hospital and infectious waste in a region, and projecting future waste generation
4. Understanding how sterilization is presently conducted in medical institutions and forecasting the development of sterilization and incineration facilities
5. Estimating the amount of infectious waste that will need treatment outside of medical institutions
6. Requiring proposals from private businesses
7. Discussing treatment arrangements (facilities operated by private business or those established jointly by several hospitals)
8. Creating an action plan for development of treatment facilities

c. Discussion of Treatment Arrangements

The government should instruct local regulatory agencies to discuss who should implement the construction of treatment facilities in the region.

One of the most important tasks is to arrange who should actually construct the facilities. It would be desirable for infectious waste treatment outside medical institutions to be conducted basically by private businesses, in light of the greater efficiency of the private sector. Some regional conditions, however, may be against private service providers.

The largest estimates of the present amount of infectious waste in Morocco are still relatively small. Since the cost of sterilization in hospitals will be less expensive than

treatment by private contractors, subcontracted treatment should handle only a small proportion of infectious waste generated. Table 6.2.1 shows an estimate of the amount of infectious waste generated in the different economic regions. According to this estimate, the daily amount will barely exceed 10 tons even in North-West and Center regions, where Rabat and Casablanca are respectively located.

Table 6.2-1 Estimated Amount of Infectious Waste in Economic Regions

Economic Regions	% of Beds	Infectious Waste t/day	Infectious Waste t/year
South	11.0	5.5	2010
Tensift	12.9	6.4	2347
Center	25.4	12.7	4632
North-West	26.9	13.4	4906
Center-North	9.5	4.7	1728
Oriental	4.9	2.5	898
Center-South	9.5	4.7	1730
National	100.0	50	18250

With the exceptions of Rabat and Casablanca, the amount of infectious waste generated is too small to attract private business in this area.

The following options can be considered when infectious waste treatment is not feasible for private business.

1. Installation of an incineration facility in large hospitals
2. Installation of a facility to be operated jointly by several medical institutions, and contracting out its operation
3. Location of the facility by a public body, and contracting out its operation
4. Postponing service provision for time being

The installation plan should mention the following: Equipment for treating emission gases should be easy to operate. Plastic waste should be avoided. Paper, clothes, and mainly pathogenic waste should be incinerated. Non-equipped hospitals should be able to contract out pathogenic waste treatment to an equipped hospital.

The public body mentioned here is the local regulatory agency, but not the commune or community. Financial aid by government will be necessary for options 2 or 3.

Postponing service provision is a possible alternative. In this context, tentative options should be taken: and some conditions must be prepared to enable future promotion of the facilities. The following options are available.

1. Using disposal sites of communes and communities
2. Increasing sterilization treatment in hospitals

The disposal-site option should be a last resort. When pathogenic waste that cannot be sterilized is generated, hospitals should coordinate carefully with the communes or communities.

6.3 Promotion of Small Incinerators in Central Hospitals in Local Areas

The government should encourage medical institutions to discuss the joint installation of incineration facilities of, especially, pathogenic waste by using the local regulatory agencies in whose areas private businesses cannot offer the service.

It is unlikely that private facilities will be feasible in any city areas except Rabat and Casablanca since such facilities are not in sufficiently large demand. Treatment of infectious and, especially, pathogenic waste, is a problem in such areas.

If there is a facility in the Center region, there are three options to take for other regions.

1. Transporting the waste to facilities located around Rabat and Casablanca by each region's own transport
2. Contracting out collection and transport of private contractors
3. Installing a small incinerator for joint use

The amount of infectious waste has not been large, especially of pathogenic waste, which requires incineration. Since the hauling distance for collected waste will be more than 100 km, its efficiency will be very low. Therefore, the above options 1 and 2 are not practically possible.

It is assumed that a small incinerator can be rationally set in a public general hospital, which is often a central hospital in its region. This assumption justifies the remaining option 3.

The choice of approaches requires the following comparison for each region. Which is best—using a small incinerator, or paying for transport and contracted treatment?

This task should involve the following kind of estimate: for a small incinerator, a facility capable of incinerating 40 to 60 kg/h will cost 800,000 DH, the cost of a large size dump truck. Assuming an economic life of 7 years, the initial cost alone will be approximately 1000 DH/ton. On the other hand, for privately contracted treatment, the initial cost will be 400 to 600 DH/ton due to the scale of the facility. After adding operation and transport costs, the charge for private service will be approximately 1000 DH.

Both options cost a great deal. Therefore, the small incineration facility should only be for treating pathogenic waste to reduce its cost. Also, the government should inform the managers of medical institutions that some expenditure is inevitable for waste treatment. (Downsizing the facility does not necessarily minimize the cost; a standard-sized one costs less than one of a specially-reduced size.)

When introducing the facility, cooperation with other medical institutions generating pathogenic waste is required including sharing of, construction operation, and maintenance costs.

Local medical institutions should set up an association for the incineration of pathogenic waste under the leadership of the region's central hospital to promote the facility.

The government should offer economic support to such facilities since this is an important investment for national health and welfare.

Using a small incineration facility is not going to be the ultimate solution. The incinerator will be outdated eventually. As the economy changes, conditions for developing the facility change. Private service providers will start handling infectious waste as the amount generated increases.

6.4 Promoting the Participation of Private Providers in Infectious Waste Management

The government should encourage private businesses to enter the field of infectious waste treatment. Business conditions should be attractive for private investment.

Basically, it is inadvisable for public bodies to carry out the treatment of infectious waste. It is widely acknowledged that services provided by the private sector are more efficient than public ones. It is also not correct that private services are more risky than public ones; in France, it is mainly public disposal sites that present problems. Private businesses are less likely to commit violations, because to do so implies severe financial risk for them if the government imposes proper supervision and regulation.

Therefore, the use of private treatment service is worth discussing in Morocco. However, conditions surrounding infectious waste treatment currently present some obstacles for private investment. The greatest obstacle is that the demand for service is not certain. Demand depends on how strict is governmental regulation of hospitals. Therefore, the following tasks must be fulfilled in order to generate opportunities for private participation: Regulation of medical institutions must be tightened. Managers in medical institutions must be well aware of the need for expenditure on infectious waste treatment. The government should be able to specify facilities that can manage the waste.

Monopolistic concessions should be assigned to private businesses. However, regulations must be imposed on the providers to enable hospitals to cancel contracts, and local regulatory agencies must audit the treatment facilities.

The government should consider how to improve conditions for private participation. It needs to start instructing medical personnel on this. Additionally, it must prepare qualification requirements; they must be made public so that private businesses can refer to them when submitting proposals for concessions in large city areas such as Rabat and Casablanca. To consider this, the government should set up a project team and prepare an action plan for the next half decade.



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