Fundamentals of health-care waste management

(1) This section provides general information on HCW and key elements of management procedures that are essential to know before developing a HCWM plan. It includes the following:

- The need for the development of supervision and management structures;
- A presentation of the risks associated with HCW;
- A definition and a classification of HCW;
- The minimum observance that should be respected for HCWM;
- A guidance for the specific management of hazardous and infectious HCW;
- Indications for the development of protective measures for HCF staff and the environment.

1.1 Supervision and management structures for HCW

(2) HCWM is first of all a *management* issue before being a technical one and therefore completely depend on the *commitment* of the entire staff within HCFs. This dedication will only be possible if people are first of all properly *trained* and made aware of the risks that this particular type of waste poses. It is therefore important to make sure the curricula of medical and para-medical staff includes this important public-health issue (see § 3.4 for further information).

(3) When a new staff member is engaged, it is highly recommended that a specific clause regarding the safe management of HCW be included in the contract, so as to make the new employee fully aware of the importance of this part of his/her work and made liable in this respect.

(4) To make sure HCW is properly managed on the long term, it is important to *supervise on a regular basis* the practices of the staff. This should be performed by the HCWM officer and/or members of a HCWM committee within each HCF (depending on the size of the facility). Typically members of such a committee are usually the same as those in charge of nosocomial infections. Appropriate on-going training and awareness sessions should be organised accordingly to keep practices at the best standards possible.

(5) To support the HCWM officer and/or these HCWM committees, *regional and national support* should be provided (see § 4.2 for further details about the support structure). These regional and national management teams are there to supply the HCF level with the necessary technical backstopping to both ensure standard and harmonized procedures are applied and facilitate the daily work of the HCWM officer and members of the HCWM committees.

1.2 Risks associated with HCW

(6) All individuals exposed to hazardous HCW are potentially at risk of being injured or infected. They include:

- *Medical staff*: doctors, nurses, sanitary staff and hospital maintenance personnel;
- *In- and out-patients* receiving treatment in health-care facilities as well as their visitors;
- *Workers in support services* linked to health-care facilities such as laundries, waste handling and transportation services;
- *Workers in waste disposal facilities*, including scavengers;
- The *general public* and more specifically the children playing with the items they can find in the waste outside the health-care facilities when it is directly accessible to them.

(7) Supporting the Governments in the implementation of adequate procedures to minimise the overall risks associated with HCW management remains the prior objective of this Guidance Manual. Waste management and treatment options should first protect the health-care workers and the population and minimise indirect impacts from environmental exposures to HCW.

1.2.1 Occupational and public health risks

(8) During handling of wastes, the medical and ancillary staff as well as the sanitary labourers can be injured if the waste has not been packed safely. In that respect*, sharps are considered as one of the most dangerous category of waste.* Many injuries occur because syringe needles or other sharps have not been collected in safety boxes or because these have been overfilled. On dumpsites, scavengers during their recycling activities may also come in contact with infectious waste if it has not been properly treated or disposed of.

(9) The general public can be infected by HCW either directly or indirectly through several routes of contamination. Dumping HCW in open areas is a practice that can have major adverse effects on the population. The "recycling" practices that have been reported, particularly, the reuse of syringes is certainly the most serious problem in some of the developing countries. The WHO estimates that over 20 million infections of hepatitis B, C and HIV occur yearly due to unsafe injection practices (reuse of syringes and needles in the absence of sterilization)[1]. There is a risk for public health as regards the sale of recovered drugs in the informal sector and the lack of controls.

Illustration 1: When people are scavenging, the risk of needle stick injuries increases greatly

1.2.2 Indirect risks via the environment

Finally, the dumping of HCW in uncontrolled areas can have a direct environmental effect by contaminating soils and underground waters.

During incineration, if no proper filtering is done, air can also be polluted causing illnesses to the nearby populations. This has to be taken into consideration when choosing a treatment or a disposal method by carrying out a rapid environmental impact assessment.

Illustration 2: the soil and underground water can be contaminated with heavy metals and other toxic products that may enter the food chain…

1.3 Definitions and classification of health-care waste

(10)*Health-care waste* includes all the wastes generated by medical activities. It embraces activities of diagnosis as well as preventive, curative and palliative treatments in the field of human and veterinary medicine. In other words, are considered as health-care waste all the wastes produced by a medical institution (public or private), a medical research facility or a laboratory.

[1] WHO Fact sheet n° 231, April 2002 (http://www.who.int/mediacentre/factsheets/fs231/en/)

(11)As mentioned earlier, an effort to bring together medical staff with waste managers has been made by combining the environmentally and pragmatic oriented approach of the second with the public health safety concerns and principles of precaution of the first.

(12)According to the Technical Guidelines on Environmentally Sound Management of Biomedical and Health-care waste provided by the Conference of the Parties to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (December 2002), health-care waste are classified as follows[2] (see figure 1):

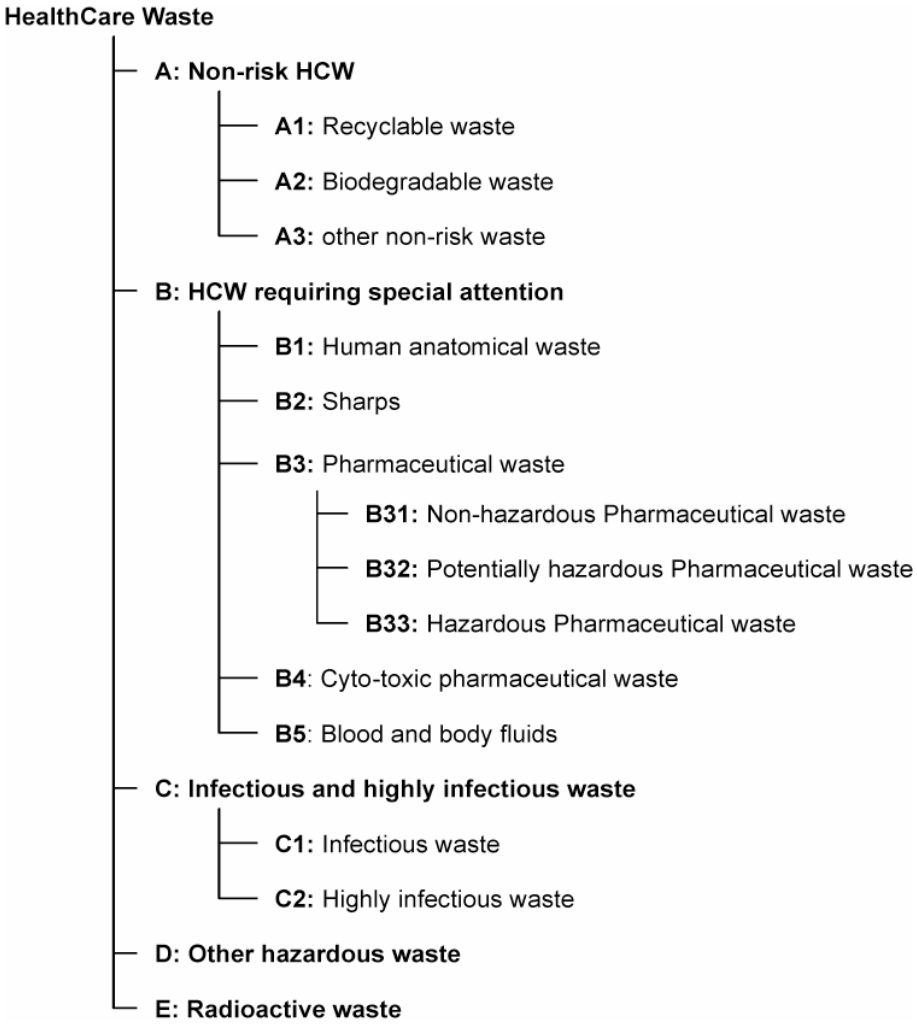

Figure 1: Classification of HCW

[2] The classification has been re-transcribed as such with two modifications only for the health-care waste of categories A and C. They have been divided into three and two classes respectively for practical but also "public-health safety" reasons to respect the most important aspects of the precautionary principals recommended by the WHO.

A Non-risk HCW

(13)*Non-risk HCW* includes all the waste that has not been infected like general office waste, packaging or left over food. They are similar to normal household or municipal waste and can be managed by the municipal waste services. They represent between 75% and 90% of the total amount of HCW generated by medical institutions. Three groups can be established:

A1 Recyclable waste

(14)It includes paper, cardboard, non-contaminated plastic or metal, cans or glass that can be recycled if any recycling industry exists in the country.

A2 Biodegradable HCW

(15)This category of waste comprises for instance, left over food or garden waste that can be composted.

A3 Other non-risk waste

(16)Are included in this category all the non-risk waste that do not belong to categories A1 and A2.

B Biomedical and health-care waste requiring special attention

B1 Human anatomical waste

(17)This category of waste comprises non-infectious human body parts, organs and tissues and blood bags.

Examples of such wastes: tissue waste, removed organs, amputated body parts, placentas, etc…

B2 Waste sharps

(18)Sharps are all objects and materials that are closely linked with health-care activities and pose a potential risk of injury and infection due to their puncture or cut property. For this reason, sharps are considered as one of the most hazardous waste generated in the HCF and they must be managed with the utmost care.

Examples of such wastes: all types of needles, broken glassware, ampoules, scalpel blades, lancets, vials without content

B3 Pharmaceutical waste

(19)The term "pharmaceuticals" embraces a multitude of active ingredients and types of preparations. The spectrum ranges from teas through heavy metal containing disinfectants to highly specific medicines. Waste management therefore requires the use of a differentiated approach. This category of waste comprises expired pharmaceuticals or pharmaceuticals that are unusable for other reasons (e.g. call-back campaign). Pharmaceutical wastes are divided into three classes. Their management occurs in a class-specific manner (see below).

B31 Non-hazardous pharmaceutical waste

(20)This class includes pharmaceuticals such as camomile tea or cough syrup that pose no hazard during collection, intermediate storage and waste management. They are not considered hazardous wastes and should be managed jointly with municipal waste.

B32 Potentially hazardous pharmaceutical waste

(21)This class embraces pharmaceuticals that pose a potential hazard when used improperly by unauthorised persons. They are considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.

B33 *Hazardous pharmaceutical waste*

(22)Class B33 pharmaceutical waste comprises heavy metal containing and unidentifiable pharmaceuticals as well as heavy metal containing disinfectants, which owing to their composition require special management. They must be considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.

B4 Cytotoxic pharmaceutical waste

(23)Cytotoxic pharmaceutical wastes are wastes that can arise by use (administration to patients), manufacture and preparation of pharmaceuticals with a cytotoxic (antineoplastic) effect. These chemical substances can be subdivided into six main groups: alkylated substances, antimetabolites, antibiotics, plant alkaloids, hormones, and others. A potential health risk to persons who handle cytotoxic pharmaceuticals results above all from the mutagenic, carcinogenic and teratogenic properties of these substances. Consequently, these wastes pose a hazard, and the measures to be taken must also include those required by occupational health and safety provisions.

Examples of such wastes: Discernible liquid residues of cytotoxic concentrates, post-expiration-date cytotoxic pharmaceuticals and materials proven to be visibly contaminated by cytotoxic pharmaceuticals must be disposed of as cytotoxic pharmaceutical waste.

B5 Blood and body fluids waste

(24)It includes wastes that are not categorised as infectious waste but are contaminated with human or animal blood, secretions and excretions. It is warranted to assume that these wastes might be contaminated with pathogens.

Examples of such wastes: Dressing material, swabs, syringes without needle, infusion equipment without spike, bandages

C Infectious and highly infectious waste

(25)Infectiousness is one of the hazard characteristic listed in annex II of the Basel Convention and defined under class H6.2. Special requirements regarding the management of infectious wastes must be imposed whenever waste is known or – based on medical experience – expected to be contaminated by causative agents of diseases and when this contamination gives cause for concern that the disease might spread. In this category two groups can be considered depending on the degree of infectiousness that is expected.

C1 Infectious waste

(26)This class comprises all biomedical and health-care waste known or clinically assessed by a medical practitioner or veterinary surgeon to have the potential of transmitting infectious agents to humans or animals. Waste of this kind is typically generated in the following places: isolation wards of hospitals; dialysis wards or centres caring for patients infected with hepatitis viruses (yellow dialysis); pathology departments; operating theatres; medical practices and laboratories which mainly treat patients suffering from the diseases specified above. It includes:

- Discarded materials or equipment contaminated with blood and its derivatives, other body fluids or excreta from clinically confirmed infected patients or animals with hazardous communicable diseases. Contaminated waste from patients known to have blood-borne infections undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable sheets, linen, aprons, gloves or laboratory coats contaminated with blood);
- Carcasses as well as litter and animal faeces from animal test laboratories, if transmission of the above-mentioned diseases is to be expected.

Examples of such wastes: *Blood* from patients contaminated with HIV, viral hepatitis, brucellosis, Q fever. *Faeces* from patients infected with typhoid fever, enteritis, cholera. *Respiratory tract secretions* from patients infected with TB, anthrax, rabies, poliomyelitis...

C2 Highly infectious waste

(27)It includes:

- All microbiological cultures in which a multiplication of pathogens of any kind has occurred. They are generated in institutes working in the fields of hygiene, microbiology and virology as well as in medical laboratories, medical practices and similar establishments;
- Laboratory waste (cultures and stocks with any viable biological agents artificially cultivated to significantly elevated numbers, including dishes and devices used to transfer, inoculate and mix cultures of infectious agents and infected animals from laboratories).

Examples of such wastes: Sputum cultures of TB laboratories, contaminated blood clots and glassware material generated in the medical analysis laboratories, high concentrated microbiological cultures carried out in medical analysis laboratories.

D Other hazardous waste

(28)This category of waste is not exclusive to the health-care sector. They include: gaseous, liquid and solid chemicals, waste with high contents of heavy metals such as batteries, pressurized containers, etc…

(29)Chemical waste consists of discarded chemicals that are generated during disinfecting procedures or cleaning processes. Not all of them are hazardous but some have toxic, corrosive, flammable, reactive, explosive, shock sensitive, cyto- or genotoxic properties. They must be used and disposed of according to the specifications provided with each type of chemical.

(30)Waste with high contents of heavy metals and derivatives are potentially highly toxic. They are considered as a sub-group of chemical waste but should be treated specifically.

(31)Pressurised containers consist of full or emptied containers or aerosol cans with pressurised liquids, gas or powdered materials.

Examples of such wastes: thermometers, blood-pressure gauges, photographic fixing and developing solutions in X-ray departments, halogenated or non-halogenated solvents, organic and in-organic chemicals.

E Radioactive health-care waste

(32)*Radioactive waste* includes liquids, gases and solids contaminated with radionuclides whose ionizing radiations have genotoxic effects. The ionizing radiations of interest in medicine include X- and γ-rays as well as α- and β- particles. An important difference between these types of radiations is that X-rays are emitted from X-ray tubes only when generating equipment is switched on whereas γ-rays, α- and β- particles emit radiations continuously.

(33)The type of radioactive material used in health-care facilities results in low level radioactive waste. It concerns mainly therapeutic and imaging investigation activities where Cobalt (^{60}Co), Technetium (^{99m}Tc), iodine (^{131}I) and iridium (^{192}Ir) are most commonly used.

Examples of such wastes: Radioactive waste includes solid, liquid and gaseous waste contaminated with radionuclides generated from in vitro analysis of body tissue and fluid, in vivo body organ imaging and tumour localisation, and investigative and therapeutic procedures.

1.4 Minimum observance for HCWM

(34)The HCW that are generated within a HCF should always follow an appropriate and well-identified stream from their point of generation until their final disposal. This stream is composed of several steps that include: generation, segregation collection and on-site transportation, on-site storage, off-site transportation (optional), treatment and disposal of the HCW. This chapter provides basic information on these different steps, which are summarized in the figure 2, and presents the minimal procedures that should be respected in each of these steps[3].

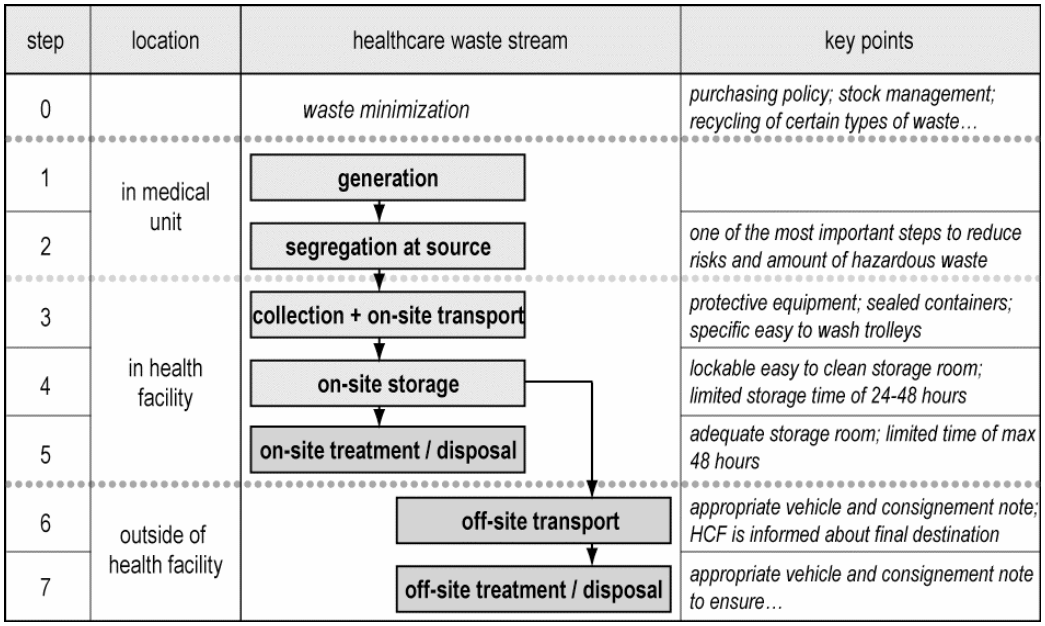

Figure 2: synopsis of the HCW stream

1.4.1 Generation of HCW

(35)Medical activities generate waste that should always be discarded *at the point of use* by the person who used the item to be disposed of. The quantity of HCW generated should always be minimized and precautions must be taken during their handling.

Waste minimization and recycling

(36)Before producing waste, it should be investigated whether the amount of waste generated could be minimized in order to reduce efforts in subsequent handling, treatment and disposal operations. The reuse of equipment has almost disappeared due to the marketing of single use items and the need to prevent the spread of nosocomial diseases. This is particularly the case for medical items such as syringe needles.

(37)There are however other opportunities for recycling or reuse, in particular of objects / items which are not directly used for health-care (paper, cardboard, glass, metal containers, plastic wrappings…). One of the most efficient measures for waste reduction lies in the careful management of medical stocks in the hospital pharmacies.

(38)Recycling of potentially contaminated items such as the plastic and metal from syringes/needles is not recommended for the moment in most Sub-Saharan countries due to the absence of availability of appropriate technologies, lack of specific training / awareness as well as adequate management procedures. Seeking information/experience from abroad is nevertheless encouraged as a way to prepare for future recycling processes.

[3] See also the « Technical Guidelines on Environmentally Sound Management of Biomedical and Health-care waste provided by the Conference of the Parties to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal » (December 2002), chapter 7.

Minimal observance for waste minimization / recycling and waste handling
❑ Make sure infectious and hazardous HCW are properly segregated from general waste so as to reduce disposal costs and increase materials for recycling; ❑ Ensure a proper stock management of the pharmacies in the hospitals by using adequate delivery and stock position forms; ❑ Purchase durable equipment, furnishing and supply; ❑ Explore waste recycling options for food or garden waste such as composting.

1.4.2 Waste segregation

(39)Segregation is one of the most important steps to successfully manage HCW.

(40)Given the fact that only about 10-25% of the HCW is hazardous, treatment and disposal costs could be greatly reduced if a proper segregation were performed. Segregating hazardous from non-hazardous waste reduces also greatly the risks of infecting workers handling HCW. Actually, the part of the HCW that is hazardous and requires special treatment could be reduced to some 2-5% if the hazardous part were immediately separated from the other waste.

(41)The segregation consists in separating the different waste streams based on the hazardous properties of the waste, the type of treatment and disposal practices that are applied. A recommended way of identifying HCW categories is by sorting the waste into colour-coded and well-labelled bags or containers.

(42)All the specific procedures of HCW segregation, packaging and labelling should be explained to the medical and ancillary staff and displayed in each department on charts located on the walls nearby the HCW containers that should be specifically suited for each category of waste.

(43)Segregation should:

- Always take place *at the source*, that is at the ward bedside, Operation Theatre, Medical Analysis Laboratory, or any other room or ward in the hospital where the waste is generated;
- Be *simple* to implement for the medical and ancillary staff and *applied uniformly* throughout the country;
- Be *safe* and guaranty the absence of infectious HCW in the domestic waste flow;
- Be *well understood and well known* by the medical and ancillary staff of the HCFs;
- Be regularly *monitored* to ensure that the procedures are respected.

<u>Colour coding system</u>

(44)The application of a *colour coding system* (see table 1) aims at ensuring an immediate and non-equivocal identification of the hazards associated with the type of HCW that is handled or treated. In that respect, the colour coding system should remain simple and be applied uniformly throughout the country.

Black	Yellow	Brown
✓ non-risk waste of category A ✓ exceptionally, small quantity of waste of category B1 ✓ pharmaceutical waste of category B3, class B31 only	✓ special waste of categories B1, B2, B4, B5 ✓ infectious waste and highly infectious waste of categories C1 and C2 ✓ radioactive waste of category E	✓ pharmaceutical waste of categories B3, classes B32 and B33 ✓ category D such as chemicals, heavy metal wastes

Table 1: colour coding system for HCW

Labelling (see table 2)

(45)All special HCW of categories B1, B4, B5, C1, C2 should be placed in yellow containers (preferably yellow polyethylene bags of minimum 300 microns gauge) marked and indicated with the international biohazard symbol. Preferably, the bags should be fixed in bag-holders. If not available, yellow bins could be used.

*(46)*HCW of category B2 (sharps) should either be destroyed at source with special devices or placed in specific cardboard or plastic safety boxes puncture and leak-proof, designed so that items can be dropped in using one hand, and no item can be removed (see annexe 1). The safety boxes should always be coloured yellow, marked « Danger ! Contaminated sharps » and indicated with the Biohazard symbol. It shall be sealed and disposed of when three-quarters full.

Category	Labelling	International symbols
B1	« Danger ! Anatomical waste, to be incinerated or deeply buried »	
B2	« Danger ! Contaminated sharps, do not open »	
B4, B5, C1	« Danger ! Hazardous infectious waste »	
C2	« Danger ! Highly infectious waste, to be pre-treated »	
B32, B33, D	« Danger ! To be discarded by authorized staff only »	
E	« Danger ! Radioactive waste »	

Table 2: labelling of HCW containers

(47)Radioactive HCW (category E) should be placed in yellow containers, sealed, marked and indicated with the international radioactive symbol as shown in the table above.

Minimal observance for waste segregation and labelling
❑ Establish a three-bin system with appropriate labelling in all the HCFs of the country as follow : 1) general HCW (black bags/bins; no symbol); 2) potentially infectious HCW (yellow bags/bins; biohazard symbol); 3) used sharps, including broken glass (yellow containers; biohazard symbol); ❑ Ensure awareness and training for medical staff and waste managers for waste segregation and labelling.

1.4.3 Collection and on-site transportation

(48)In order to avoid accumulation of the waste, it must be collected on a regular basis and transported to a central storage area within the HCF before being treated or removed. The collection must follow specific routes through the HCF to reduce the passage of loaded carts through wards and other clean areas. The carts should be 1) easy to load and unload, 2) have no sharp edges that could damage waste bags or containers and 3) easy to clean.

Waste handling

(49)Great care should be taken when handling HCW. The most important risks are linked with the injuries that sharps can produce. When handling HCW, sanitary staff and cleaners should always wear protective clothing including, as minimum, overalls or industrial aprons, boots and heavy duty gloves.

Minimal observance for waste collection and transportation
❑ Each HCF should have an HCWM plan which should include collection points and routes of waste transport. A timetable of the frequency of collection should also be set-up; ❑ Provide heavy duty gloves, industrial boots and apron for waste collectors; ❑ Ensure that waste containers are appropriately sealed, removed and replaced immediately when they are no more than three-quarters full; ❑ Ensure that hazardous / infectious HCW and non-risk HCW are collected on separate trolleys which should be marked with the corresponding colour (black/yellow) and washed regularly.

1.4.4 On-site storage

(50)HCW are temporarily stored before being treated / disposed of on-site or transported off-site. A maximum storage time should not exceed 24 hours. Non-risk HCW should always be stored in a separate location from the infectious / hazardous HCW in order to avoid cross-contamination.

(51)A storage facility, sized according to the volume of waste generated as well as the frequency of collection, must be found inside all HCFs. The facility should not be situated near to food stores or food preparation areas and its access should always be limited to authorised personnel. It should also be easy to clean, have good lighting and ventilation, and designed to prevent rodents, insects or birds from entering.

Minimal observance for on-site storage of HCW
❑ Ensure that a dedicated place, lockable and with no possibility for animals / insects to have access is designed to store hazardous / infectious HCW; ❑ Ensure that HCW isn't stored for more than 24 hours before being treated / disposed of.

1.4.5 Off-site transportation

(52)Off-site transportation is required when hazardous HCW is treated outside the HCF. The waste producer is then responsible for the proper packaging and labelling of the containers that are transported. One of the reasons for labelling HCW bags or containers is that in case of an accident, the content can be quickly identified and appropriate measures taken. The labelling system should comply with the United Nations Recommendations and contain at least:

- The United Nations substance class (e.g. class 6, division 6.2, UN n° 3291 for infectious waste);
- The proper shipping name and the total quantity of waste covered by the description (by mass or volume);
- The date of collection.

(53)The transportation should always be properly documented and all vehicles should carry a consignment note from the point of collection to the treatment facility. Furthermore, the vehicles used for the collection of hazardous / infectious HCW should not be used for any other purpose. They shall be free of sharp edges, easy to load and unload by hand, easy to clean / disinfect, and fully enclosed to prevent any spillage in the hospital premises or on the road during transportation.

Minimal observances for off-site transportation of waste
❑ Ensure that the responsible authorities always approve the off-site transportation plan before any transit occurs; ❑ Ensure that all categories of HCW are collected every second day at least; ❑ Ensure that each HCF practising off-site transportation is aware of the final destination of the HCW they produce.

1.4.6 Treatment and disposal

64) Each class of HCW require specific treatment, however, in order to be pragmatic, it is advisable to distinguish three major classes polarizing around 90 % of the biomedical waste production. These major categories could be:

- Waste sharps ;
- Infectious and cytotoxic wastes;
- Organic wastes (blood and body fluid wastes, human anatomical waste…).

• Hazardous / infectious HCW can be treated to reach a level of hazard / infectiousness that is considered as acceptable. Thus, after treatment, they follow the non-risk HCW stream and are disposed of with the general solid waste. They can also be directly disposed of by incineration or in sanitary landfills. Detailed information on the advantages and the disadvantages of each treatment / disposal technologies are provided in annexe 2.

(54)Hazardous / infectious HCW can be treated *on-site* (i.e. in the HCF itself) or *off-site* (i.e. in an other HCF or in a dedicated treatment plant).

<u>On-site treatment</u>

(55) This option is often the only one possible in the rural HCFs of the primary sector but on-site treatment can be also carried out for HCW generated in major HCFs. On-site treatment facilities are particularly appropriate in areas where hospitals are situated far from each other and the road system is poor.

(56)The advantages of providing each health-care establishment with an on-site treatment facility includes convenience and minimization of risks to public health and the environment by confinement of hazardous / infectious HCW to the health-care premises. However, the treatment costs may be high if there are many hospitals: extra technical staff may be required to operate and maintain the facilities and it may be difficult for the relevant authorities to monitor the performance of many small facilities. This may result in poor compliance with operating standards, depending on the type of facilities, and increased environmental pollution.

<u>Off-site treatment</u>

(57)The HCW generated in a HCF can be treated off-site, when centralized regional facilities exist. Although off-site treatment increases dependency of the HCF on an external actor and requires a fine-tuned transportation system, it provides the following advantages:

- Hospitals will not have to devote time and personnel to manage their own installations;
- Efficient operation can be more easily ensured in one centralized facility than in several plants where skilled workers may not be readily available;
- Greater cost-effectiveness for larger units, through economies of scale;
- Future modifications or expansions (relating to flue-gas cleaning systems of incinerators, for example) are likely to be less expensive;
- Where privatization of facilities is seen as a desirable option, this can be achieved more easily on a regional basis than for numerous small units;
- It will be easier for the relevant government agencies to supervise and monitor the facilities;

- Air pollution may be more easily kept to a minimum at a centralized plant (costs of monitoring and surveillance as well as flue-gas cleaning, for example, will be reduced);

Minimal observances for waste treatment and disposal
❑ Ensure that the most hazardous HCW (i.e. sharps) and (highly) infectious waste are properly treated and disposed of in all HCFs of the country; ❑ Ensure that treatment / disposal options that will be recommended in the National HCWM plan will be homogeneously applied in the country; ❑ Ensure that the selected options will be compatible with the local operation and maintenance capacities; ❑ Always select the most environmental friendly options taking into consideration the operation and maintenance costs.

1.5 Guidance for HCWM per category of waste

A (non-risk HCW)

(58)Non-risk HCW, if well segregated, can be disposed of with the domestic waste. Depending on the quantities of this category of waste, it might be worth investigating ways of recuperating/recycling items such as paper and cardboard as well as plastic and metal cans that come from the administration and kitchen. Left-over food from the kitchen as well as garden waste (leaves, etc) can be recycled into valuable compost.

B1 (human anatomical waste)

(59)It is primarily for ethical reasons that special requirements must be placed on the management of waste human body parts, organs and tissues. The waste must be collected in appropriate containers or bags as soon as possible at the place where it is generated. It must be kept in tight receptacles and under stable low temperature (5-8°C) conditions when stored temporarily for a prolonged period of time. Intermediate storage takes place at a location that is accessible only to trained personnel (in general the mortuary).

(60)Normally, the waste must always be incinerated completely in an appropriate facility. Household waste incineration plants are, as a rule, not suitable for the incineration of amputated body parts, removed organs and placentas. Crematoria are usually used to dispose of amputated body parts. When cremation (or incineration) isn't possible/acceptable, waste can be buried in a dedicated area.

Exemptions and special provisions

(61)Where only small quantities of these wastes are generated (e.g. in medical practices), they can be collected in appropriate containers and managed jointly with the municipal waste.

B2 (sharps)

(62)Sharps require that measures be taken to prevent injury and infection during their handling within and outside of the HCFs. They have to be collected and managed separately from the other categories of HCW: the collection containers (safety boxes) must always be puncture and leak-proof.

(63)The storage of sharps to be disposed of should always take place at a location that is accessible only to trained personnel. Once the safety boxes are sealed, they can be disposed of with the other infectious waste depending on the type of disposal technology that is selected. For more information refer to annexes 1 and 2.

Special provisions for needles and syringes

(64)All *disposable syringes and needles* must be discarded of immediately following use. Syringes even without needles must be considered as unsafe. Needles should never be recapped. In addition,

under no circumstances are used syringes or needles, or safety boxes, to be disposed of in normal garbage or dumped randomly without prior treatment.

(65)Two possibilities currently exist to dispose of needles and syringes:

- They can be collected in safety boxes that are then disposed of with the infectious HCW if the disposal/treatment technologies are suitable: incineration or encapsulation are in general the adequate treatment technologies (cf. annexe 2). This option is certainly the safest since it minimizes the handling of the syringe and the needle. Other options include shredding and autoclaving;
- They can also be "treated on the spot". The treatment consists either in destroying the needle using a needle destroyer or separating the needle from the syringe using a device where the needle drops directly in a puncture-proof container (cf. annexe 1).

B3 (pharmaceutical waste)

(66)Pharmacy department stores in each HCF should be rigorously managed to reduce the generation of pharmaceutical waste. Especially, stocks of pharmaceuticals should be inspected periodically and checked for their durability (expiration date). Stock positions should be recorded on a regular basis.

(67)While pharmaceutical wastes of class B31 can be managed jointly with municipal waste, pharmaceutical wastes of classes B32 and B33 should be considered as hazardous and their management should take place in an appropriate waste disposal facility. Ideally, they should be returned to a national central collection point to ensure they are properly neutralized. Alternatively and only if the return cannot be ensured, an inertization[4] technique may be used and the inerted waste disposed of in a sanitary landfill.

B4 (cytotoxic pharmaceutical waste)

(68)The risks posed by cytotoxic pharmaceuticals are primarily of relevance for persons who come into contact with them during preparation and during or after their use. It has long been common practice in hospitals that the number of persons who come into contact with these products is small. Specific guidance on this is available[5]. These wastes usually arise at central locations, i.e. in pharmacies and laboratories and they are also often found at places where the ready-to-use cytotoxic solutions are prepared.

(69)The precautions taken during the use of cytotoxic pharmaceuticals must also be applied on their journey outside the respective establishment, as releases of these products can have adverse environmental impacts. The management of these wastes, in covered and impermeable containers, must therefore be strictly controlled. Solid containers must be used for collection. The use of coded containers is recommended. For reasons of occupational safety, cytotoxic pharmaceutical wastes must be collected separately from pharmaceutical waste and disposed of in a hazardous waste incineration plant.

B5 (blood and body fluids waste)

(70)Special requirements must be imposed on the management of this category of waste from the point of view of infection prevention in and outside the HCFs. Double bags or containers made of strong and leak-proof material are used for the collection of these wastes.

(71)If a household waste incineration plant is available or a *controlled* sanitary landfill site exists, this waste can be disposed of with the general domestic waste. However, in the Sub-Saharan context, this category of waste should be disposed of with the HCW of category C1 (infectious waste) since no proper household waste incineration plant or controlled sanitary landfill currently exists in the country.

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4 Inertization consists in mixing pharmaceutical waste with cement and lime in a container before burying to minimise the risk that toxic substances migrate into the surface or groundwater. The packaging should previously be removed.

5 Cf for instance, *Safe management of waste from health-care activities*. Edited by Prüss, Giroult and Rushbrook, WHO. 1999.

C1 (infectious waste)

(72)Infectious wastes must be collected in leak-proof containers carefully sealed and transported to a central storage facility/delivery point in a way that precludes direct contact. They must either be incinerated or be disinfected prior to final disposal using a recognized method, preferably treatment with saturated steam (autoclaving). Disinfected wastes may be disposed of in the same way as domestic waste. The disinfection plants must be operated under the operating parameters prescribed for waste disinfection, and this mode of operation must be documented and controlled.

(73)If autoclaving is the selected option for infectious waste treatment, the efficiency of the vapour disinfection plant must be verified by a recognized institution when the plant is first put into operation and at regular intervals thereafter (e.g. twice a year), using appropriate microbiological indicators.

Exemptions and special provisions

(74)Body fluids and excreta of infected patients with hazardous communicable diseases can be discharged to the sewerage system if there is a strict separation between the waste and drinking water installations and the sewerage system is connected to a wastewater treatment plant. In other cases, the body fluids and excreta have to be disinfected before being discharged to the sewerage system. Exceptionally, infectious waste can be disposed of by using a special area in a controlled landfill if there is no risk of contamination of ground or drinking water and the infectious waste is directly covered with earth or other material.

C2 (highly infectious waste)

(75)Some medical areas produce HCW that can reasonably be suspected to be contaminated with highly contagious pathogens. Such sources include: all laboratory samples containing body fluids, tissues or faecal stools; isolation wards; and medical research facilities handling class 3 or higher pathogens.

(76)Waste from these sources should always be pre-treated at source and then placed into yellow bags before joining the waste stream within the hospital. Autoclaving at a temperature of 121°C at 1-1.5 bars for at least 20 minutes should be the selected pre-treatment option. However, if a *distinct* autoclave is not available at source to ensure a thermal treatment, highly infectious waste can be disinfected in a concentrated 2% solution of sodium hypochlorite and left overnight before being discarded in a specific yellow bag properly sealed and itself discarded with the infectious HCW of category C1.

D (other health-care waste)

(77)Large quantities of *chemicals* should be returned to the supplier for adequate treatment. Considering that there is currently a lack of appropriate treatment facilities for chemicals in most of the Sub-Saharan countries of Africa, on-site disposal must therefore be foreseen. In such circumstances, non-corrosive and non-flammable chemicals may be encapsulated separately to avoid unwanted chemical reactions after neutralisation.

(78)Waste with high contents of *heavy metals* should normally be treated in specific recycling/ treatment facilities. Alternatively, as for chemical waste, it may be encapsulated. Waste with high contents of heavy metals, in particular mercury or cadmium, should never be incinerated.

E (radioactive waste)

(79)With the noticeable exception of Cobalt (^{60}Co), their half-life is reasonably short (6 hours for ^{99m}Tc, 8 days for ^{131}I and 74 days for ^{192}Ir) and the concentrations used remain low. A proper storage with an appropriate retention time is sufficient to allow decay to background level. Radioactive waste should be placed in large containers or drums and labelled with the radiation symbol showing the radionuclide activity on a given date and the period of storage required.

(80)Containers or tanks with radioactive waste that has not yet decayed to background level, should be stored in a specifically marked room with thick concrete walls (minimum 25 cm).

(81)*Non-infectious radioactive waste,* which has decayed to background level, should follow the non-risk HCW stream while *Infectious radioactive waste*, which has decayed to background level, should follow the infectious HCW stream. *Liquid radioactive waste* should be discharged into the sewerage system or into a septic tank only after it has decayed to background level in buffer tanks.

1.6 Development of awareness and protective measures for HCF staff and the environment

(82)Management of HCW is an integral part of hospital hygiene and infection control. Infectious HCW contributes to the risk of nosocomial infections, putting the health of medical staff and patients at risk. Proper HCWM practices should therefore be strictly followed as part of a comprehensive and systematic approach to hospital hygiene and infection control. A range of measures should be developed in relation with the handling and the treatment/disposal of HCW to promote personal hygiene and protective measures. These measures should also concern municipal staff operating in solid waste management at the city level. This chapter develops basic guidance that should be respected to limit the risks of injury/contamination linked to the management of hazardous/infectious HCW.

1.6.1 Personal hygiene

(83)Basic personal hygiene is important in reducing the risks that occur from handling HCW. Hospital administrators and planning officers should ensure that washing facilities are made available to people handling HCW. This is particularly important at storage and treatment facilities.

(84)One of the most basic measures for the maintenance of hygiene, and one that is particularly important in the hospital environment, is cleaning. As the hands are the most frequent vectors of nosocomial infections, hand hygiene is the primary preventive measure. Thorough hand washing with adequate quantities of water and soap removes more than 90% of micro-organisms encountered on the hands. However, the efficacy of the cleaning process depends completely on this mechanical action, since neither soap nor detergents possess any antimicrobial activity and can be counterproductive if is done too superficially. Cleaning has therefore to be carried out in a standardized manner.

1.6.2 Immunisation

(85)Staff handling HCW should be offered appropriate immunization, including hepatitis B and tetanus. As HCW are often found in municipal solid waste municipal staff should also be offered this immunisation.

1.6.3 Personal protection

(86)As already mentioned, staff which are in contact with HCW should wear the following personal protective clothing:

- Suitable heavy-duty gloves when handling HCW containers;
- Safety shoes or industrial boots to protect the feet against the risk of containers being accidentally dropped;
- Industrial apron or leg protectors when container handling could cause wounds.

1.6.4 Training and information

(87)To be effective, a HCWM policy has to be applied carefully, consistently and universally. Training is a crucial aspect to successfully upgrade HCWM practices. The overall aim of training is to develop awareness of the health, safety, and environmental issues relating to HCWM. It should highlight the roles and responsibilities of each actor involved in the management process of the HCW (duty of care).

Employees to be trained

(88)Separate but equally important training programs should be designed for the following categories of personnel: 1) hospital managers and administrative staff responsible for implementing regulations on HCWM, 2) medical doctors; nurses and assistant nurses, 3) cleaners, porters, ancillary staff, and waste handlers, 4) municipal solid waste labourers and waste pickers.

Content

(89)Staff education programmes should cover:

- Information on, and justification for, all aspects of the HCWM policy;
- Information on the role and responsibilities of each hospital staff member in implementing the policy;
- Technical instructions, relevant for the target group, on the application of waste management practices;
- Information on monitoring techniques.

1.6.5 Procedures in case of accidents and spillages

(90)In HCFs, spillage is probably the most common type of emergency involving infectious or other hazardous material or waste. Response procedures are essentially the same regardless of whether the spillage involves waste or material in use, and should ensure that:

- Contaminated areas are cleaned and, if necessary, disinfected;
- Exposure of workers is limited as much as possible during the clearing up operation;
- The impact on patients, HCF staff and the environment is as limited as possible.

(91)One person should be designated as responsible for the handling of emergencies, including coordination of actions, reporting to managers and regulators. Staff should be trained for emergency response, and the necessary equipment should be readily available at all times to ensure that all required measures can be implemented safely and rapidly. Written procedures for the different types of emergencies should be drawn up.

(92)Spillages usually require that only the contaminated area be cleaned-up. For spillages of infectious material, however, it is important to determine the type of infectious agent; in some cases, immediate evacuation of the area may be necessary. In general, the more hazardous spillages occur in laboratories rather than in HCF departments.

Special provision for needle stick injuries

(93)Due to their high potential for injuries and contamination, needles are one of the most dangerous items that are handled in a HCFs. Any accident should be reported to the infection control nurse and a reporting system should be established in each HCF. This information should then be reported to the competent authorities at central level.

(94)Cuts with sharps or needle stick injuries should always be immediately disinfected. It is highly recommended to perform blood tests after such an injury to ensure that the person has not been contaminated by any pathogen, in particular hepatitis B and C or HIV.

1. **Evacuate** the contaminated area.
2. **Decontaminate** the eyes and skin of exposed personnel immediately.
3. **Inform** the designated person who should coordinate the necessary actions.
4. Determine the **nature** of the spill.
5. **Evacuate** all the people not involved in cleaning up.
6. Provide **first aid** and medical care to injured individuals.
7. **Secure** the area to prevent exposure of additional individuals.
8. Provide adequate **protective clothing** to personnel involved in cleaning-up.
9. **Limit** the spread of the spill.
10. **Neutralize or disinfect** the spilled or contaminated material if indicated.
11. **Collect** all spilled and contaminated material. [**Sharps should never be picked up by hand**; brushes and pans or other suitable tools should be used]. Spilled material and disposable contaminated items used for cleaning should be placed in the appropriate waste bags or containers.
12. **Decontaminate or disinfect** the area, wiping up with absorbent cloth. The cloth (or other absorbent material) should never be turned during this process, because this will spread the contamination. The decontamination should be carried out by working from the least to the most contaminated part, with a change of cloth at each stage. Dry cloths should be used in the case of liquid spillage; for spillages of solids, cloth impregnated with water (acidic, basic, or neutral as appropriate) should be used.
13. **Rinse** the area, and wipe dry with absorbent cloths.
14. Decontaminate or disinfect any tools that were used.
15. Remove protective clothing and decontaminate or disinfect it if necessary.
16. **Seek medical attention** if exposure to hazardous material has occurred during the operation.

Box 1: Example of general procedures to be followed in case of spillages
[source: *safe management of health-care waste*, WHO 1999]