Reduction and Utilisation of Hospital Waste, with the Focus on Hazardous, Toxic and Infectious Waste
(LIFE96ENV/D/10)

Practical Guide for Optimising the Disposal of Hospital Waste

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1. Introduction

The European research project involved the comparison of the hospital waste disposal practices in five hospitals in different European countries.

The partner institutes of the study were the Institute Cerdà in Barcelona together with the hospital Consorci Hospitalari del Parc Pauli in Sabadell, the Azienda USL Forlì with the hospital Ospedale G.B. Morgagni - L. Pierantoni, the company Girus in Grenoble with the university clinical centre Centre Hospitalier Universitaire Grenoble, the Institute for Environmental Medicine and Hospital Hygiene, the Freiburg University Clinical Centre, and the Queens Medical Centre in Nottingham.

The project was sponsored by the European Union with the LIFE funding instrument (reference number: LIFE96/ENV/D/10) and completed between April 1997 and May 2000 under the coordination of the Institute for Environmental Medicine and Hospital Hygiene.

This practical guide is designed to present the results of the projects which are to serve other hospitals as a basis for discussions and ideas and suggestions for optimising their disposal practices. Particular emphasis is placed on the following aspects:

- the composition of waste, elements of a waste analysis and setting up a system for collecting waste materials which can be reused.
- discussing the current definitions of hospital waste and the consequences for waste separation
- criteria for the safe disposal of hospital waste

The experiences made in the course of this project have shown that the cooperation among the different hospitals and the resulting comparison options have provided a wide range of ideas and suggestions for improving one´s own disposal practice. We would therefore like to encourage all other hospitals to adopt similar measures and actions.

2. Implementation of regulations and definitions

The comparison of the regulations and of the disposal practices in the hospitals participating in the project has shown three basic aspects for the classification of waste as hospital-specific and/or infectious waste: material, site, activity.

Normally, the medical knowledge of the transmission of diseases or the suspicion that a risk of an infectious disease is likely to emanate from waste material forms the basis for drawing the line between waste material similar to domestic waste and infectious waste. Examples are used to describe the types of waste in greater detail, but since the descriptions are not conclusive it is usually left to the hospitals to interpret the definitions and to implement them into action.

When applying the definition in practice, there is the option of determining the waste according to the site where it is generated, to the type of activity resulting in the waste, or according to material. In practice, one normally finds a mixture of these criteria, with certain differences in the weighting and the evaluation of the individual criteria. In waste classed as carrying a risk of infection, the contamination with organic material originating from patients plays a crucial role. But evaluating this contamination risk is very difficult in practice, with the effect that the site or the activity is normally used as a second best choice.

2.1 Focus: Activity

If the different activities generating the waste are used as a criterion, and if one decides to classify all waste originating from patients as potentially hazardous, containers for hospital-specific and/or infectious waste must be provided at every point where patients are cared for or treated. Since additional waste is generated in these areas which has not come into contact with patients, this system usually means that two waste containers are placed next to each other. This approach creates the additional difficulty for personnel of having to decide which waste goes where. This project has shown that this normally results in a greater volume of hospital-specific and/or infectious waste than would be necessary under normal conditions. Carrying out waste separation properly requires adequate personnel training and easily comprehensible information material. The success of the separation ought to be checked and discussed at regular intervals with the employees involved.

2.2 Focus: Space use

For the purpose of making it easier for personnel to find their way around, it may be advisable to determine by location where infectious waste may be expected and where it is unlikely, and to provide the appropriate waste collection bins. This circumvents the problem of incorrect waste classification, but it still generates more hospital-specific and/or infectious waste to be disposed than would actually be necessary. The one difficulty inherent in this system is training personnel such

that there is no confusion in placing and discharging the bins. This is why the fraction to be collected in the locations ought to be identifiable independent of the waste containers.

2.3 Focus: Material and/or contamination

If the emphasis is placed on evaluating the material which eventually turns into waste, it is mainly the contamination with blood and body secretions which causes problems in the classification. If each and every contamination with blood and secretions is assigned to infectious waste, it will be very difficult to pinpoint those areas where infectious waste is not expected and where, as a consequence, no waste bins for this fraction need to be available. Therefore, clear-cut criteria for evaluating the contamination ought to be worked out which will allow personnel to classify the waste quickly and without any complications.

In Freiburg, the issue of waste bins for the collection of infectious waste is monitored by Hygiene and tied to very closely defined criteria (patients with defined diseases and defined material/contamination containing material containing pathogens), with the effect that wards with non-infectious patients normally have no collection bins for infectious waste. There are also clearly defined area such as Dialysis, the Blood Bank or operating theatres, where blood, body secretions and tissue are regularly generated at larger quantities and where infectious waste is therefore collected.

In Barcelona, material contamination is also a central aspect. For the purpose of easier disposal, Barcelona also carries out a job appraisal in order to minimse the number of fractions collected at any one work place. If in doubt, a container of the fraction with the greater risk potential is placed.

The classification according to material and/or contamination is only feasible if the definition allows a clear distinction and separation of the waste types. But if the deficnition of the hospital-specific and/or infectious waste does not only refer to the known risks but also includes suspected risks, it is relatively difficult for hospitals to draw clear lines. In these cases the best approach might be to determine waste from areas where patients are also treated as disposable like normal domestic waste. In any case, training and information of the personnel is an essential condition for the successful waste separation.

The focal points for the disposal of hospital-specific and/or infectious waste which are presented here are highly abstract and are unlikely to be practiced in their "pure" form in any hospital. They provide a number of different approaches for the practical implementation of the definition of waste material from hospitals, with the appropriate consequences for the quantities of the different waste fractions. This is designed to account for the external legislation and laws which hospitals need to comply with, in order to ensure that there is no risk to public health from hospital waste.

2.4 Regulation levels

A wide variety of different institutions with different geographic scope, ranging from the EU down to local government level, are involved in the regulations affecting waste disposal. In the course of the project it became evident that the EU regulations are not very well known in the hospitals. Through the application of the European waste catalogue, this will change in future. The question arises, however, whether the categories selected for the European waste catalogue will affect the actual disposal practices or whether the new descriptions will not simply be assigned to the previous, familiar practices with the effect that the categories will be interpreted in very different ways.

The discussion should therefore continue on which level and which subjects of disposal of hospital waste should best be regulated.

Catalonia has its own laws on hospital waste disposal which are designed to bring about a uniform national disposal practice. This created a clear point of reference for the hospitals. In France there is also a regional plan for waste disposal which affects the definition of the waste fractions, but which does not represent independent and detailed regulations for hospitals.

The project therefore asked which areas of waste disposal and on which level certain specifications ought to be made. Both the national feaatures and traditions and the demand for more clarity were to be taken into account.

2.5 Regulation areas

There are many regulations affecting the waste disposal from hospitals: the general waste disposal legislation, rules and regulations from the hygiene sector and the epidemics legislation, technical guidelines for the logistics involved in waste disposal, international standards for waste transport, regulations involving the handling of biological working substances and other regulations from the public health and safety sector.

The question arises in this context how well all these institutions cooperate and whether there is also some scope for improvement in this sector. For instance, better cooperation between the areas of industrial medicine and the experts for technical regulations would be desirable with the aim of developing regulations offering a high degree of safety for hospital employees because these are the people who are in direct contact with hospital waste. The project attempted to formulate basic requirements of the disposal of waste material similar to domestic waste which ought to be met in order to guarantee safe disposal. These specifciations could also be used to evaluate the components of the hospital-specific waste fraction to answer the question whether the safety conditions prevailing for the disposal of waste material similar to domestic waste represent an adequate protection from these waste components. The aim is to bring the practical options of waste disposal more in line with the regulations to make work easier for the hospital employees.

2.6 Proposals for regulation levels and contents

The survey of the legal parameters for the disposal of hospital waste has demonstrated how different the number of regulations, the details with direct relevance for hospitals, but also the sources necessary for these in the individual countries participating in the project still are at present.

The discussion therefore continued in the course of the project which areas and on which level (EU down to hospital) require regulations in order to create clearer disposal parameters for the hospitals.

2.6.1 Hospital-specific regulations

The fist issue discussed revolved around the question whether special regulations are needed for the disposal of hospital waste and on which level such regulations would be desirable.

The majority of our project partners favoured specific legislation for hospital waste both on the European and on the national level. In this process the EU should develop guidelines both for the classification of waste and for the manner of disposal which each of the countries would need to adapt to their own specific rquirements.

From the point of voew of this project the focus of this European regulation should, however, not necessarily be on the issue of waste classification but also on the actual areas of disposal, industrial health and safety, hygiene, options of waste separation, internal and external transport, and the storage of waste. If, as for instance in Germany or in Spain, there is a federal state competence with respect to waste disposal, hospital-specific regulations should also be laid down on these levels.

2.6.2 Elements which ought to be included in specific regulations for hospital waste disposal

The following elements have been suggested for hospital-specific regulations and have been assigned to the different regulation levels.

- characterisation of the waste types generated in hospitals
- regulations for personnel handling waste
- specifications for bins and containers used for the collection, storage and transport of waste
- specifications involving the storage of hospital waste

- responsibilities for the organisation and implementation of waste disposal activities
- description of suitable disposal methods and processes for the different waste materials from hospitals
- determining possible treatment methods for hospital waste
- specifications for the documentation and control of waste disposal from hospitals
- nature of the means of transport used for hospital waste
- location of the final treatment of hospital waste
- prices and charges for the different activities involved in waste disposal

The above list is by no means complete; it is designed to initiate discussions on which level of legislation in Europe the subject of hospital waste disposal is to be regulated in order to make the application of these regulations in hospitals as easy as possible.

The above mentioned elements for the regulations involving hospital waste disposal were evaluated as follows.

2.6.3 Characterisation of the waste types generated in hospitals

The majority of project partners favoured the idea of leaving the characterisation of the waste types to the national legislators. This appears to account best for the current situation, i.e. that the classification of the waste materials largely rests on the assessment of the risks associated with the waste. Also, the regulations need to take account of the regional particularities, both with regard to the working situation and the people's mentality and with regard to the available infrastructural possibilities. National legislation is also more likely to come closer to clearer and more practical definitions. The EU specifications should relate more to the practical implementation of the waste disposal.

2.6.4 Regulations for personnel handling waste

As the handling of waste has to do with industrial health and safety and with hygiene, there should be regulations on the European level which serve the protection, integrity and health of the employees.

Hospital management, however, should specify certain additional, internal regulations which provide clear and unambiguous statements on the handling of waste under hospital conditions.

2.6.5 Specifications for bins and containers used for the collection, storage and transport of waste

All project partners agreed that specified requirements involving containers used for the collection, storage and transport of hospital waste would provide an important improvement bonus for the safety of disposal. Specific requirements, accounting for the characteristic properties of the waste and the working conditions, should be defined for each waste type.

2.6.6 Specifications involving the storage of hospital waste

The fundamental requirements with respect to the storage of waste at a central point in the hospital ought to be regulated on the European level.

But the situation prevailing in the individual departments of the hospitals where waste is allowed to be stored for short periods only should be regulated on the national level because the specific conditions of the national hospital play a crucial part in this context.

2.6.7 Responsibilities for the organisation and implementation of waste disposal activities

This was an issue where opinions varied significantly. The spectrum of opinions ranged from central European regulations to harmonise conditions in the individual countries, via national regulations in tune with national legislation, right through to regional regulations which account for the federal structures in countries such as Germany and Spain. The regulations, it was said, should also allow the option of controls, which appears to favour national or regional regulations.

2.6.8 Description of suitable disposal methods and processes for the different waste materials from hospitals

At this point the project partners largely agreed that there should be EU regulations which set the framework for the methods involved in hospital waste disposal. These regulations should, however, be supplemented by a regulation on the spatial unity (mostly the region) in which the disposal actually takes place. Spain has the "principle of closeness" for disposal, i.e. waste should be disposed of near as possible to the point of generation.

2.6.9 Determining possible treatment methods for hospital waste

There should be uniform regulations in Europe on the methods allowed for the treatment of hospital waste and on how to carry out the treatment.

In line with local conditions and the responsibility for observing the regulations, there should also be regional regulations for the treatment of hospital waste.

2.6.10 Specifications for the documentation and control of waste disposal from hospitals

To obtain a better overview of the subject of hospital waste, there should be a uniform European method for documenting and controlling the waste disposal.

But regulations are also necessary on the regional level in order to lay down the tasks, responsibilities and methods as required by regional conditions and circumstances.

2.6.11 Nature of the means of transport used for hospital waste

There are already ADR-based regulations for the transport of hazardous waste outside the hospital. But for reasons of health and safety at work, minimum requirements involving the internal waste transport would be desirable.

The EU framework regulations should be implemented more accurately on the regional level in order to account for particular regional features, whether of climatic or infrastructural nature.

2.6.12 Location of the final treatment of hospital waste

This is also an issue where it would be reasonable to find uniform regulations for fundamental principles, e.g. the avoidance of longer transport distances, but the details of the disposal practices may be better regulated on the regional level to account for local circumstances.

2.6.13 Prices and charges for the different activities involved in waste disposal

There were a number of different proposals on the subject of prices and charges for waste disposal: From the price supervision by the region (as practised in Forlì) or by communal regulations for the appropriate catchment area of a disposal plant, right through to the interplay of free market forces, with a regulation on price transparency with respect to the individual disposal services considered desirable.

Regulations restricting the trasport of waste also have an impact on the disposal charges.

3. Approaches for improving waste disposal

One focal point of the discussions of the third workshop revolved around the issue of how future hospital waste disposal could be designed and which recommendations can be given in light of the project experiences.

To structure the discussion, a classification (shown in Table 1) was first worked out.

First, the disposal of waste material similar to domestic waste was discussed in great detail, followed by highlighting the special characteristics involved in the disposal hospital-specific and/or infectious waste.

No.	Text	Subitem 1	Subitem 2	Subitem 3
1	Collection at the site of waste generation	Primare collection vessels	"Waste producers"	Placement of waste collection vessels
2	Collecting full containers for transport to intermediate storage	Collector bins	Personnel for collecting the primary collection vessels	Means of transport
3	Waste storage in the department areas	Storage bins	Storage rooms	Storage organisation
4	Transport to handover point and/or to intermediate storage until pickup	Transport personnel	Means of transport	Transport organisation
5	Storage of waste until pickup	Storage rooms	Storage personnel	Storage organisation
6	Pretreatment of waste in the hospital	Volume reduction	Weight reduction	Reduction of the infection risk
7	Waste handover to the disposal firm	Waste disposal personnel	Technical equipment	Spatial conditions
8	Waste transport to site of disposal	Transport firm	Personnel of the transport firm	Transport control
9	Waste treatment outside the hospital	Volume reduction	Reduction of organic components	Risk reduction
10	Waste disposal	Disposal methods	Costs and charges	Control
11	Documentation	Doccumentation contents	Time of reporting	Evaluation of the documentation
12	Control	Control responsibility	Checkpoints	Repeat frequency

Table 1: Overview of the subject classification for discussing the best possible disposal practice.

The discussion of the different definitions for hospital-specific and/or infectious waste already showed that a common solution for waste disposal in hospitals can be found much easier if based on the practices employed in the hospitals than on a mostly theoretical level of definitions. Although the objective of a common and practicable definition should still be pursued, it should be aligned in its content and structure to the function of setting parameters for the practical concerns of waste disposal. This paper is therefore going to highlight in detail which parameters for

the practical disposal of hospital waste may contribute to develop the disposal further under economic and ecological aspects.

3.1 Collection at the site of waste generation

One important area of waste disposal is the step from the waste generation to the first collection bin. Suitable containers must ensure the safe disposal right from the beginning, and the personnel ought to be trained and instructed in the correct separation of the waste.

For waste material similar to domestic waste (DoW), the **primary collection vessels** ought to be bags, preferably made of **reusable plastic.** The recommended colours for these bags are black or grey, with the colours best selected as part of a nationwide colour code for waste materials. Also, the volume of the bags should not be greater than 80 litres. The bag holders should have a lid.

Two variants are conceivable for hospital-specific and/or infectious (HS) waste: First, solid drums which are incinerated together with the waste, or bag liners in solid drums, with these drums being used for the collection and the transport and preferably designed as reusable items. These containers should in any case be non-transparent and preferably be made of reusable plastic. The handling of the containers should be as easy and safe as possible. The volume should not exceed 60 litres, and the maximum filling level should be clearly marked. Full containers should have a locking or sealing device which prevents the containers from being opened again without a tool.

Staff training is another important aspect of primary waste collection. Both the personnel reponsible for the waste disposal and the actual waste generators ought to be trained and instructed. The following minimum subjects ought to be addressed in the training seminars:

- risks in connection with the waste
- identification and/or colour coding of the different waste types
- waste disposal costs/charges for all fractions collected separately
- the path of the waste from the point of origin to the last stage of disposal
- responsibilities in the area of waste disposal
- basic information on waste storage
- criteria for sorting the waste into the different waste type
- specific information with reference to the working environment of the different professional groups
- effects of errors in waste allocation: health risks, risk of accidents, costs, etc.

Selecting the most suitable collection vessels is as important for a well functioning separate waste collection as the number and the **spatial distribution** in the different working areas. For this reason the demand for waste containers ought to be accurately determined and every precaution ought to be taken to ensure that the correct waste container is positioned as closely to the point of origin of the waste as possible. It was also shown that arranging the different waste types next to each other can have a negative effect on the sorting result.

3.2 Collecting full containers for transport to intermediate storage

Once the primary collection containers are full, they must be taken to an internal intermediate storage area in the department. This is normally a duty of the **personnel** which is also responsible for cleaning the rooms; in some instances it is up to the nursing personnel to ensure that the waste containers may be used again. The frequency for discharging the waste containers, defined by the normal working processes in the different departments, should therefore be determined. Prior to transport, the primary collection vessels must be sealed and often need to be reloaded and transshipped. There are therefore many opportunities to come into contact with the waste. For safety reasons the waste should not be refilled. Instead, it should be placed in bags and collected in a larger container for later reloading. Also, if waste is collected separately in different fractions, post-sorting of the waste which is already in the waste containers should be strictly discouraged.

Detailed personnel **training and instructions**, as described above, is therefore necessary to ensure safe handling of the waste. Suitable gloves should be provided. Normally, robust household gloves are sufficient for this purpose. The use of disposable gloves is not recommended because of the lack of protection and because extra waste is created.

The **containers** used for collecting the primary collection bins should be made of solid material and provide protection against leakage of liquids. Also, personnel entrusted with waste collection should be able to tell at one glance which waste fraction belongs into which container. This can best be done by using a uniform colour code. The size of the containers is largely determined by the ambient conditions such as the transport distances or the floor space of the storage rooms. The maximum filling level of the containers should be easily identifiable. The containers themselves should not pose any risk of injury to personnel, e.g. through sharp edges and corners or dangerous locking mechanisms. When selecting the most suitable containers, the following criteria ought to be observed:

- filling and emptying should be as easy as possible, e.g. by providing large openings or low loading ledges, such that loading or emptying the containers requires as little effort as possible.
- sharp edges and corners can cause the bags to rip open.

- the containers should be easy to clean, e.g. provided with a lockable bottom. outlet
- a simple mechanism for opening and closing the container is important for safe handling.
- also, the containers should be easy to move and control.
- depending on the options available for storing the waste, it may be advisable to purchase lockable containers.
- when selecting new containers, it is advisable to ask the different professional groups for advice with respect to their individual requirements and needs.

3.3 Waste storage in the department areas

As the space requirement for waste should ideally be planned properly as early as during the construction stage of the hospital, and since the conditions with regard to waste volume and fractions have often changed over time, it is sometimes difficult in older buildings to find the necessary space for storing the waste. A viable compromise between storage options, container volume/capacity and transport frequency must therefore be found. As a minimum for the **transport frequency**, the intermediate storage should be cleared at least once every day.

The storage rooms should be easy to **clean**, e.g. with tiled floors, and cleaning ought to be regulated in a journal which determines the responsibilities, the technique, the frequency of the cleaning, and the suitable disinfection.

Also, every conceivable care should be taken to ensure that the storage room is well ventilated and that fire-fighting equipment (e.g. fire extinguisher) is available. Access to the storage room should only be allowed for authorised personnel, with an appropriate notice at the door identifying the room as a waste storage area. To make it easier for personnel to find their way, certain areas should be allocated for the differnt waste fractions.

In practice, there is often not enough space, with the effect that lockable containers need to be placed in hallways and corners. If this arrangement is or becomes permanent, it is advisable to mark out these areas and to secure the containers against unauthorised tampering and relocation.

3.4 Transport to central intermediate storage and/or to the store where the waste is picked up by the disposal firm

Larger hospitals which do not have an automated transport system often have special **personnel** responsible for supplying the different areas of the hospital and for removing waste. As mentioned in the previous chapters, it is important to ensure that the transport personnel is also adequately trained and instructed in order to guarantee safe disposal and to be prepared for incidents. The personnel

should be capable of handling leakages, fires or errors in the waste allocation. Suitable protective equipment should be provided which, as a minimum, should include steel-capped working footwear and pierce-proof working gloves.

When **organising** the waste transports, there should be as few overlaps and interferences with the transport of patients, visitors or supplies. Ideally, this is guaranteed by special lifts and underground transport gangways. If lack of space does not allow this, certain transport times and paths can be agreed to meet this requirement. As said above, the intermediate store ought to be cleared and emptied at least once every day. Emptying is best organised at regularly recurring times which are also recorded in a journal.

Well sealed containers, checked for any external contamination, are also a first step in the right direction. As in other areas, personnel that is thoroughly familiar with its tasks and duties is an important basis for a well functioning waste disposal system.

When transporting the waste, care should be taken to ensure that the different waste fractions are kept separate. Although this is done best by organising separate transports, this may not be all that reasonable in terms of work organisation when it comes to small fractions. Suitable transport trolleys and carts can facilitate the separate handling of the different waste fractions.

3.5 Storage of the waste until picked up by the disposal firm

In many cases, a central intermediate waste storage area with easy access for the vehicles of the waste disposal firm has proved to be the best solution for ensuring the smooth disposal of waste. Ideally, this area ought to be located such that the transport distances from the different hospital areas to the intermediate storage area are as short as possible. Unauthorised persons and animals should not be allowed access to these premises. The waste should not be exposed to direct sunlight. As to the rest, the above requirements also apply to intermediate storage areas.

Since the personnel looking after the intermediate central waste storage area is normally the same as that handling the transport, it may suffice at this point to refer to the above annotations.

If reloading (e.g. from the transport bins to the baling presses) is necessary in the central intermediate waste storage area, mechanical equipment (e.g. forklifts, lifting gear) should be used wherever possible. This reduces the risk of potential contact between the waste and the personnel and also eases the manual workload for the personnel.

The equipment of the central intermediate storage area should also provide facilities for cleaning and disinfecting the waste containers and transport trolleys. If a large number of containers and trolleys need to be cleaned at regular intervals, a

mechanical cleaning/washing unit is advisable. After cleaning/disinfecting, the containers ought to be placed in their own area away from filled waste containers.

In order to make the biological activity in the waste subside, a refrigerated room may be advisable for storing HS waste. This is particularly appropriate if the waste volumes are so small that larger transport intervals are needed. Otherwise, the storage times are defined by the appropriate regulations and must match the local infrastructure.

If a more detailed collection of the waste volume from the different hospital areas is envisaged, the central intermediate waste storage area should be equipped with devices such as scales, laser scanners, etc. Random samples at irregular intervals may also be a reasonable solution to obtain data for optimising the waste disposal.

3.6 Treatment of waste in the hospital

For waste similar to domestic waste and recyclable waste, it is mainly a reduction in the volume of the waste (e.g. in baling presses) which is of interest. Care should be taken, however, that the containers are secured against liquid leakages.

Compression or baling is not advised for HS waste and for sharp and pointed objects because they can cause the collection vessels to burst open.

Since the method of incinerating waste in internal hospital incinerators, widely used at one time, has largely disappeared as a consequence of today's stringent specifications for flue gas cleansing, HS waste must either be taken to an external incinerator or be treated by a suitable method such it is no longer hazardous and can so be disposed of as normal domestic waste. The high charges for the disposal of HS waste boost the development and use of waste treatment technologies. The waste is disinfected using different methods (steam, dry heat, steam and microwave, chemicals, etc.). Some of these methods are illustrated in greater detail in chapter 0. During treatment the waste is shredded in order to anonymise its origins from hospitals and to reduce the waste volume. These treatment methofs can be applied locally by the hospital or be carried out by an external firm. Local treatment has the benefit that the expenditure for the road transport as hazardous waste can be avoided. But an internal system requires appropriate investments, space and personnel. This is only feasible if a clear financial advantage is identifiable for the hospital. Another problem may be the long-term commitment for hospitals which may eventually be overtaken by rapidly changing conditions in the disposal market. Models which allow hospitals to rent-lease such system may perhaps offer an interesting perspective.

3.7 Waste handover to the disposal firm

As mentioned before, the central intermediate storage area should be easily accessible also for larger vehicles of the waste disposal firm. If waste similar to

domestic waste is collected in a baling container, the waste quantity can be determined better because it must be picked up separately. If reloading is required, mechanical equipment should be used in order to avoid direct contact with the waste. If such waste has not been precompressed, this may be done during pickup by the disposal form, for instance in their waste collection vehicle. HS waste or sharps should on no account be compressed or compacted.

Similar to the intermediate storage area, suitable equipment in case of accidents and a telephone should be available at the handover point. Also, the site should be easy to clean and be fitted with liquid-proof pavement. Means and equipment to take up/soak up liquids and contaminants should be within easy reach.

3.8 Transport to waste disposal site

The waste should be transported only by qualified firms approved for this kind of work. These firms should also have suitable vehicles and well trained personnel. The personnel should be thoroughly familiar with the risks involved in the transport and should know how to counteract these risks. This applies, in particular, to the transport of HS waste or chemical waste because the regulations for the road transport of hazardous goods must be observed. The proper identification of the waste containers and of the vehicle is of great importance, e.g. hazard symbol of Class 6.2 ADR for infectious waste.

More often than not, the prices and charges for waste disposal are not transparent for hospitals. The hospitals should therefore be better informed about the costs of the individual disposal steps. The exact transport charges should also be clearly defined in the final account. In future, this will also force the disposal firms to justify their charges and prices.

The hospitals should be involved in the control of the correct and proper waste disposal. They should check once or twice a year whether the waste is carried correctly and also whether it reaches its specified destination. The quantity details should be determined and evaluated and compared with the in-house data.

3.9 Waste removal

Waste material similar to domestic waste may be dumped on landfills or burned in domestic waste incineration plants. The drawbacks and benefits of incineration versus landfill dumping are the same as those for waste from communal households. For this reason we refer at this point to the discussion in the pertinent literature.

Manual sorting of hospital waste prior to disinfection ought to be prohibited because direct contact with the waste should be avoided.

The charges for the removal of waste material similar to domestic waste ought to be the same as for the removal of communal household waste. Better transparency of the individual cost items should also help to clarify the difference

between the removal of domestic waste and HS waste. This may be of particular interest if the waste is incinerated in one and the same plant.

If the HS waste has not been pretreated to eliminate any potential risk, it should definitely be incinerated. Incineraton in an incineration plant for domestic waste is usually sufficient for the safe removal of these waste types.

3.10 Documentation of the waste disposal

Although there are far fewer regulations with respect to documenting the disposal of waste material similar to domestic waste then for HS waste, the data situation should be improved to optimise the waste disposal process. The following minimum information should therefore be documented:

- weight in tonnes of the waste disposed
- nature and origin of the waste
- date of transport
- persons responsible
- name and registered place of business of the disposal firm
- nature and location of the waste disposal

The waste disposal data should be analysed and evaluated at regular intervals. A report to the hospital management should present details if and how waste disposal conditions have changed, both with regard to the quantities of the diffrent waste fractions and to their disposal costs. Without these figures it is virtually impossible to tell if measures for waste separation or waste reduction have been successful or not, which savings potentials are still available, and where specific problems in waste separation occur. As mentioned before, some initial experiences have been made with acquisition systems which are so far developed that they even provide an accurate documentation of the waste quantities from the individual hospital departments. This would allow the accurate accounting for the disposal costs with reference to the cost centres, which, in turn, would provide a substantial incentive for the individual departments to reduce their waste quantity. This approach also creates a solid basis for department-related actions. If such a system is not available in a hospital, it may be advisable to take regular random samples of the waste from the individual hospital departments in order to establish the nature and volume of the waste from these departments.

3.11 Control

Besides the figures obtained from the documentation of the waste quantity, a certain degree of control is also needed in order to establish whether the separation and disposal system is actually capable of meeting expectations.

One such system could involve the appointment of contact persons for waste disposal issues in each working area of the hospital who are always up to date on information by receiving special training and instruction and are so able to advice the other members of staff. These persons are also available as contacts for difficulties encountered in waste disposal and accept suggestions and proposals for improvements. If any difficulties are met during waste disposal, these persons can attempt to find out together with their colleagues how these problems can be solved.

The contact persons for waste issues als pass on current information from the documentation of the waste quantity; they are important for providing training in all issues of waste disposal because they are familiar with the specific problems of their own working area.

To make sure that this subject is fully appreciated even at the highest echelons of the hospital management, hospital management should also appoint a contact person for waste disposal issues.

The local authorities should be encouraged to aim for cooperation with the hospitals by offering advisory services and a certain degree of control. This relates both to the implementation of the legal regulations of waste disposal and to the requirements of the local infrastructure, since local governments are often also responsible for the disposal of domestic waste. Close cooperation can be very helpful for the hospitals.

4. Waste avoidance

According to the objectives of the European waste legislation, the first priority of waste management is waste avoidance. But in practical hospital waste disposal, the implementation of this priority is not very evident. In the course of the project the partner hospitals were therefore asked if they know of any examples of waste avoidance. To gain an outline of the examples, the following structure was developed. The examples which the partners quoted as known are listed further below. This list is far from complete, and it would be a good complement to this projects if the EU would set up a central information office which disseminates this information to hospitals throughout Europe.

The present state of development shows that waste avoidance is actually practised in some instances, but that a systematic approach has as yet not been worked out. Some principles of waste avoidance are therefore highlighted in greater detail in the following chapter.

4.1 Product development

The central question in waste avoidance is: Where does waste avoidance actually begin? Ignoring products which are not produced because they are not wanted by anybody, waste avoidance begins far outside the hospitals during the manufacture

or production of the products. This relates both to the quantity and to the quality of the waste associated later with these products. The Institute for Environmental Medicine Aand Hospital Hygiene has therefore completed a number of projects together with manufacturers, with the aim of providing a positive impulse on waste generation at the earliest possible point in time, i.e. during the production of the product. Normally, hospitals are unlikely to be able cooperate directly in such developments. But feedback from experience, e.g. involving products which have unnecessary wrappings or packagings or which create problems during waste disposal, as well as suggestions for improvements made by hospitals, are perfectly possible.

4.2 Product selection

Looking at the purely financial turnover of a hospital, it becomes evident that a hospital (as a customer) has a certain power. Major hospitals, in particular, or purchasing pools of smaller hospitals have a great deal of consumer "muscle". Ideally, each product should display a notice saying what waste quantity will result from the application or use of that product. Obtaining this information is most likely to remain a pipedream because no-one is telling or compelling manufacturers to provide this information. The only avenue open to hospitals is, therefore, to take a close look at the product and to assess the potential waste quantity and the suitability in terms of waste separation. Naturally, this assessment will always be a second-line criterion after the quality of the product and its price, but with certain criteria and assessment results being equal, it may ultimately prove a decisive element. The fact alone that a hospital actually carries out such an assessment can show some dramatic effects. If the hospital has a document in which the objectives of the supplier company are presented (e.g. quality and environmental policy), determining products in accordance with their waste generation potential would provide an important signal.

Time and again hospitals are faced with the choice of having to use products which can only be used once, or to look for products which can be reused after reconditioning. Of course, reconditioning requires a certain infrastructure, and establishing such an infrastructure must pay dividends. The waste quantity which the hospital saves by reconditioning must be included in this costing calculation. The question of reconditioning is also inextricably linked to the question of hygiene, with the effect that suitably competent personnel is required to carry out the reconditioning. Products which the manufacturer has intended for reconditioning also carry information on the reconditioning process.

More problematic are those products which the manufacturers intended to be disposable, but which can easily be used several times in practical working life. Using a classification of products according to risk groups and depending on the nature of patient contact (e.g. invasive or skin contact only), the hospitals can usually assess these products themselves.

In order to be able to make a correct economic appraisal when choosing between disposable and reusable products, details on costs of reconditioning and details on the costs of disposal should be available.

The problem that hospitals do not have their own infrastructure for reconditioning has resulted in a service sector which allows hospitals to use reusable products without actually handling the reconditioning themselves. This has been a long-standing practice in the laundry sector and may also be extended in future to include other products and services..

4.3 Package sizes

The package sizes in which products are marketed also affect the later waste quantity. The package size is usually related both to the use of the product and its storage. Depending on use, the package size of a product ought to be such that the package content is used up before the shelf life of the product is exceeded. Products which must be sterile in use are particularly sensitive in this respect. The sterility requirement often calls for smaller package sizes. To find out the best possible package size for the different work requirements demands good cooperation between the user of the product, the purchase and procurement department, and the manufacturer of the product.

As the packaging of a product accounts for a major share of the waste to be disposed later, it may be advisable to buy products often needed in smaller quantities in large package sizes and then to refill (e.g. detergents and cleaners). This leads to a substantial reduction in the waste volume.

4.4 Purchasing and ordering

In a hospital with its numerous different departments it is important that there is a central office which handles the purchases for all departments. This prevents products from being ordered in small quantities - in the worst case scenario at the same time and even from different suppliers. The different purchasing processes also trigger different delivery processes which entail an unnecessary amount of waste both during transport and in terms of packagings. This is also very unreasonable in financial terms because quantity discounts are given away and because additional transport costs are generated.

To develop the benefits of jointly organised purchasing and ordering further, smaller hospitals may be well advised to cooperate in purchase with other hospitals. Of course, the demands made on the ordering and purchasing organisation rise with ever-increasing number of products and ordering processes. Fortunately, there are computer-based systems available today which make leafing through voluminous (and often outdated) catalogues a thing of the past. If the volume of the goods to be ordered exceeds certain dimensions, it is advisable to assign certain goods assortment and ranges to certain purchasers. These then have the special knowledge in the product range within their

responsibility, special knowledge from which the hospital can benefit. This is another reason why cooperation in purchase makes very good sense for hospitals.

4.5 Stockkeeping

Keeping exactly the right amount of stock to have adequate supplies, but without having to sort out products which have exceeded their shelf life or their use-by date, is certainly a major challenge. This is also an element where the above mentioned cooperation can be applied. The higher the throughput in the departments/hospitals linked to a store, the less likely is it that products exceed their use-by date or their shelf life. A central store therefore offers advantages over many stores spread over the individual departments. A large number of users also means that the reserves for unusually large but rare consumptions can be reduced because the likelihood of all of them exceeding their normal stock removal volume at the same time is relatively small.

Naturally, the demands made on the internal ordering and transport management rise with the number and quantity of the products. To find the right balance between central and local stockkeeping requires a wealth of information on the flow of goods and quantities in the hospital. If the hospital has a computer-assisted accounting office which is capable of allocating the consumption of the individual products to the various departments (cost centres), the basic data is usually available.

Correctly estimating the demand for individual products in the various hospital departments calls for attentive and well trained personnel. The continuous training of staff members entrusted with ordering the necessary products for the individual areas is therefore an important contribution towards efficiency and successful hospital management in terms of economy and ecology.

4.6 Evaluating work processes

A process which is much more difficult is the assessment of work processes designed to avoid unnecessary or even wasteful working modes. In this context, issues of hygiene also play a major role. A few examples may suffice to highlight options for reducing waste: optimising surgical coves for patients during operations, reduced standard equipment and changing intervals for hospital beds, nature and scope of area disinfection or reduced infusion and dressing change intervals. More examples are listed in the tables at the end of this chapter. Attentive and well trained members of staff, cooperating with the hygienists, can make a substantial contribution to the optimisation of the work processes. These issues are best dealt with by setting up an independent, interdisciplinary study group which will look into possible improvements. Examples known to date have been listed in a number of publications by the Institute for Environmental Medicine and Hospital Hygiene.

Examples for waste avoidance and waste reduction are listed on the following pages. For this purpose the hospital has been structured into the following areas: nursing ward, operating theatre, OPD, laboratory, store, pharmacy, technical departments, buildings and greens, house cleaning and sterilisation/disinfection, laundry, kitchen and canteen, administration, purchase.

4.6.1 Area: Nursing wards

Air humidifiers with reusable textile filters	Metal kidney bowls for multiple use
Reusable medicine bowls made of glass	Empty packagings used as tube disposal containers, e.g. 10 litre dialysate canisters
Reusable textile napkins	Multiple use suction systems
Collecting unused drugs in plastic boxes, central collection in the pharmacy and return to suppliers	Use of baskets with grid bases for collecting household glass for reuse (small medical glassware drops through the openings in the bottom)
Use of reusable transport crates for soft drink bottles in place of carton packages	Non-mercury thermometers (electronic or infrared)
Separate collection of white glass (Perfuverre)	No respiration filters
Reconditioning e.g. respiration training units, oxygen masks and bellows, diet probes	Collection of paper at special designated points (e.g. ward office) to avoid contamination with other waste
Routine change of dressings and drips after 72 hours	Oral hygiene sets assembled in-house and reused after use
Buying hand disinfecting agents and liquid soap in large sales units and refilling in-house	Use of secretion and urine bags with discharge devices (valves), changes as required, non-routine

4.6.2 Area: Operating theatre

Optimised clothing and draw sheets for patients	Reusable aprons and frocks
Multiple use suction systems	Collecting solvents in special containers
Separate collection of batteries and rechargeables	Separate collection of cartons from packagings
Use of reusable instruments instead of disposable instruments, e.g. scalpels, clamps, forceps, etc.	Reusable clothing for personnel, e.g. hoods, frocks, aprons
No disposable overshoes	Surgical sets in sterile containers instead of disposable material

4.6.3 Area. Out-patient department, A&E

Separate collection of paper at designated points to avoid contamination with other waste (e.g. office of doctors and of nursing staff)	Covering examination benches only in the area where skin makes contact with base

Reconditioning developers for X-ray films	Silver recovery from fixing solutions

4.6.4 Area: Laboratory

Reuse of empty containers, e.g. for diluting disinfectants	Central management and storage of toxic substances
Negotiate return of products by the supplier	Separate collection of solvents and alkalines in special canisters with letter markings for regeneration
Separate collection of cartons from packagings	Separate collection of concentrated reagents and rinsers
Neutralisation of waste waters	Detoxification of solvents containing cyanide
Concentrating toxic substances from solvents, e.g. ethidium bromide on adsorption columns	Redestillation of solvents

4.6.5 Area: Storage

Use of reusable standard pallets	Separate collection of cartons
Separate collection of plastic film outer wraps	Large packagings refilled in smaller units as required
Control of use-by date / shelf life of articles	Reducing stock quantities in decentralised smaller stores
Data evaluation on material flow to hospital	

4.6.6 Area: Pharmacy

Infusions in glass bottles instead of plastic bags	Reuse of empty containers
Separate collection of cartons	Separate collection of plastic film outer wraps
Collecting unused drugs and medicines, return to supplier	Transport in reusable transport containers
In-house production of ultrasound gel	In-house production of liquid nourishment in reusable bottles
Reusable gallows for infusion bottles	

4.6.7 Area: Technical department

Separate waste oil collection for incineration in cement furnaces	Reconditioning solvents
Separate collection of batteries and rechargeables	

4.6.8 Area: Buildings and greens incl. gardens

Metal collection for reuse via scrap yards	Collection of polystyrene for reuse as granulate

Composting freshly cut grass/brush	Separate collection of neon strip lights

4.6.9 Area: House cleaning and disinfection/sterilisation

Separate collection of cartons from packagings	Use of large multiuse packing units

4.6.10 Area: Laundry and laundry shop

Bags for dirty washing from recycled polyethylene	Reuse of residues from dry-cleaning

4.6.11 Area: Kitchen and canteen

Separate collection of waste oil	Collection of cartons and compressed in baling press
Separate collection of plastic film outer wraps	no disposable cutlery and dishes
Reusable bottles and drinking fountain for carbonated tap water	

4.6.12 Area: Administration

Separate collection of paper, avoiding crumbled paper for denser packing	Refillable cartridges for printers and copiers

4.6.13 Area: Purchase

Waste bags and containers made of plastic originating from waste recycling	Use of recycled paper instead of white paper
Integrating waste charges in negotiations with supplier (example Lausanne, total: 34): Petri dishes 60/40 - disposal / purchase, smaller diameter of the dishes used	Purchasing refillable cartridges for printers and copiers
Purchasing high quality cartridges with higher page rates for copiers and printers	

5. Reuse

As mentioned in the context of waste avoidance, reuse plays a major role. This ranges from the packagings used for goods transport right through to highly complex medical apparatus, e.g. catheters for cardiac examinations.

As far as disposable products are concerned, the question whether the same products (with minor modifications) could also be suitable for multiple use is often ignored. As long as disposable products can be manufactured cheaply, they are reputed to make work easier and enhance hygienic safety. They also save the hospital the expense of a reconditioning infrastructure.

Today, a number of ecological balances, some of which highly complex, have made the attempt to highlight this issue in scientific terms and to evaluate the products under the aspects of work practice, economy and ecology. Individual hospital may, however, find it difficult to make their own evaluations and so rely entirely on the published results of the above ecological balance accounts.

These difficulties also require fundamental decisions by the management of the hospital laying down a line of orientation and defining which aspects need a higher ranking priority if information is sporadic or sparse. Seen from this angle, well formulated and published corporate principles for hospitals are important and make good sense.

Besides the direct reuse of products, reusing residual quantities provides one more option for reducing the waste volume. Of course, this approach should always go hand in hand with improvements in the organisation of purchasing and stockkeeping. An example for the organised reuse of materials is a Chemicals Exchange and Mart, as practised at the Freiburg University Clinical Centre.

The Centre set up a central collection point which accepts both unopened chemicals and partly used residual quantities of chemicals.

The "exchange" must employ qualified personnel capable of assessing the degree of impurity and contamination of partly used chemicals. After the assessment, the chemicals are then released for reuse and re-labelled, or disposed of. As a rule, partially used chemicals will only be used for applications in which the required degree of purity is not very high (e.g. culture media, demonstration tests for medical students, etc.).

An important element in the proper function of such an exchange is the commitment of the staff who detect where chemical residues are stored and who determine whether these are unlikely to be used in the near future. When ordering new chemicals, a first look at the products on offer at the chemicals exchange should become routine. For this reason it is best to organise the purchase of chemicals along central lines and to link it with disposal and the chemicals exchange. If a networked computer system is available in which all departments partake, access to the chemicals exchange is possible with very little effort. This means that savings can be accomplished both in disposal and in purchase, and deficiencies in stockkeeping and in ordering can be compensated later.

6. Analysis of the waste composition

This project has demonstrated that the analysis of the composition of the different waste fractions is an important help for further developing the separate collection and the disposal of hospital waste.

Interesting results and impulses can already be obtained by the random sampling of individual part areas. The following notes are therefore designed to give hospitals, wishing to carry out their own waste analysis, some fundamental hints.

6.1.1 Selecting the areas to be investigated:

Since a complete analysis of the hospital waste is normally out of the question, it is best to select a number of individual areas. The following information should therefore be obtained:

- which waste fractions are currently being collected separately in this area?
- at which intervals is the waste normally taken to the intermediate waste storage area?
- when picking up the waste, is it mixed with waste from other departments?
- who is responsible for the transport of the waste?
- after the waste is picked up, can its origin be identified in any way? (containers, means of transport, storage site, etc.)

It is easiest to carry out the analysis for areas with their own intermediate storage area where no other waste is stored. When transporting the waste from this intermediate storage area to the site of the waste analysis, the waste should however not be mixed with waste from other areas. This risk prevails if the normal way of disposal to a central waste collection point is used and if the personnel in charge has not been adequately informed and instructed.

Additional safety is provided by specially marking the waste containers or bags included in the analysis. To do so, it is best to distribute marked and labelled bags among the personnel.

Another important point in the preparations is estimating the waste volume expected for each waste fraction so as to be able to plan the number of days needed for waste collection and the subsequent analysis. According to the experiences made in this project it is best to weigh a waste container with an average filling from each waste fraction in order to increase the accuracy of the estimate.

The room used for the analysis should be adequately sized (> 50 m^2), well lit and, above all, well ventilated. It should also be lockable to deny access for unauthorised persons.

The following minimum quantities should be collected for the analysis:

Area	Min. quantity [kg]
Kitchen	500
Nursing ward	100-200
OPD and A&E	100

Administration	100-200
Pharmacy	100-200
Laboratory	100

Using the estimated daily quantities, a schedule for the waste collection is prepared and the personnel involved is given detailed information on the procedure.

Analysing these waste quantities (grading and/or manual sorting) requires about 1 week with a workforce of between 5 and 6 people. Adequate personnel protection (e.g. breathing equipment, gloves, protective goggles and working clothes) must be provided. The persons in charge should also check if the personnel has been inoculated against tetanus, hepatitis A and B. Also, adequate sanitary equipment should be provided near the waste sorting point.

A sorting table with a surface area of 2 by 1 meters and a perforation of 40 mm is particularly suitable for sorting. Such a table can easily be in-house by using a metal sheet with 40 mm diameter holes drilled into it at regular intervals. The 40 mm diameter hole size is designed to eliminate small components and particles.

Using the sorting table, the waste is then sorted into the following fractions:

- waste < 40 mm
- paper > 40 mm
- carton > 40 mm
- glass > 40 mm
- organic material (irrespective of size, if possible)
- residual waste > 40 mm

Each fraction is collected in smaller containers and weighed (empty container weight to be determined first).

Even a less involved and less accurate analysis can provide important information and indicators for improving waste disposal.

7. Collection of waste for reuse

Following the empirical data obtained from the analysis of waste from different hospital areas, there appear to be interesting options in virtually every working area for collecting waste components separately and for reusing these components. This helps to reduce the waste quantity and/or the costs incurred by the hospital for waste disposal, and the material can be reused. The success of

separate collection depends largely on the skill and motivation of the employees, but also on the infrastructure available for the separate collection. The fundamental principles which need to be observed when setting up a separate waste collection will be outlined on the following pages.

Important basic principles for the separate collection of reusable waste components from hospitals include:

- separate collection as close as possible to the point of generation of the waste
- the quality of the collection is more important than the quantity
- only materials which can be reused should be collected separately

7.1 Container size and design

Selecting suitable containers is an important step when setting up a system for the separate collection of reusable waste components. The size of the containers should match both the quantities expected and the spatial conditions. As a rule, the lack of suitable placement options for the containers is one of the major obstacles when introducing separate collection. Before buying the containers, the spatial situation in the different departments should therefore be studied in detail and the expected quantities should be determined in a trial collection. Attention should be paid to the point where the waste is generated in order to be able to place the collection bins as close by as possible. It is advisable not to place the reusable waste material directly next to the domestic waste to avoid confusing the waste bins. As long as the container size meets the spatial requirements, there is often a corner, a niche or space underneath working surfaces which can be used for collecting the waste. The ergonomic design of the containers is also important. This begins with opening and closing the lids (by foot pedal, if possible, and without making excessive noise) via emptying and fitting new bin liners right through to moving/wheeling the containers, to name but a few aspects.

7.2 Container marking and labelling

Another important feature is the marking and identification of the containers to be able to distinguish the different waste fractions easily. Lettering combined with a colour code has proved to be best. Both the holder and the bags/lids should be identifiable. The waste allocation can also be made easier by selecting certain materials, e.g. paper bags for paper collection, etc. The different waste fractions should also be identifiable easily when looked at from above. Another good option for distinguishing the different waste fractions is to design the inlet opening to match the material to be collected in the appropriate container, e.g. oblong square for paper and circular openings for glass.

7.3 Information material

Besides marking and labelling the containers, detailed information material should be provided which gives accurate instructions on sorting the different waste materials. These may be in the shape of wall posters above the waste containers with basic information on waste separation, or brochures or loose-leaf binders containing detailed information on the different waste materials, their handling and their correct disposal. A loose-leaf compendium has the advantage that information can be updated, also in part. If persons with an inadequate command of the national language are employed among the cleaning staff, it is also advisable to provide information material in other languages.

7.4 Advice

Even with the best designed information material there will always be questions on correct disposal. It is therefore important to appoint or designate contact persons who can assist in these instances. This may be a central contact who is responsible for organising waste disposal, or contact partners in the different departments acting both as advisers on waste disposal issues and as instructors for in-house staff training.

7.5 Training

Training and instruction in waste separation is important, particularly for new employees of the hospital. As the systems still differ from hospital to hospital, it is important to explain the system used internally in detail to the employees. It is good practice to refresh the employees' level of knowledge at regular intervals, to discuss newly emerging problems, and to look for the best solutions for the workplace. A brief, annual training seminar for the different departments of the hospital is normally sufficient.

7.6 Evaluating the results of collections

When surveying the data for waste disposal, the results of the waste separation should also be surveyed and evaluated. The results should also be conveyed to the members of staff so that further improvement options can be fathomed and implemented. This can be done both in writing (e.g. in an in-house news sheet) or by word of mouth during training seminars.

7.7 Control

As mentioned previously in the context of waste analysis, the composition of the waste collected separately should be checked every now and then by means of random samples. Only a good separation result will guarantee that the waste is actually reused and that the hospital incurs fewer or even no costs. It also allows products to be identified which cause particular problems during waste separation. To be able to make direct contact with the members of staff responsible for the

waste separation, the random samples should include only waste from a clearly defined area of the hospital. The problems encountered during these checks can then be discussed during the personnel training seminars. A system which continuously monitors the quantity of each waste fraction is of course much better to mirror success and failures of waste separation. By allocating the costs to the various cost centres, the savings gained by the successful waste separation can also accrue to the benefit of the appropriate department, with the effect that the efforts made by the employees is also reflected in financial terms.

8. Reuse of waste material

In principle, there are three sorting stages in the reuse of materials from hospital waste: First, the reuse of a very specific kind of material which is either collected because of interesting components (e.g. syringes, infusion flasks, X-ray film fixing agents [containing silver]) or because their special treatment results in a substantial reduction in the quantity of domestic waste and hence in cost savings (example: napkin recycling).

The next stage involves the collection of uniform materials in mixed embodiments, such as glass in different colours, paper of different grades, or mixed scrap metal and carton. The reuse of these fractions has long been well established.

The third kind of reuse involves the collection of packaging material containing a blend of widely differing materials and embodiments. The fraction is collected separately only by virtue of a return acceptance undertaking on the part of the packaging manufacturers and is reusable only after an extensive sorting process into different material fractions.

9. Treatment of waste

The local treatment of hospital-specific and/or infectious waste in hospitals is, in a sense, also a form of reuse. Although the treatment does not reduce the waste volume generated in the hospital, the expenditure and effort for transport and packaging and, compared with domestic waste, the higher expenses for removal does indeed show a decline. The advantages for hospitals are found mainly in cost savings in relation to HS waste disposal.

The methods of waste incineration which were quite common in most hospitals at one time will not be dealt with in detail at this point because today's specifications involving the reduction of air-borne emissions caused by incineration processes require an incineration technology and flue gas cleansing equipment which can no longer be guaranteed by the old hospital plants and which would result in prohibitive costs for the installation of new systems.

The following aspects must be taken into account when appraising the different methods:

- effectiveness of the disinfection method on different micro-organisms
- effects or risks of the method for hospital personnel
- emission caused by the method into air, water and the soil, both in regular operation and in case of plant breakdowns or malfunctions
- effects of the treatment with respect to volume and mass of the treated waste
- plant capacity
- nature of the waste which can / cannot be treated with that method
- spatial, technical and personnel requirements for the operation of a treatment plant
- support by external service specialists
- disposal of the residual substances and/or liquids and waste gases caused by the method
- investment and operating costs
- ease of repairs, user friendliness and robustness of the plant
- handling risks in case of necessary maintenance work involving the plant, e.g. plant disinfection in case of malfunctions

Rising charges for the removal of HS waste make local treatment technologies for HS waste in hospitals more and more attractive. The following pages give a brief outline of the currently available treatment technologies.

When selecting a treatment method, information should first be obtained from authorities whether this method is also approved as a method for treating HS waste.

In general, waste treatment can be classified and distinguished into thermal and chemical methods. There are also combinations of both methods.

Mobile treatment units, used by disposal operators for local treatment, provide an interesting alternative for hospitals both for thermal and for chemical waste treatment. It may be a particularly interesting solution mainly for smaller hospitals because there is no need for them to operate the system themselves and because they are not responsible for the proper function of the system.

A major problem for hospitals are operational system breakdowns resulting in extended downtimes. As the storage capacities for HS waste tens to be very limited, and since legal regulations demand the rapid removal of the waste

materials, technical problems involving the plants can quickly lead the hospitals into difficulties.

9.1 Thermal treatment of waste

A technique known in hospitals from laboratories and the reconditioning of instruments is the treatment with pressurised hot steam, also known as autoclaving.

To optimise the effect of hot steam, it is good practice to shred the waste before autoclaving. Since shredding is often disrupted by malfunctions, the shredder should also be disinfected with hot steam to make service and maintenance work safer. If the waste is not shredded, the waste containers must be suitable for treatment in the autoclave and must allow the access of hot steam.

Using suitable test methods, the efficiency of this process must be reviewed at regular intervals. To do so, defined test organisms (e.g. spores of bacillus subtilis and bacillus stearothermophilis) are treated together with the waste under worst possible conditions, e.g. in a box or in a tube. Data on temperature, pressure and the duration of the individual treatment stages are recorded and documented in newer plants. This serves as proof of proper function of the plant.

The minimum duration to take effect in case of smaller waste quantities has been determined to be 60 minutes at 121°C and a pressure of 1 bar. These values must however be checked for each unit using suitable tests.

Besides the treatment with pressurised humid heat, there are also methods for disinfecting waste with dry heat. In this method the waste is shredded and carried by a worm mechanism inside a reaction tube which is heated from the outside with hot oil to a temperature of 110-140°C. The heat treatment takes approx. 20 minutes. Unlike the autoclave, this process can be kept up continuously. The waste gases from this process are dehumidified and cleaned.

A relatively new method is the waste treatment with microwaves where the interaction between water molecules and microwaves is used to heat the waste material. Before exposure, the waste must be moistened to make sure that sufficient water is heated by the microwaves. Shredding the waste prior to the treatment is also advisable in this method. Compared with autoclaving, this method is more expensive and also more complicated if malfunctions occur. This technique is still at the development stage; improvements and more reasonably prices system may be expected in the near future.

9.2 Chemical treatment of waste

Handling disinfectants is a common everyday affair in hospitals. Based on this experience, systems for disinfecting HS waste have been developed.

To ensure adequate contact with the disinfectant, the waste must first be shredded in this method. This is a relative troublesome process which often causes disruptions. If malfunctions do occur, it is difficult to remove or disinfect the waste remaining in the shredder.

Since the disinfection requires the use of highly aggressive chemicals, the operation of such a plant can be a health hazard for employees and an environmental hazard. The personnel operating such a unit must therefore be equipped with the necessary protective equipment and be very well versed in the operation of the unit and in the handling of malfunctions. Also, the residual substances after the waste treatment still contain high concentrations of disinfectants which may be emitted into the air and into water.

What is more, hospitals repeatedly report resistant germs after the application of disinfectants. These problems must also be expected when disinfecting waste materials.

Another possible option for the use of chemical disinfection is the treatment of liquid or pasteous waste such as body fluids or excrements. Since this materials are easier blended with the disinfectant, this method requires less aggressive chemicals and smaller quantities of disinfectants But waste water is still polluted by this treatment method, with resistance developments to be expected.

As a result of these problems, chemical waste disinfection is certainly less suitable than thermal methods. Chemical disinfection may be considered in the absence of other treatment options or as substitute measure if other plants fail. When applying chemical disinfection method, every conceivable precaution ought to be taken to ensure the proper protection of the personnel and of the environment.

10. Criteria for the safe disposal of hospital waste

The concept involving the criteria under which hospital waste may be disposed of like domestic waste covers four areas:

The first area covers the destinations for the disposal of hospital waste. As a guideline for the hospital staff it is important that the hospital management formulates objectives which reflect the management concept with respect to the disposal of waste.

The second area involves the conditions which must be met to ensure that hospital waste may be disposed of like domestic waste. These conditions will be explained in detail, using examples for the appropriate implementation options.

The third area involves fundamental safety principles during the disposal of hospital waste. A high standard of safety can be upheld in the long run only if the weak points in the disposal of hospital waste are reviewed at regular intervals.

The fourth area includes the necessary measures outside the hospital designed to support the safety concept of the hospital.

10.1 Objectives for the disposal of waste from hospitals

The following objectives for the disposal of waste have been suggested, discussed and evaluated:

1. No risk of infection for patients, personnel or visitors must evolve from the waste

This objective was given top priority by all project partners; it is therefore to be regarded as the central and fundamental principal of disposal.

2. Waste disposal must comply with legal requirements.

This objective has also been graded with very high priority by all partners. This requires that the hospitals keep up to date and well informed on changes in law, that they have these regulations available and that they supervise and control their implementation in the hospital.

3. No spreading of diseases in the environment

This is also considered one of the central objectives of waste disposal. The hospitals must therefore ensure that infectious material is safely disposed of.

4. Reducing the hazards emanating from waste

When viewing the risks of the spread and transmission of diseases, one should not overlook the fact that other hazardous waste materials are generated in hospitals. These are mainly cytostatic and radioactive waste materials.

5. Disposal with cost awareness

Even if the above objectives are ranking higher in priority, the increase in cost pressure should be taken seriously. All members of staff are therefore called upon to act responsibly and correctly by separating and avoiding waste and so to contribute towards a more cost-effective waste disposal. Training programmes and regularly reporting on waste disposal activities can provide important impulses.

6. Avoiding direct contact with identifiable body and organ parts

Ethical reasons demand that identifiable body and organ parts are treated as a separate waste fraction because the public is reluctant to be confronted with this aspect of hospital work.

7. Reducing the waste quantity

Within the meaning of cost-effective disposal, the reduction in the waste quantity is already included in objective 5. The major cost saving effect is, however, at present achieved not by reducing the total quantity but by improved sorting with the aim of the reducing the quantities in the expensive waste fractions. But the environmental pollution caused by the total waste quantity should also be kept in mind.

10.2 Conditions for the disposal of waste material similar to domestic waste

Criteria under which the disposal of hospital waste may be feasible and reasonable are discussed in the following chapter. Using examples, this will be followed by explanations of how these criteria can be implemented in practice.

1. No contamination with material known to contain pathogens liable to cause dangerous diseases, both from the culture of pathogens in laboratories or from test animals and patients who carry such a disease.

2. No possibility of injuries caused by this waste.

3. No blood in a condition and quantity which may cause contamination by splatter.

4. Leakages and outpourings of liquids from disposal containers must be avoided to the largest extent possible.

5. The generation of aerosols must be avoided as far as possible.

6. Direct contact between humans and waste must be reduced to an absolute minimum.

7. Waste must not be sorted manually.

8. Waste must not contain hazardous substances such as chemicals or cytostatic agents

9. Waste storage must not become a source of health hazards.

10. Waste must not cause technical/operational disruptions during waste disposal outside the hospital.

11. Origin and nature of the waste must be identifiable and traceable.

Measures which may help to meet these conditions are described on the following pages. A concept for the safe disposal of waste material similar to domestic waste is designed to keep the waste fraction of the hazardous waste components to a minimum.

Condition 1: No contamination with material known to contain pathogens liable to cause dangerous diseases, both from the culture of pathogens in laboratories or from patients who carry such a disease.

The first measure to be defined for each countries involves the definition of which diseases must be classified as dangerous or infectious and which materials may contain the pathogens of these diseases. By way of an example, reference is made to the above definitions for infectious and/or hospital-specific was by Freiburg and Barcelona (see annex).

Another indicator is given by the classification of pathogens in the EU directive for protection when handling biological working materials. Reference is also made to the appropriate national legislation for the area of epidemics prevention and control.

Scientific literature provides a wealth of information on the survival capability of pathogens in the environment and the paths of possible disease transmissions. The hygiene specialist in the individual countries are quite familiar with this subject, also with regard to health and safety at work for hospital personnel.

Due to the differences among the European countries in terms of geography, climate and culture, it would appear to be more reasonable if each country prepares its own list of disease for its own area and for conditions and/or materials most conducive to transmission.

Another important measure is the forwarding of the above criteria to the hospital employees. Although medical personnel is usually highly qualified and knowledgeable with regard to diseases, it is important to use the forum of advanced training seminars to highlight specific problems of waste disposal. These occasions may also be used to discuss problems and ways of improving waste separation in everyday practice. The employees ought to be well acquainted with the requirements for waste collection and/or transport containers intended for the correct disposal of the different waste fractions.

A good method of bringing information across to the employees is pinboards and clearly structured brochures giving the most important and immediate basic information relating to waste separation.

A survey of those area in which waste materials contaminated by hazardous pathogens are expected helps to optimise the logistics involved in the collection of this waste, to determine the level of knowledge among the employees, and to lay down the priorities for staff training.

Since the question of whether the waste is to be classified as contaminated or not is a recurring one in everyday working life, it is important to appoint a contact person who can provide further assistance in this issues.

If a patient is found to carry a dangerous and infectious disease, it is important to inform **every** member of the hospital involved on suitable measures during the disposal of the waste. This may also be an occasion to find out how successful the staff training was and what needs to be improved in this area.

Condition 2: No possibility of injuries caused by this waste

The central issue in this context are sharps and other pointed objects. A uniform definition of the criteria which containers used for the collection of injurious waste must meet could help to reduce the risks inherent in the disposal of this waste. The construction design of the container, a uniform colour code and the lettering, the mechanism for separating syringes, needles and other sharps and for opening and closing, as well as the upper filling limit of the containers should be kept in mind.

Since accidents involving sharps are quite common, recording these accidents should also include specific questions on the disposal of waste so that this information can be used later for optimising the disposal. It is advisable to entrust persons who are thoroughly familiar with the place of work where the accident occurred with the recording of accidents.

Also, sharp waste should be investigated in order to establish the risks to which the employees are exposed during waste collection and separation. This is designed to account for the specific local working conditions and to find solutions which can be integrated as smoothly as possible into everyday operations.

Minimising the contact with waste (condition 6) helps to reduce the risk of injuries.

A market for safe products for hospital work has developed for quite some time in the USA. The extent to which these products can help to enhance the safety of hospital waste disposal should also be reviewed in Europe.

Meeting these conditions requires training seminars for the personnel which intensify the awareness for this problem area. The seminars should convey working techniques which help to reduce the risk of injury, and the known risks should be highlighted.

The division of work in hospitals in medical personnel which generates the waste and in often inadequately trained cleaning personnel which is responsible for collecting and disposing of the waste means that personnel, which has nothing to do with the generation of the waste, is often endangered through incorrect waste separation, e.g. sharps in domestic waste. If the origin of the waste is clearly identifiable (condition 10), the causative polluter can easily be traced.

The use of mechanical equipment for reloading the waste bags helps to reduce contact with waste and the risk of injury for personnel. If the containers for waste transport outside the hospital are used for the intermediate storage in the departments, there is no need for reloading. Waste compressed in a baling press

also requires reloading, although this can be done with mechanical equipment without contact between waste and personnel.

Condition 3: No blood in a condition and quantity which may cause contamination by splatter.

If blood in larger quantities in contained in the waste without the waste materials soaking up all of the blood, or if blood is held in a bag which is likely to burst if outside pressure is applied, there is a real risk of endangering personnel by blood splatter. The pathogens transmitted via blood have been a focus of discussions ever since the discovery and spread of AIDS.

From an accident involving blood to a final disease, there are several conditions which must be met before an infection can set in.

The person contaminated with blood, for instance, must have an inadequate power of resistance to the pathogen. Inoculating the personnel against hepatitis B can also help to prevent infection with this pathogen during the work at the hospital.

Furthermore, the pathogen must find access to the person's body. This can be largely avoided by wearing protective gloves, appropriate clothing, goggles and a mouth masks.

Also, the number of pathogens must be large enough to be able to trigger an infection.

This means that not every contact with blood necessarily results in an infection, provided that the appropriate precautionary measures are taken. This again demonstrates the importance of proper staff training so that attention is drawn to the potential risks and to the appropriate protective measures.

The risk of infection through blood can also be reduced by the following measures:

The amount of blood taken for analysis can often be reduced further. Work in the laboratory can largely be made by automatic instruments.

The vessels in which blood is stored must comply with well established criteria. In this context it is advisable to change from glass to plastic for the container material to avoid the risk of injury through glass breakage. The personnel should be well informed on the properties of the correct vessels and containers.

If changes in the work processes are introduced, the personnel must be adequately informed and special risks must be pointed out.

Blood bags over the use-by date must not be placed in waste fractions which are later compressed.

Whenever possible, blood should be discharged into the sink. To do so, the sinks may have to be modified to prevent liquid splatter.

Condition 4: Leakages and outpourings of liquids from disposal containers must be avoided to the largest extent possible

For hospital waste which is to be disposed of as domestic waste, it is important that liquid waste is kept well away from this waste flow. An adequate number of containers for liquid waste and/or facilities for emptying containers must therefore be provided which allow blood and other body fluids to be discharged without the risk of contamination.

The persons in charge should also check if there are any problems in the hospital with liquid waste so that an ad hoc decision can be taken whether special containers need to be provided for the disposal of liquids or whether the liquids can be discharged via the sink. The points where waste collectors secured against liquid leakages need to be placed should also be determined at this stage.

To check if the operating instructions laid down for the waste separation are actually observed, it is important that the origin of the waste can be identified.

The use of suction or vacuum systems which are intended for multiple use and which are therefore designed to be emptied will also help to keep liquid out of the other waste fractions.,

In-house training seminars and meetings for the staff should be organised where information on the correct disposal of liquids are given and where known problems encountered during work are discussed.

Condition 5: The generation of aerosols should be avoided as far as possible.

Aerosols also carry the risk of transmitting diseases from waste material. There are as yet no adequate scientific findings on the extent to which aerosols are involved or instrumental in the practical waste disposal in hospitals.

In any case, the liquid content of the waste and the nature and duration of the storage have some bearing on the subject of aerosols. Spore formation is not expected under short-term storage. This is particularly important for the period of time in which the waste containers are being filled. The waste containers should therefore have a suitable volume capacity which matches the amount of waste over time.

Transporting open containers should be avoided.

Containers which are to be reused must be checked for contamination and cleaned/disinfected at regular intervals.

Waste collected in bags should not be compacted or compressed before the bags are fully sealed. Also, the volume of air trapped when sealing the bags should be as small as possible. This can be supported by providing appropriate bag holders, but proper handling by the personnel is an absolute requirement. Staff training is

therefore also required for this subject field. The appropriate information should also be provided for the employees.

To avoid aerosols and to prevent the risk of liquid leakages, waste material likely to pierce the wall of the container should be disposed of separately.

Aerosols can also develop when emptying containers. Liquids should therefore not be poured into the sink too quickly and from great heights. Technical improvements to the drains and sinks offer some scope for progress.

The workplaces with potential aerosol pollution should be determined in order to provide the personnel with the appropriate protective equipment.

Condition 6: Direct contact between humans and waste must be reduced to an absolute minimum.

As addressed under condition 2 above, disposal logistics which prevents the direct contact between humans and waste to the greatest possible degree allows for a higher standard of safety in waste disposal.

For this reason the disposal path from collection to the final stage of disposal should be investigated to see if there are any technical possibilities for avoiding the direct contact with the waste. Examples herefore are automated transport systems, mechanical reloading equipment or a minimum number of container changes.

Wherever possible, the waste should be collected in suitable collection bins as soon as possible after the waste is generated.

Containers should be sealed before transport.

The safety of disposal can also be enhanced by setting up suitable barriers, whether by selecting the type of container, the location of the containers, straps or other holding devices around the containers, and by providing protective equipment for personnel.

Sorting the waste by hand after it has been thrown into the waste container should be ruled out. (see also condition 7). Waste intended for recycling should therefore be collected separately only at the point of generation.

When loading the waste on lorries or when feeding the disposal plant, contact between humans and waste should be kept to a minimum. This also requires appropriate training for the personnel of the disposal firms.

Condition 7: Waste must not be sorted manually.

The contracts with the disposal firms should stipulate that the waste originating from the hospitals must not be sorted manually, unless the waste has first been disinfected.

The hospital staff should also be informed and instructed that waste, once it has been put in the waste containers, must not be sorted by hand. This must be observed, in particular, in connection with the sorting of material intended for recycling. This means that waste may only be sorted immediately after its generation, never later.

The system of separate collection must be optimised such that the different waste fractions are not confused. This can be achieved by the design of the containers, the lids/openings and the distribution of the containers in the different working areas.

Containers must be closed/sealed before transport, and the transport must be handled by trained and qualified personnel.

During storage of the waste and also during the forward transport of the waste outside the hospital, every precaution must be taken to prevent unauthorised persons from gaining access to the waste.

The use of mechanical devices for emptying the containers, whether during refilling into larger containers or at the end of the disposal chain, will help to prevent the manual sorting of the waste.

Condition 8: Waste must not contain hazardous substances such as dangerous chemicals or cytostatic agents

The correct waste separation which must result in dangerous substances being disposed of separately large depends on the knowledge level of the personnel. This is why training seminars where the identification of hazardous substances, their correct handling and their correct allocation during waste disposal are conveyed, are an indispensable element. To make sure that the personnel can clarify certain issues immediately and on site, the seminars and training sessions should be accompanied by suitable information material. Training ought to be offered separately for the various professional groups to deal with the specific requirements of the different working areas.

The persons responsible should find out which dangerous substances are used / are generated in the different working areas. They can then ensure that the required information on these substances is available and that suitable disposal containers are provided at the point of waste generation. Waste separation can be made easier by spatially separating the waste containers for the different waste fractions, both during collection, storage and transport. A room specially designed for the storage of hazardous waste is necessary and sensible. The waste quantities should also be recorded with as much detail as possible via this central disposal point.

The relevant legal regulations in their current version must be observed and maintained on every level of disposal. Directive 98/24/EG on the protection of health and safety of employees from risks of chemical working substances at work

must be implemented in national law by the members states by 5 May 2001. This directive may also lead to different requirements in hospitals.

The principle of avoidance applies generally to hazardous substances. The search for harmless alternatives should be upheld continuously by using information on the use and the quantity of hazardous substances. Since many areas of the hospital are involved in these activities, the appointment of a special study group is recommended.

Condition 9: Waste storage must not become a source of health hazards.

Detailed instructions resting on the known hazard features of the substances are usually available for the storage of hazardous substances. On the other hand, the requirements for the storage of domestic waste are often not specified in detail.

As a matter of principle, the storage of domestic waste should also be subject to certain safety standards.

For instance, waste should be stored in the departments for the shortest possible time only. The storage rooms and/or the containers in which domestic waste is stored should be accessible only to authorised personnel and should be located well away from other stores. Precautions in case of fire and in case of leakages ought to be taken. If the waste is stored outdoors, protection from exposure to direct sunlight is recommended. Animals should also be denied access to the waste. Adequate lighting and ventilation must be ensured.

The speed with which pathogens procreate in the waste and whether they increase or decrease in number when in competition with other micro-organisms warrants further scientific investigation. For reasons of abating odour nuisance alone, the storage duration of waste should be adapted to the prevailing climatic conditions. The recommended mean times are 48 hours in summer and 72 hours in winter for moderate climate regions.

The different waste fractions should be strictly separated to prevent mistakes, e.g. if the waste is loaded by inadequately trained personnel.

Condition 10: Waste must not cause technical/operational disruptions during waste disposal outside the hospital.

Meeting this condition requires good cooperation between the hospital and the disposal firms. The disposal firm ought to specify which substances must not be dumped together with domestic waste because operational disruptions may be expected. These criteria must be included in the separation concept of the hospital and be addressed in the training seminars. The separate disposal of liquids and hazardous waste is recalled at this point. If the waste is to be incinerated, spray cans should not be disposed of together with domestic waste. The concentration of certain materials (e.g. tin cans, glass or napkins) can lead to problems resulting from an excessive specific weight or from mechanical resistance.

Condition 11: Origin and nature of the waste must be identifiable and traceable.

To be able to draw the necessary conclusions from problems encountered in the disposal of hospital waste, it is important to know the origin of the waste. An easy solution is marking the waste bags with the most important details such as name and address of the hospital and the type of the waste inside the container or bag. The exact origin from within the hospital can also be shown by attaching labels or adhesive tape used for sealing the bags.

With the option of being able to determine the origin of the waste, past problems in the allocation of waste can be used much better for future internal improvements. Since subsequent controls can be made, the discipline and care taken in the waste separation can be enhanced.

This is particularly important in cases where an inadequate waste separation endangers the waste disposal personnel.

Regarding the methodical course of action within the above mentioned safety concept, the suggestion has been voiced to oblige the hospitals to specify how they intend implementing these criteria in practice the respective hospitals. The disposal concept of the hospital could so be improved in close consultation with the relevant controlling authorities. Evaluating the disposal concept from different hospitals could provide important impulses for general improvements in the disposal practice.

Actions for implementing, controlling and developing the disposal practice

The measures which may contribute to the implementation, control and further development of the disposal practice are outlined on the following pages. The suggestions and proposals have been submitted to all project partners for discussion and evaluation.

Forming an interdisciplinary study group on the subject of waste disposal and the documentation of problems and accidents was considered one of the most important measures.

Experience has shown that the disposal of waste can no longer be considered a purely technical problem and that every department and professional group must make its contribution towards correct and proper disposal. An interdisciplinary study group (whose composition proposals by the project partners will be presented later) will be an important link in the organisation and control of the waste disposal.

Since problems, incidents and accidents are relatively common during the disposal of waste, it is important to establish the systematic recording procedure of the incident and its causes. Only complete and meaningful information will result in improvements in the disposal practice.

Annual reporting procedures on the status of waste disposal and the formation of a control team which regularly appraises the practical waste disposal in the different departments and documents its findings were discussed as another important aspect of waste disposal. These measures promote the continuous development of the waste disposal or, at least, secure the status quo. This means that the subject of waste disposal experiences an upgrade in priority and importance in the hospital and becomes a recurring topic of discussions.

Another option for strengthening waste disposal in terms of organisation is the appointment of a contact person for waste issues in every department of the hospital. This person may also act as central exchange and distribution point for the flow of information. This approach is designed to enhance the awareness and the sense of responsibility in the different departments for the waste generated by these departments. Since this person is familiar with the working conditions in the respective department, he or she should also cooperate in the identification of problems and accidents.

Irrespective of the investigations of the control team, a certain degree of self-control may also be established in the departments. This instrument is also designed to strengthen the initiative and the sense of responsibility of the members within the departments. Self-control may help the staff members to search for specific improvements in the disposal practice of their working area. Random samples can be used, for instance, to determine the waste quantity in one's own department, or a survey among the staff members can be conducted to locate problems and to find ways of improving waste disposal.

Proposals and suggestions by staff members which will make the disposal easier, simpler, safer, more cost-effective or more environmentally friendly should be honoured in a suitable manner.

11. Interdisciplinary study group "Waste Disposal"

The proposal for the composition of the study group differed to some degree, with the effect that a rough overview will be presented at this point.

The following members of the study group were envisaged in all proposals:

- a doctor from the area of industrial medicine
- the hygiene sector, represented by a member of the nursing staff and/or a doctor
- the technical sector, represented by a staff member from waste disposal and/or of the cleaning service

the following were named in most cases:

- a doctor from standard ward work

- a member of the nursing staff from standard ward work
- the environmental protection expert, if appointed

named only once:

- a member of staff from Purchase
- the hospital director
- staff members from the laboratory
- a member of the administrative staff for financial affairs

For the purpose of waste avoidance, it also makes good sense to include a member of staff from Purchase in the study group.

11.1.1 Duties of the study group "Waste Disposal"

The following duties of the study group were named:

- the study group is to deal with issues relating to safety in handling waste, in particular with the handling of sharps, chemicals and infectious material.
- the group is to draw up a definition for the classification of waste which allow a clear distinction of waste to be made as either infectious or as domestic.
- the group is to critically examine the infrastructure of waste disposal and to contribute to its improvement, e.g. by testing new containers or transport trolleys, etc.
- the group should also promote and encourage the exchange of experiences among the hospitals.
- the group should check if the current disposal practices generally comply with statutory regulations and if these are actually implemented in the everyday activities of the hospital departments.
- the group is to assist in staff training with respect to the different aspects of waste disposal.
- the group is to keep injury statistics relating to waste disposal and draw up an annual report.
- the group should submit an overview of the financial situation in waste disposal, whether by way of savings potentials through waste separation, disposal charges for the individual fractions or the financial budgeting for the years to come.

- the study group should draw up indicators allowing the evaluation of the waste disposal.

The composition and duties of the study group "Waste Disposal" are to be understood as basis for discussions which need to be adapted to local conditions depending on the local organisational structure of the different hospitals.

12. Support measures from outside the hospital

The following measures should support the safety concept of the hospital from the outside.

The control of the disposal firm was seen as the most important support because it is very difficult for hospitals themselves to control and supervise the work of the disposal firms.

Also, the quality of the waste collection and transport containers should be more standardised and controlled. Both the area of waste transport and of waste collection should be included in these control measures.

The cooperation with other hospitals can provide many valuable impulses for improving the waste disposal. Exchanging information on the different charges for waste disposal from hospitals will also help to strengthen the position of hospitals in their contract negotiations with companies.

The assessment of the waste disposal practice by outside experts can also be helpful to draw on new ideas. This is an element which is envisaged anyway as part of an environmental management system.

13. Annex

13.1 Definitions of infectious waste

France:

French ordinance no. 97-1048 6/11/1997 on the disposal of body parts and infectious waste from the public health sector.

ArtR.44-1: Waste from the public health sector is waste originating from the diagnosis, monitoring and prevention, curative or lenitive activities in the area of veterinary and human medicine. Waste subsumed under the above ordinance are waste materials which:

1. constitute a risk of infection by containing viable micro-organisms or their toxins of which it is known or reasonably suspected that, by virtue of their nature, their quantity or their metabolism, they may cause diseases in humans or living organisms.

2. even if not infectious, but belonging to one of the following categories:

sharp objects and materials destined for disposal, irrespective of whether they have come in contact with a biological product;

blood products beyond the use-by date for therapeutic use;

visually identifiable human body parts.

Waste from teaching, research and industrial production in veterinary and human medicine, also waste from pathology if they have the above properties under 1. and 2., belong to waste from the public health sector and are subject to this ordinance.

Catalonia (Spain):

Group III:

Non-specific waste from the public health sector *is waste which must be handled, collected, transported and disposed of within and without the hospitals with due regard to preventive and protective measures* ***because it constitutes a fundamental risk for employees and for public health***

These materials include: liquid blood and blood products, needles and sharp objects, live and attenuated vaccines, body parts (with the exception of corpses and identifiable human body parts from miscarriages, mutilations and surgical operations), infectious laboratory cultures, infectious animal waste ***and any kind of waste material from the public health sector likely to cause infections with the following diseases: (infectious material named in the brackets)***

Haemorrhagic fevers caused by viruses*: Congolese red fever, Lassa fever, Marburg, Ebola, Junin, Machupo, Arbo-virus, Absettarow, Hanzalova, Hypr, Kumlinge, Kiasanur-Fores disease, Omsk fever, Russian spring-summer encephalitis (any kind of human secretions, excrements, etc.);*

Brucellosis *(pus);*
Diphtheria *(diphtheria of the respiratory system: respiratory secretions, diphtheria of the skin: skin secretions);*
Cholera (*excrements),*
Creutzfeld-Jacob disease *(excretions),*
Borm *(skin secretions),*
Tularaemia *(tularaemia of the lung: respiratory secretions, tularaemia of the skin: skin secretions),*
Anthrax *(skin anthrax: pus, lung anthrax: skin secretions),*
Plague *(bubonic plague: pus, pneumonic plague: respiratory secretions),*
Rabies *(respiratory secretions),*
Q-fever *(respiratory secretions),*
Active tuberculosis *(respiratory secretions)*

Germany:

Group C: *Waste which, under the aspect of infection preventions, requires special care during disposal inside and outside public health (so-called infectious, contagious or highly contagious waste):*

Waste required to be treated pursuant to § 10a Federal Epidemic Law. This is the case if the waste carries pathogens of transmittable diseases requiring registration and if the spread of the disease must therefore be expected.

The necessity of additional requirements (e.g. separate collection, disinfection) is defined by the nature of the pathogens with respect to their contagious aggressiveness, survival capability and transmission routes, the extent and the nature of the contamination, and the waste quantity.

At the present state of discussions, waste of this group can cause the following diseases:

Cholera, diphtheria, leprosy, tularaemia, anthrax, typhoid, paratyphoid, virus-induced haemorragic fevers, plague, brucellosis, smallpocks, meningitis/ encephalitis, poliomyelitis, Q-fever, dysentery, farcy, rabies, tuberculosis, viral hepatitis

Waste of this kind can, for instance, be generated in infection wards, dialysis wards and dialysis centres with yellow dialysis, pathology departments, blood banks and doctors' surgeries and in veterinary surgeries and hospitals. This is usually waste generated during the treatment of patients, e.g. material contaminated with secretions or excretions containing pathogens; packaging

materials are normally not included. This waste also includes microbiological cultures generated in hygiene institutes, microbiology and virology, as well as in laboratory medicine and in doctors' surgeries with the appropriate activities.

United Kingdom

Ordinance on waste requiring supervision 1992 (SI 1992/588)

Hospital waste is:

a. any waste consisting in whole or in part of the following components: human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs ordressings, syringes, needles or other sharp instruments hazardous for persons coming into contact with such waste unless it has been first safely treated. Also:

b. any other waste from treatment, care, dental medicine, veterinary medicine, pharmacies or similar facilities, the examination, treatment, teaching or research, blood donations which can cause infections in persons coming into contact with it.

In Nottingham, the fraction of the hospital-specific waste is internally subdivided into five sub-fractions, although all fractions are incinerated together externally.

Group A: Contains the following components: identifiable human tissue*, blood, animal carcases and tissue from centres of veterinary medicine, hospitals and laboratories.

Soiled surgical dressings, swabs and similar polluted waste.

Other waste, for instance from patients with infectious diseases, except those belonging to Group B-E.

Group B: Used syringe needles, cartridges, broken glass and other contaminated sharp objects or instruments to be disposed

Group C: Microbial cultures and potentially infected waste from pathology and other clinical or research laboratories.

Group D: Drugs and other pharmaceutical products.

Group E: Items used for the disposal of urine, stool or other bodily secretions or excretions and which do not belong to Group A. These include used disposable bedpans or bedpan linings, incontinence drawsheets, urine bags and urine bottles. **

* All identifiable human tissue, whether infected or not, must be incinerated.

** If the risk assessment shows that there is no risk of infection, waste of Group E is not counted among the clinical waste.

13.2 Further literature

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