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**HANDLING AND MANAGEMENT OF HOSPITAL  
WASTES**

Master Thesis

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## **Abstract**

Each hospital deals with problems of waste. The conduction of treatment with waste materials is left to the discretion of each hospital individually. Due to the disorganisation and large costs regarding the handling of waste in the health sector, the problems associated with the management and handling of wastes is being resolved only gradually. Adopted legislation has aided considerably in speeding up the creation of solutions to the problems of waste management. Nevertheless, it is the institutions themselves which can contribute most to resolving this issue.

In the following study, the situation regarding treatment of waste in the hospital of Maribor is shown. Our goal was to lower the quantity of waste as well as the costs associated with the uneconomical treatment of waste.

The study shows technical possibilities, quantities of waste arising from healthcare and the costs associated with them. Additionally, organisational capacities and the route to processing wastes are displayed. Compared to Landeskrankenhaus Universitätsklinikum Graz (LKH University Clinic Graz) we have as yet done too little in regard to treatment of waste.

The study has shown that with proper management of waste we can lower also the bigger costs associated with transport and destruction of wastes. In the future, it will be necessary to attend to the material and energy utilisation of waste, depositing as little waste as possible to landfills.

## **Key words**

Waste, hospital waste, treatment of waste, management of waste, healthcare, environment

## **Izvleček**

Vsaka bolnišnica se sooča s problematiko odpadkov. Vpeljevanje in vodenje sistema ravnanja z njimi je v Sloveniji prepuščeno vsaki bolnišnici posebej. Žal se problem ravnanja in gospodarjenja z odpadki rešuje počasi, predvsem zaradi neorganiziranosti in velikih stroškov, povezanih z ravnanjem z odpadki. K hitrejšemu reševanju problemov na tem področju je veliko pripomogla sprejeta zakonodaja, ki sicer veliko pripomore k hitrejšemu reševanju problematike odpadkov v zdravstvu, realno pa kljub vsemu lahko največ stori vsaka institucija sama.

V pričujoči študiji je prikazano vpeljevanje sistema ravnanja z odpadki v bolnišnici Maribor. Za cilj smo si zadali zmanjšati tako količino odpadkov, kot tudi zmanjšati stroške povezane z negospodarnim ravnanjem z odpadki.

Za dosego omenjenih ciljev smo uvodoma pregledali stanje na področju ravnanja in gospodarjenja z odpadki pred pričetkom pilotske študije, v nadaljevanju izvedli enoletno pilotno študijo, ter na koncu prikazali njene rezultate oziroma ekonomske učinke.

V študiji so prikazane tehnične možnosti, količine odpadkov nastalih v zdravstvu in stroški povezani z njimi. Prikazane so tudi organizacijske možnosti, in poti procesiranja odpadkov.

Opravljena je bila tudi primerjava sistema ravnanja z odpadki z bolnišnico v Grazu, Landeskrankenhaus Universitätsklinikum Graz (LKH University Clinic Graz), pri kateri smo ugotovili precejšnje zaostajanje bolnišnice Maribor na področju ravnanja z odpadki.

Študija je pokazala, da lahko s pravilnim gospodarjenjem z odpadki zmanjšamo tudi velike stroške, ki so povezani z odvozom in uničevanjem odpadkov.

V bodoče bo potrebno poskrbeti za še boljšo snovno in energetska izrabo odpadkov in čim manj odpadkov odlagati na deponijo.

## **Ključne besede**

Odpadki, bolnišnični odpadki, ravnanje z odpadki, gospodarjenje z odpadki, zdravstvo, okolje

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## List of abbreviations

EU:	European Union
OG RS	Official Gazette of the Republic of Slovenia
ZVO:	Environmental Protection Act
NEPP:	National Environmental Protection Program
MGH:	Maribor General Hospital
PVC:	Polyvinyl chloride
PE:	Polyethylene
TS:	Department of Thoracic Surgery
OP:	Operating room
OP 3:	Operating room 3 – Department of General and Abdominal Surgery
OP 7:	Operating room 7 – Department of General and Abdominal Surgery
OP SEPTICS:	Septics operating room
OP CARDIAC:	Operating room – Department of Cardiac Surgery
LKH–UK Graz:	Landeskrankenhaus - Universitetsklinikum Graz

## **1. INTRODUCTION**

Waste originates everywhere where there is production, consumption, work and dwellings. The growth of populations, and increasingly more intensive implementation of economic and other processes are the reason why the amount of waste is steadily increasing among which, there are also those types of wastes harmful to the environment.

Wastes in the healthcare industry evolve from processes of healthcare and hospitalisation of patients. Large amounts of wastes arise daily and their handling presents a large material cost for healthcare institutions. The healthcare industry had closed its eyes for a long time to the problem of adequate handling of waste paying no regard to it, for the basic activity of hospitals is to treat patients!

It was only legislative implementation, defining the handling and management of wastes in healthcare that led to this activity sector realising the seriousness of the problem of hospital wastes. An additional factor leading to increased awareness was that with regard to classic disposal, for example infectious waste sent to disposal facilities can cause infections to people outside of the hospital, in short creating a serious problem for the environment.

The realisation that wastes today represent marketable goods and that locations for depositing wastes are becoming an increasingly more expensive natural resource demands a different approach to the handling and management of wastes. The healthcare sector has realised that too much waste is deposited at landfills which plays a large role in polluting soil and water, particularly when quantities are large and handling of them, inadequate. They have also comprehended that the consequence of inappropriate treatment of waste has long-term effects and that these can be perceived immediately and directly.

With Slovenia's membership in the European Union (hereinafter: the EU), the problems associated with waste handling have become more critical, while costs associated with them have grown.

However, we can, through proper waste handling and management in healthcare lower not only costs, but simultaneously, protect the environment, preventing the possibility of potential contaminations caused by waste.

The aim is for a fundamentally reduced amount of wastes ending up at landfills, and if unavoidable, should include only wastes selected according to thorough selective processes.

### **1.1. Fundamental principles and goals for handling of wastes in healthcare**

More and more, healthcare officials are realising the necessity of changing their relationship to the environment. Environmental awareness must be raised, both that of the staff and that of the patients. It's a fact that in the future wastes will no longer be able to be handled as they are now. As a result of an increasing amount of resulting waste, and the costs associated with this increase along with problems of environmental burdening, it will become imperative to introduce changes that will lead to a positive treatment of environmental legislation, in short, without causing additional financial burdens.

For proper waste treatment and management in healthcare, the following goals and fundamental principles must be set. These are, at the same time, basic strategic principles for handling waste in the Republic of Slovenia:

- set up an efficient system for handling wastes in healthcare organisations,
- decrease the generation of wastes and their potential dangers at their source,
- prevent possible harmful effects of waste from healthcare establishments on the environment,
- prevent risks of infection and harm to persons having contact with wastes,
- resolve waste problems at their source,
- design preventative measures, and
- respect the rule of return to nature.

The basic starting point should be that healthcare use as many items as possible made from materials which were once waste products, simultaneously arranging the handling of waste in a way which would allow ensuing waste to be reused or reprocessed to as great an extent as possible.

The main goals for developing waste treatment and management in healthcare establishments should be:

- Decrease the amount of waste for deposit to landfills.
- Reduce costs through an individually designed logistics management system for each type of waste separately.

To achieve these goals the following measures should be implemented:

- Monitoring the quantity of generated wastes and determination of their actual status.
- Forming a team responsible for protection of the environment.
- Improving the separation of paper, glass, metals and plastic.
- Introducing of the transparent separation of wastes (e.g. coloured containers for waste collection).
- Purchasing of environmentally suitable and safe substances.
- Lowering the frequency of waste transport by department (e.g. once daily instead of two or three times a day as performed currently).
- Introducing of an electronic records management system for wastes which would allow for waste track-keeping and comparison of generated quantities of wastes.
- Restructuring of the existing transport and logistical system of disposed wastes.

The resolution of the problems of wastes in healthcare is to decrease the production of wastes thereby reducing the danger to humans and minimising the impact on the environment.

In order to reach these goals, the recycling and reuse of waste and recovery of energy from waste must be increased, and also an optimal mode of final deposit of wastes whose material characteristics are of no benefit, implemented.

When wastes arise, they must be handled in a way that insures their safe final disposal.

## 2. OVERVIEW OF EXISTING LEGISLATION

### 2.1. National Slovenian regulations

In Slovenia, the protection of the environment is regulated by the Environmental Protection Act (ZVO) which was published in the Official Gazette of the RS, No. 39/06. It replaced the law of 1993. One of the main reasons for adoption of the new law instead of only supplementing or amending the old one was the adaptation to the European legal order in the field of environmental protection. The new law introduced a more uniform terminology harmonised to that of the European Union.<sup>1</sup>

Key executive acts regarding the treatment of waste are the Rules on the Management of Waste which is harmonised with EU directives on waste, defining the mandatory management and other conditions for waste collection and transport and the processing and removal of waste. Important is the provision that waste must be processed when technical and other possibilities exist as well as removing waste which can not be processed in such a way which will not excessively burden the environment.<sup>2</sup>

The rules define the classification of wastes and hazardous wastes while also prescribing the mandatory recordkeeping and monitoring of waste management by keeping records. It also defines that producers of wastes are required to have a waste management plan if the annual quantity exceeds 150 tons of waste and/or 200 kg of hazardous waste. Each year, by 31 March, a report on waste must be prepared if the annual quantity exceeds 5 kg of hazardous waste and/or 80 tons of other waste.

The Rules on the management of waste originating from healthcare activities and subsequent research<sup>3</sup> is a regulation which prescribes in detail, the mandatory management of waste originating from healthcare activities and all research related. Provisions of the Rules are not used for body parts and organs, inclusive of blood bags and conserved blood and for waste dental amalgams.

Producers of waste are required to ensure the delivery of medical waste to waste collectors. The producer must ensure that medical waste be transported within the area in which health care activities are carried out only in such appropriately-marked containers and bags intended for the storage of medical wastes. Only transportation modes intended for the transport of these types of wastes can be used. Waste producers must name an authorised person who will carry out all prescribed tasks. The Rules also set forth the conditions for the set up of collectors intended for storage of these wastes. Furthermore, the Rules define the collection and removal of wastes originating from health care activities.

The Rules obligates Heads of health care establishments to prepare and implement waste management plans for wastes arising from health care activities. These plans must be prepared for a period of four years, reviewed annually and financially evaluated.

Decree on management of packaging and packaging waste<sup>4</sup> was adopted in order to regulate the area of packaging and waste packaging in Slovenia. These Rules define handling the production, transport and use of waste packaging and subsequent collection, reuse, recycling and removal of waste packaging. The Rules apply to all packaging put into circulation and all waste packaging originating in industries, by craftsmen, and other trade services and activities.

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<sup>1</sup> Environmental Protection Act (Official Gazette of the RS, No. 39/06; Zakon o varstvu okolja (Ur. l. RS št. 39/06)

<sup>2</sup> Rules on the management of waste (Official Gazette of the RS, No. 84/98; modifications and amendments - Nos. 45/00, 20/01, 13/03; Pravilnik o ravnanju z odpadki (Ur. l. RS št. 84/98, 45/00, 20/01, 13/03)

<sup>3</sup> Rules on the management of waste generated by health services and related research activities (Official Gazette of the RS, No. 47/04); Pravilnik o ravnanju z odpadki, ki nastanejo pri opravljanju zdravstvene dejavnosti in z njo povezanih raziskavah (Ur. l. RS št.47/04)

<sup>4</sup> Decree on management of packaging and packaging waste (Official Gazette of RS, No. 84/06); Uredba o ravnanju z embalažo in odpadno embalažo (Ur. l. RS št. 84/06)

Decree on the landfill of waste<sup>5</sup> prescribe the mandatory management of landfills and conditions and measures connected with the planning, construction, operation and closure of landfills and subsequent steps to be taken upon their closure. Waste must be assessed and given an appraisal of their important characteristics. This is known as waste estimation.

Waste estimates must include a denotation with the name or description of the waste and its characteristics, estimated admissibility for removal to landfills, an assessment of the expected consequences, the characteristics of the disposed waste and a description of prior or additionally required processing of the waste and determination of any hazardous characteristics as defined in Rules on the landfill of waste.

The Order for the management of separately collected fractions in the public service of urban waste management<sup>6</sup> defines the minimum scope and contents for management of separately collected fractions which must be ensured within the scope of local public service regarding the management of municipal waste. Management includes the separate collection of fractions as a part of municipal waste originating in the area of the local community as household waste and due to their nature and make up, household waste similar to industrial or commercial waste regarding activities by craftsmen and other service providers, inclusive of the waste packaging all considered urban waste.

The Decree on environmental tax for environmental pollution caused by waste disposal<sup>7</sup> prescribes the amount, manner of calculation, assessment and payment of taxes for environmental pollution for disposal of wastes and the measure and conditions for refunding remitted environmental tax.

The aim of the tax for environmental pollution is to acquire funds for the execution of operative programs of environmental protection in the area of municipal waste management including the creation of prepared works for the construction and implementation of infrastructure facilities for the incineration of municipal waste.

The environmental tax ensures the decrease in the quantity of waste at its origin, the disposal of as little waste as possible, the decrease in the quantity of biologically degradable waste, the acceleration of separation of collections of individual fractions of municipal waste intended for processing, or respectively recycle and a gradual increase in the scope of reprocessing and utilisation of waste.

The Contagious Diseases Act<sup>8</sup> treats measures for preventing and managing contagious diseases. The prevention and management of hospital diseases is prescribed in Article 44: Each natural or legal person performing a health activity must implement a program for the prevention and management of hospital infections. The program is prepared by expert management of the organisations performing health activities. The program must contain doctrines on sterilization, disinfection, cleaning and handling of wastes.

The Health Inspectorate carries out inspections supervising the implementation of laws and regulations also in the area of infectious wastes which originate while performing health care activities. The Health Inspection Act<sup>9</sup> obliges the inspector to carry out inspection and upon having performed an inspection, to prescribe the procedure for getting rid of any irregularities. Most often, inspectors will perform the ridding of irregularities through a decision.

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<sup>5</sup> Decree on the landfill of waste (Official Gazette of the RS, No. 32/06; Uredba o odlaganju odpadkov na odlagališčih (Ur. l. RS št.32/06)

<sup>6</sup> Order on the management of separately collected fractions in the public service of urban waste management (Official Gazette of the RS, No. 21/01); Odredba o ravnanju z loženo zbranimi frakcijami pri opravljanju javne službe ravnanja s komunalnimi odpadki (Ur. l. RS št. 21/01)

<sup>7</sup> Decree on environmental tax for environmental pollution caused by waste disposal (Official Gazette of RS, Nos. 129/04, 68/05, 28/06); Uredba o okoljski dajatvi za onesnaževanje okolja zaradi odlaganja odpadkov (Ur. l. RS št. 129/04, 68/05, 28/06)

<sup>8</sup> Contagious Diseases Act (Official Gazette of RS, No. 69/95, 112/04, 33/06); Zakon o nalezljivih boleznih (Ur. l. RS št. 69/95, 112/04, 33/06)

<sup>9</sup> Health Inspection Act (Official Gazette of RS, Nos. 36/04, 47/04 – official consolidated text); Zakon o zdravstveni inšpekciji (Ur. l. RS št. 36/04, 47/04)

The Rules on the incineration of waste<sup>10</sup> defines the mandatory treatment and other conditions for the incineration of waste and the conditions and measures regarding the design, construction and operation of a waste incinerator. The incineration of hazardous waste in incinerators is only allowed based upon an assessment of the wastes' characteristics for incineration. This assessment for hazardous wastes must contain:

- a denotation, name and description of the wastes and their physical and main chemical characteristics,
- a description of dangerous characteristics of the wastes in accordance with regulations covering the management of wastes and hazardous substances with which the wastes may not be mixed,
- an evaluation of the admissibility and suitability of these wastes for incineration,
- a description of the preliminary needs of processing wastes prior to incineration or a detailed explanation on the omission of preliminary processing and
- indication of the required safety measures regarding the handling of wastes prior to incineration.

The formation of an evaluation of hazardous wastes must be supplied by the holder of the wastes being submitted for incineration.

The Rules on the classification, packaging and labelling of dangerous substances and the Rules on the classification, packaging and labelling of dangerous preparations<sup>11,12</sup> define the marking and storage of hazardous substances and whether they should be recycled or destroyed. Each packaged unit of dangerous substances/preparations must be clearly and legibly marked with the following data:

- Chemical names of dangerous substances/preparations (waste);
- Name, full address and telephone number of legal and physical persons placing dangerous substances into circulation within the Republic of Slovenia;
- Graphic mark (symbol) depicting the danger, letter symbol depicting the danger and a description warning of the danger;
- Standard warning R;
- Standard warning S;
- Classification number of the waste type;
- Nominal quantity of substances in the packaging, or respectively the weight of the waste.

Minimal expert, organisational and technical conditions for the preparation and implementation of the programme for prevention and management of hospital infections are defined by the Rules on the conditions for preparation of the programme for the prevention and management of hospital infections<sup>13</sup>. The hospital, in order to implement this program, must fulfil minimum technical requirements of these Rules, including those for collection, transport and disposal of wastes.

The Rules on storage, consignment, transport and disposal of unusable blood and blood preparations<sup>14</sup> define the procedures, manner of storage, release, transport and disposal of

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<sup>10</sup> Rules on the incineration of waste Official Gazette of RS, Nos. 32/00, 38/00, 53/01, 81/02); Pravilnik o sežiganju odpadkov (Ur. l. RS št. 32/00, 38/00, 53/01, 81/02)

<sup>11</sup> Rules on the classification, packaging and labelling of dangerous substances (Official Gazette of RS, No. 35/05); Pravilnik o razvrščanju, pakiranju in označevanju nevarnih snovi (Ur. l. RS št. 35/05)

<sup>12</sup> Rules on the classification, packaging and labelling of dangerous preparations (Official Gazette of RS, No. 67/05); Pravilnik o razvrščanju, pakiranju in označevanju nevarnih pripravkov (Ur. l. RS št.67/05)

<sup>13</sup> Rules on the conditions for preparation of the programme for the prevention and management of hospital infections (Official Gazette of RS, No. 74/99); Pravilnik o pogojih za pripravo in izvajanje programa preprečevanja in obvladovanja bolnišničnih okužb (Ur. l. RS št. 74/99)

<sup>14</sup> The Rules on storage, consignment, transport and disposal of unusable blood and blood preparations (Official Gazette of RS, No. 100/02); Pravilnik o skladiščenju, oddaji, prevozu in odstranjevanju neuporabljene krvi in krvnih pripravkov (Ur. l. RS št. 100/02)

these kinds of materials from organisations performing transfusions. The Rules define that unused blood and blood preparations may be disposed of as waste or upon defined conditions be used in laboratories, or respectively for research purposes.

The area covering transboundary shipment of wastes is regulated by the Decree of the EEC No. 259/93 of 1 February 1993 on the monitoring and control of consignments of wastes within the European Community, both internally and outside of the Community (Official Gazette of the RS, No. 30 of 6.2.1993, with all amendments). The Slovenian Decree on transboundary shipment of waste<sup>15</sup> prescribes the handling for the implementation of Council Directive 259/93/EEC and defines that it is prohibited to send consignments of wastes across Slovenia for their disposal in the soil or on it or to dispose of them on the sea floor except when this is in accordance with Council Directive 259/93/EEC.

The Resolution of the National Environmental Protection Programme<sup>16</sup> (hereinafter: NEPP) was adopted by Parliament in 2005.

It is a document which in its introduction states that the programme is not a collective wish, but an operationalisation of already adopted guidelines of the Environmental Protection Act and tasks from Agenda 21 or the European Environmental Protection Programme Towards Sustainability. This decision caused a number of clarifications during the preparation of the document because a mere repetition of known definitions without the support of suitable measures would not contribute to a more rapid resolution of the problems.

The problems associated with environmental protection, are by nature complex, their study is interdisciplinary and their solutions are linked to the harmonisation and active participation of numerous and diverse factors. One could approach environmental problems from the view of the surroundings in a narrower sense which would include economic development, the development of knowledge and technology. Each national programme, including this one, due to the complexity of the problems fails to answer many questions or merely leaves them to be integrated into the NEPP for solution by future generations.

The NEPP is focused on resolving the most important problems facing the environment but has, unfortunately, only taken the first step towards the long-term management of the problems of the relationship between nature and society.

## **2.2. International agreements**

The Act Ratifying the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal<sup>17</sup> was signed, or respectively ratified by those countries convinced appropriate measures were needed for the handling of hazardous wastes and other wastes. The import or export and disposal of such wastes must be in accordance with the protection of human health and the environment, regardless of the location of their disposal. These countries have also realised that dangerous wastes and other wastes should be disposed of in their countries' of origin if this is in compliance with environmentally safe and effective handling. Additionally, they recognised that the import or export of such wastes from countries of production to any other country is allowed only if transported under conditions which would not threaten human health or the environment and if they abided by the stipulations of these conventions.

The Act Ratifying the Basle Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted at the third session of the on 22 September 1995 in Geneva (Official Gazette of RS, No. 23/04).

Regarding the disposal of biologically-degradable waste, which also includes medical waste creating greenhouse gas emissions (e.g. methane) which for its quality solution, demands

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<sup>15</sup> Decree on transboundary shipment of waste (Official Gazette of RS, No. 101/04, 46/05); Uredba o čezmejnem pošiljanju odpadkov (Ur. l. RS št. 101/04, 46/05)

<sup>16</sup> The Resolution of the National Environmental Protection Programme 2005-2012 (Official Gazette of RS, No. 2/06)

Resolucija o nacionalnem programu varstva okolja 2005 – 2012 (Ur. l. RS št. 2/06)

<sup>17</sup> Act Ratifying the Basle Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Official Gazette of RS, No. 15/93, 23/04); Zakon o ratifikaciji Baselske konvencije o nadzoru prehoda nevarnih odpadkov preko meje in njihovega odstranjevanja (Ur. l. RS št. 15/93, 23/04)



adherence also to the provisions and decisions of the Convention on climate changes<sup>18</sup>, particularly its Protocol on the reduction of greenhouse gas emissions<sup>19</sup>. Slovenia has ratified the convention and signed the Kyoto Protocol.

### **2.3. European Union legislation**

With Slovenia's membership to the European Union (EU), EU legislation is now valid and is directly applied also in Slovenia.

Decrees of the EU are directly transferable to the Slovenian legal order, without the need for any amendments. They become valid upon the date of their translation into the Slovenian language.

EU directives (guidelines) are the most frequently used legal basis. Member states may only define the form or the directive with which it will manage the problems covered by the directive.

#### EU legislation

The European legal order or *Acquis communautaire* contains all the laws and regulations, political guidelines, practices and obligations which a member state adopted during the process of EU development on the basis of the Constitution. It is divided into thirty-one contextual areas, with twenty-two chapters covering the area of environment. New member states have had to adopt the entire European legal order prior to their entry into the EU.

Primary EU legislation consists of the Constitution and all its amendments, as well as the treaties of accession of new member states.

Treaty of Accession has the status of an international treaty and binds new member states to respect and implement the European legal order. Constituent parts are the Act of Accession, annexes, protocols and final decisions with declarations. The Act of Accession is the result of negotiations, adaptation to the EU legal order, a transitional period, exceptions, technical adaptations and other measures.

EU secondary legislation creates binding legal acts (decrees, directives and decisions/resolutions), as well as non-binding legal acts (recommendations, opinions, resolutions).

Regulations are general in nature and directly used and binding in their entirety. They are more legally binding than state regulations and are used for the purpose of creating a uniform system for all member states of the EU. Regulations are published in the Official Journal of the European Union, but not in the Official Gazette of the Republic of Slovenia!

Directives are the most commonly used acts of the EU. Their contents are binding for all member states. However, the manner or execution is left up to the members (e.g. as a law, regulation, rules...) and is only binding with regard to inclusion of the requirements. Member states may also adopt stricter measures than those specified in directives.

Decisions are directed at individual member states, organisations or even at individuals. They have a limited scope and use and focus on details, administrative demands or technical viewpoints from directives or regulations.

Recommendations only offer a suggestion on handling and are not legally binding; the same applies to resolutions which express the political will (opinion) after measures are taken in a specific area.

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<sup>18</sup> Convention on climate changes, Rio de Janeiro, 13 June 1990

<sup>19</sup> Protocol on the reduction of greenhouse gas emissions, Kyoto, 21 October 1998

#### Council Directive on waste<sup>20</sup>

This directive sets out guidelines on:

- encouraging the prevention, or respectively the reduction of waste production through:
- development and utilisation of clean technologies,
- utilisation of techniques and technologies having little or no influence on the environment and
- development and utilisation of techniques for final disposition of hazardous substances and for recycling.
- utilisation of recycling and reuse or any other process for:
- attaining secondary raw materials or
- using waste for energy production.

The directive lays down basic guidelines for ensuring a safer living environment and decreasing harmful effects on the environment (on water, air, soil, animals, plants, noise, rural areas).

EU member states will ensure an infrastructure which will allow for the safe disposition of wastes through the use of the best and most available technologies at reasonable costs. Each member state will itself ensure the safe disposition of its wastes. Each member state must report every three years to the competent commission of the European Union on the measures it is implementing to fulfil these directives. On the basis of these reports, the commission issues a joint report.

A constituent part of the directive also includes a list of wastes and hazardous wastes which in our legal order, constitutes a constituent part of the Rules amending the Rules on the management of waste and the Rules on the management of waste (Official Gazette of the RS, Nos. 20/01, 13/03).

#### Council Directive on Hazardous Waste<sup>21</sup>

Member states must ensure that the disposal of all hazardous wastes are identified and recorded. Simultaneously, they must observe all measures guaranteeing that hazardous wastes do not become mixed among themselves or with other non-dangerous wastes. Member states must also ensure the collection, transport and temporary storage of wastes which must be properly packaged and marked in compliance with valid international or European standards.

Companies involved in activities in which hazardous wastes arise must prepare a management plan which is publicly accessible and accessible also to the EU Commission which will review methods of disposal and recycling. In cases of danger or extraordinary circumstances, the member state must ensure that all necessary measures are taken so the hazardous wastes are disposed of in a manner which will not threaten humans or the environment. It must also inform the EU of all such events.

#### Council Directive on Landfills<sup>22</sup>

The chief goal of this directive is to impose strict operational and technical requirements for wastes and substances which are disposed of in landfills.

It ensures the measurements, instructions and guidelines for the prevention, or reduction of negative effects on the environment, particularly for surface waters, subsoil, soil and air and the global environment inclusive of greenhouse gas emissions, as well as every risk to human health related to the disposal of wastes, through the entire life-cycle of disposal.

#### Council Directive on the Incineration of Waste<sup>23</sup>

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<sup>20</sup> Directive on Waste (75/442/EEC & amendment 91/156/EEC, 91/692/EEC, 96/350/EC)

List of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste 2000/532/EC

<sup>21</sup> Hazardous Waste Directive (91/689/EEC)

<sup>22</sup> Council Directive on Landfills (1999/31/EC)

<sup>23</sup> Council Directive on the Incineration of waste 2000/76/EC

The purpose of this directive is to prevent, or limit negative effects on the environment such as pollution of the air and subsoil and to human health due to the incineration of waste.

This aim is achieved through strict operational conditions and technical requirements defining emission limit values for incineration facilities and the incineration of wastes. The incineration plant must be planned, outfitted and operated in a manner which complies with all the requirements of this directive for the category of waste which will be incinerated at the facility. The heat from incinerating wastes must be used for the pre-heating of wastes, for the preparation of steam or for heating the premises. By-pass waste must be stored as prescribed by national EU legislation.

Decision Setting up a network for the epidemiological surveillance and control of communicable diseases in the Community (2119/98/ EC)<sup>24</sup>

This directive sets forth a network of cooperation among member states under the control of the EU Commission for improving prevention and control over individual types of contagious diseases as defined in the annex. This network should be used as an epidemic control over these diseases, as an early warning system regarding the prevention, or respectively control over these diseases. It allows ongoing communication among competent national institutions which have in their position, data on epidemics and contagious diseases.

Pruss A., Giroult E., Rushbrook P. Safe management of wastes from health-care activities<sup>25</sup>

The World Health Organisation (WHO) has defined and classified medical wastes and the effects of medical wastes on health and the environment. In addition, WHO has developed guidelines for the preparation of legislation and political management of wastes. These prescribe the planning, handling and management of wastes and the measures for the reduction, recycling and reuse of wastes. They also prescribe the storage, transport, processing and technologies for the disposal of wastes. Also shown are the costs associated with wastes and the practice of protecting the health and safety of staff, visitors and patients.

The crowning law on waste management in Austria is the Abfallwirtschaftsgesetz 2002 (AWG 2002).<sup>26</sup>

This legislation also defines medical waste with the goals of protecting staff from injuries, infection, poisoning and negative effects on the environment. All staff must comply with these regulations.

Abfalle aus dem medizinischen Bereich (Medical Wastes)<sup>27</sup>

The Medical Waste Act prescribes the correct handling of wastes in health care services, the prevention of injuries, infections or poisoning of people by waste and threats to the environment. All employees must be acquainted with ONORM 2104 and observe provisions of the law during their work.

## **2.4. Important terms and definitions in Slovene and European regulations**

Enormous quantities of diverse wastes are produced in healthcare. Regulations in the area of waste management are for the most part, based on the Environmental Protection Act<sup>1</sup>. They meet the requirements of the European Community. The basic regulation covering waste is the Rules on the Management of Waste<sup>2</sup>. These rules supplement three subordinate groups of regulations. Regulations defining individual types of wastes (e.g. the handling of medical wastes, packaging wastes, batteries, construction materials, etc.) are in the first group. The second group contains the regulations covering facilities and equipment for handling wastes (storage, incineration), and the last group contains regulations on the transboundary passage of wastes.

Again, the legal order of the Republic of Slovenia must also comply with the guidelines of the European Community regarding the waste.

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<sup>24</sup>Decision Setting up a network for the epidemiological surveillance and control of communicable diseases in the Community ( 2119/98/ EC)

<sup>25</sup> Pruss A., Giroult E., Rushbrook P. Safe management of wastes from health-care activities, World Health Organization, Geneva 1999

<sup>26</sup> Abfallwirtschaftsgesetz 2002, Bundesgesetzblatt Fur Republik Osterreich (AWG 2002), issued 30.12.2004

<sup>27</sup> ONORM S 2104 Abfalle aus dem medizinischen Bereich, (Medical Wastes), 1.2.1999

### 2.4.1. Classification list of medical wastes

Within the entire legal system for waste management, the various types of wastes having a secondary nature are clearly defined. The classification list of wastes is a constituent part of the Rules on the Management of Waste<sup>2</sup>. It classifies them by origin, separating them into hazardous and non-hazardous waste groups.

The European Waste Catalogue and Hazardous Waste List is thus a list of both hazardous and non-hazardous wastes, classified by group according to their origin. Each waste type must, in addition to the given name, as well as a suitable classification number.

The classification number tracks waste from its origin to its final disposal and represents key data for all administrative procedures regarding waste management. The classification system encompasses twenty groups of wastes. For the correct classification of individual waste, its origin or the activity generating it must be known. This is shown by the first two numbers which represent the main group classification. The second two numbers identify the sub-group and a combination of all six numbers together, identifies the individual waste.

The European Waste Catalogue and Hazardous Waste List is a fundamental part of the waste management system. Through their classification, wastes are assigned defined fundamental conditions for their management. The most important is the classification of hazardous or non-hazardous because it determines the mode of management and level of control. Hazardous wastes are marked with asterisks next to their classification numbers.

#### 2.4.1.1. Classification list of medical wastes

The Rules on the management of waste generated by health services and related research activities<sup>3</sup> is a regulation which defines more detailed methods for managing the following types of wastes:

Waste classification no.	Name of waste
18	WASTES FROM HUMAN OR ANIMAL HEALTH CARE AND/OR RELATED RESEARCH (except kitchen and restaurant wastes not arising from immediate health care)
18 01	wastes from natal care, diagnosis, treatment or prevention of disease in humans
18 01 01	sharps (except 18 01 03)
18 01 03*	wastes the collection and disposal of which is subject to special requirements in order to prevent infection
18 01 04	wastes the collection and disposal of which is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)
18 01 06*	chemicals consisting of or containing dangerous substances
18 01 07	chemicals other than those mentioned in 18 01 06
18 01 08*	cytotoxic and cytostatic medicines
18 01 09	medicines other than those mentioned in 18 01 08

\* hazardous wastes

These Rules do not cover wastes with the classification number 18 01 02, which are body parts and organs including blood bags and blood preserves or waste dental amalgams with the classification number 18 01 10.

#### 2.4.2. Waste

According to the Environmental Protection Act<sup>1</sup>, waste is defined as any substance or object the owner of which is unknown or any substance or object, which the generator, owner or holder discards or intends to discard, or is required to discard.

Waste is any solid, liquid or gaseous substance or object the owner of which is unknown or which is no longer required or desired by its producer, owner or holder which must, due to its harmful effects or in the interest of environmental protection or other public interest, be handled, processed or disposed of as prescribed.

Waste is any substance or object which has been classified as a waste within a group of wastes defined in the European Waste Catalogue.

#### 2.4.3. Hazardous waste

Hazardous wastes are substances which if unprocessed can, due to their physical, chemical or infective properties pose a threat to health if not isolated from the environments, which indirectly or directly have an effect on the organism by exposure or imposition via the food chain, or because of reciprocal effects or other factors. Wastes are considered hazardous until proven to be nonhazardous.<sup>1</sup>

#### 2.4.4. Medical wastes

Wastes from healthcare and related research are defined in detail in the Rules on the management of waste which originate from the performance of healthcare activities and related research.<sup>3</sup>

Medical wastes are all wastes which arise from the performance of medical services in health care institutions and research establishments including institutions, both social and laboratories, connected with healthcare services. This group also includes smaller and dispersed sources of waste which originate in personal healthcare and dental care establishments and in homecare. Wastes originating from healthcare include wastes from natal care, diagnosis, treatment or prevention of disease in humans, sharps, dressings, plaster casts, linen, disposable clothing, diapers, hazardous chemicals, chemicals which are not classified as hazardous, cytotoxic and cytostatic medicines, medicines which are not classified as hazardous waste and wastes from dental care.

#### 2.4.5. Infectious wastes

Infectious wastes are medical technical supply materials and objects for single-use which have come into contact with infected persons, or body secretions or fluids from infected patients. These are culture implements used in laboratory work with infectious materials, equipment parts, clothing, gloves, towels and other hygiene accessories used during dialyses, patient wastes in isolation, all other substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.

#### 2.4.6. Municipal wastes

Municipal wastes are wastes originating in households and due to their nature and make-up, are comparable to wastes from production, trade, services and other activities.

#### 2.4.7 Cytostatic wastes

Cytostatics are substances which originate from cell growth and procreation. All materials which have been in contact with cytostatics, either directly or indirectly are considered contaminated wastes.

#### 2.4.8. Other wastes

In addition to the aforementioned, there are also other kinds of wastes which originate both in health institutions and other places and are therefore, unspecified with regard to activity. Into this group, we could classify bulky wastes, metals, plastic, glass, wood, electrical and electronic equipment, various solutions (photo chemicals such as fixers and developers, leftover paint, varnishes, solvents, etc.), batteries, accumulators, construction waste, used cars, water preparation wastes, etc.

In healthcare and all related activities in hospitals, a large variety of biodegradable wastes originate such as kitchen wastes (food rests, oil, lard, etc.), wastes arising from the maintenance of lawns and gardens and other wastes which are biodegradable when exposed to anaerobic processes of breakdown.

The aforementioned wastes were not included in the subject of this research.

### 2.5. Strategies for waste management in healthcare

The majority of requirements covering waste management in healthcare originates from the Rules on the management of waste<sup>2</sup> and the Rules on the management of waste generated by health services and related research activities<sup>3</sup>. A more detailed description of the requirements which must be met when executing the pilot project on waste management at the Maribor General Hospital, and the manner of implementing these requirements follows.

The Rules on the management of waste generated by health services and related research activities<sup>2</sup> clearly specify that the waste holder must ensure its processing and disposal through disposal at a collection site. The rules further specify that he processes or disposes of it according to the prescribed procedures or that he forwards the waste to a processing or disposal facility.

The generator of waste arising from the performance of healthcare activities and related activities must ensure the following:

#### 2.5.1. Collection

The generator of the waste must ensure that the waste originating from healthcare is collected in a location as close as possible to its point of origin, that it is placed into containers or bags which are adapted to the physical, chemical, biological and other properties of the waste and in accordance with the quantity and manner for temporary storage and it be processed according to the European Waste Catalogue.

#### 2.5.2. Markings

Waste must be appropriately marked in such a way that prior to the transfer of waste to a container or bag, a denotation and label depicting the bar code with recorded data on the waste' place of origin, type and quantity and time of origin are visible. The classification number of the waste should also be included, as well as the title of the authorised consignee (collector, processor or disposal company) and all possible warning signs.

Wastes originating from healthcare may not be mixed with other wastes, or may not be combined with each other if they are different varieties of waste according to the list of wastes.

Organisational unit:	DEPARTMENT OF THORACIC SURGERY
Type of waste:	GLASS PACKAGING
Classification no.:	15 01 07
Consignee:	SUROVINA MARIBOR
Warning:	POSSIBLE INJURY!
Special requirements:	EMPTY PACKAGING
Date	8.4.2005

**Figure 1:** An example of proper labelling of an individual type of waste

Waste generator: Maribor General Hospital	
Address: Ljubljanska ulica 5	
2000 Maribor	
Tel.: (02) 3211000	
Name: WASTE MEDICINES (cytostatics)	
(name given in the European Waste Catalogue)	
Waste classification number: 18 01 08	
(classification number of the waste)	
<u>Warnings</u>	
R22	Harmful if swallowed.
R52/53	Harmful for aquatic organisms: Can cause long-term harmful effects to the aquatic environment.
<u>Notices</u>	
S24/25	Prevent contact to skin or eyes.
S35	The contents and packaging must be safely disposed of.
NET WEIGHT: 150 KG	No. of packaging units: xxxx

**Figure 2:** An example of proper labelling of hazardous waste

### 2.5.3. Packaging

Wastes are collected in packaging which identify the wastes contained within.

These forms of packaging must be adapted to the physical-chemical, biological and other properties of the waster. When dealing with hazardous wastes, packaging must also comply with regulations on the approval of packaging for the transport of dangerous goods.

Packaging (bags, containers, crates) must be manufactured in a way which allows for undisturbed disposal of wastes into its opening while simultaneously avoiding its leakage upon packaging. Materials which constitute the packaging must be resistant to sharps, fluids, chemically aggressive substances and the like. The constitution of materials must not present an ecological burden.

Containers must be air-tight to prevent the emission of gases.

Proper labelling (description, colour) of the packaging is mandatory.

#### 2.5.4. Transport

The waste generator must ensure adequate transport for the transfer of wastes within the area in which healthcare activities are performed. This means that waste generator must ensure safe passage, loading and unloading and temporary storage for these types of wastes.

The vehicles and containers for waste transport must have smooth, air-tight and water-proof surfaces that can be easily and satisfactorily cleaned, disinfected and dried.<sup>3</sup> They should be constructed so as to allow easy loading and unloading while preventing the shaking of substances or spilling of fluids.

Internal transport includes the collection of wastes in hospital departments, inclusive of transport to a temporary storage facility.

#### 2.5.5. Temporary storage

Wastes are not stored at their place of origin, but are regularly transported to a temporary storage facility.

The waste generator must ensure a temporary storage facility for wastes collected within the establishment to ensure protection against pollution of the environment or threats to human health. The generator must also ensure that the consignee has undisturbed access to the wastes.

#### 2.5.6. Collection areas

Waste collection areas must be in compliance with requirements for such types of storage areas intended for dangerous wastes and must be separated from remaining areas. The location should be chosen so as to allow undisturbed access to vehicles transporting wastes.

Temporary storage or waste collection areas must be visibly marked and labelled, prohibiting access to unauthorised persons and warning of the danger. Access must be protected and monitored (locked, fenced in).

The walls and ceiling of the collection area must be composed of materials allowing for their easy cleaning and disinfection. The collection area must have a sufficient number of collection bins for the containment of possible spills of dangerous fluids and ventilating devices with filters for controlling emissions to the atmosphere. Temperature control may be needed for thermally liable and highly volatile materials.

The collection area must have a timetable for the consignment of wastes from organisational units or hospital departments.

#### 2.5.7 Recordkeeping

Recordkeeping allows for the monitoring of wastes from their place of origin to their final disposal, the so-called crabel to grave manifest. The healthcare waste generators must name an authorised person for the management of the wastes and keeping of records on waste management:

The waste generator, depending on the type and quantity of wastes, must keep the following records:

- wastes produced and their origin,
- wastes in storage,
- wastes placed in waste collectors,
- wastes which the facility processes or disposes of on its own,
- wastes consigned to processing or disposal companies, if the waste generator does not perform these activities on its own, and
- wastes which are processed or disposed of abroad.

The procedure for recording wastes at the Maribor General Hospital includes a description of the wastes according to type, quantity, place and time of origin, properties, type of container or bag used, internal transport and the manner of temporary storage.



A special form is needed for this procedure with controls carried out on a number of levels. (entry materials, used quantities...).

Records are kept separately for each type of waste.

Wastes which are transported outside of the health institution must be labelled and packaged in accordance with legislation regulating the transport of dangerous substances. Each waste must be accompanied by a manifest which becomes a part of the waste's records. The manifest is filled out by the waste generator, confirmed by the consignee or by the processing or disposal facility accepting the waste.

Waste generators must archive documentation regarding annual records for a minimum period of five years.

#### 2.5.8. Waste handling and management plan

The waste management plan is a mandatory document prepared by the waste generator and is defined in the Rules on the management of waste<sup>2</sup> when over 150 tones of waste is produced annually and/or exceeds 200 kg of dangerous wastes annually. Depending on its contents, it can be taken as a planning document for the area in question.

The head of the health establishment is responsible for the preparation and implementation of the waste management plan.

The waste management plan for the healthcare industry is prepared for a 4-year period and annually reviewed and updated or supplemented if necessary

The waste management plan for healthcare must contain the following data:

- type, quantity and sources of wastes and any foreseen changes in future medical waste,
- manner of separation of individual types of medical wastes,
- manner of labelling containers and bags and the type of materials of which the bags and containers are made,
- transport of wastes from the area of health care activities,
- waste collectors and their maintenance and cleaning,
- temporary storage of medical wastes in a waste collection facility,
- a waste consignment timetable,
- internal instructions on the handling of medical and other wastes originating from healthcare activities,
- recordkeeping and reports on the production of waste, consignment to collectors or directly to processing or disposal facilities for all varieties of wastes in compliance with the Rules on the management of waste<sup>2</sup>,
- agreements for the consignment of medical waste to consignees,
- staff training in medical waste handling,
- employees authorised by the generator of the wastes for medical waste management from their origin to their disposal to consignees,
- protective measures regarding the effects of dangerous wastes,
- a financial assessment of the medical waste management plan and
- a time plan for the implementation of the medical waste management plan.

Regarding the fact that this research treats a particular group of wastes for the most part, that is medical wastes, the entire waste management plan will not be treated in detail.

#### 2.5.9. Tasks and expert qualification of staff working with wastes

A person must be employed for the waste collection facility, defined by the internal acts for work with wastes.

The expertly qualified person in the waste collection facility is responsible for ensuring that:

- all wastes consigned to waste collection are properly marked with stickers,
- the quantities of wastes are weighed and recorded in the prescribed record document,

- wastes in the storage facility are stored according to type of waste, time limits of storage and deadlines for consignment to further processing,
- wastes are placed on plinths which can be cleaned and disinfected and are lifted off the floor,
- packaging containing a diversity of wastes are stored separately and placed in a way preventing damage or spillage or shaking of the wastes,
- the surface area or space is cleaned immediately after a spillage of the wastes occurs due to an earthquake,
- records on the waste are kept,
- records on wastes are archived for a period of five years and
- reports on the production and handling of waste are prepared and submitted for the previous calendar year.

#### 2.5.10. Requirements for security persons handling wastes

- All employees coming into direct contact with wastes must be equipped with personal protective equipment (clothing, footwear, gloves, if necessary goggles and headgear).
- They must be acquainted with the dangers and procedures to be taken in the case of damage to packaging or if a shake-up or spillage occurs.
- They must participate in training with an assessment of knowledge in the area of hazardous waste management.

#### 2.5.11. Responsibilities of waste collectors

Waste collection can only be performed by persons obtaining the appropriate permission for this activity and are denoted on a list which is kept by the Ministry of the Environment and Spatial Planning – the Environmental Agency of the Republic of Slovenia.

Waste collectors must have a medical waste collection plan which contains the following data:

- territory of medical waste collection,
- types of medical wastes to be collected,
- anticipated annual quantities of all consigned medical wastes and annual quantity of medical wastes which the waste collector guarantees the processing, or disposal,
- type and resource capacities and equipment for collection and transport,
- type and capacities of equipment or devices for disinfection of medical wastes if collecting medical waste with a classification number of 18 01 03\* and accompanying direct disposal or incineration,
- environmental protection measures for the prevention of uncontrollable effects on the environment when managing medical wastes and
- technical equipment for keeping records on medical wastes.

#### 2.5.12. Responsibilities of waste disposal employees

Medical waste disposal can only be performed by persons with an environmental protection permit for the disposal of medical wastes as prescribed by regulations covering waste management.

If the waste disposal employee is also the waste collector, this must be denoted on the permit received by the waste collector.<sup>28</sup>

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<sup>28</sup> A. Viler Kovačič, Ravnanje z odpadki, GV Založba, Ljubljana 2001

### 3. RESEARCH

#### 3.1. Waste management at Maribor General Hospital

##### 3.1.1. Presentation and organisation of Maribor General Hospital

Maribor General Hospital is a contemporary health establishment. It is one of the largest general hospitals in Europe.



**Figure 3:** *Photography of the Hospital in Maribor (Photo: Photolaboratory of Hospital in Maribor)*

The hospital performs healthcare activities on the secondary and tertiary levels. These include:

- hospital healthcare activities,
- specialised healthcare activities outside of hospital premises,
- independent activities not performed by doctors,
- pharmaceutical activities
- research and experimental development in medicine
- commercial activities performing activities based upon the establishment's founding purpose

Hospital departments are organised separately and divided into various medical services, namely:

- Surgery
- Internal medicine
- Gynaecology and perinatology
- Other independent departments
- Joint medical services

Administrative technical services:

- Human Resources and Legal Affairs
- Purchasing
- Financial Accounting
- Economic Analysis
- Care and Maintenance Services<sup>29</sup>

As the central health establishment in the region, Maribor General Hospital ensures healthcare for inhabitants of the regions of Štajerska, Pomurje and Koroška.

Maribor General Hospital is today a contemporary health establishment with a diverse organisational structure:

Several statistical data for 2004 show the make up and scope of performed services:

• expert medical departments	43
• employees	2604
• hospital beds	1316
• checked out patients in 2004	56,832 patients
• visits to dispensary in 2004	357,752 patients
• hospital treatment days in 2004	374,489
• total number of services performed (hosp. and ambul.)	5,512,528
• average hospital bed occupancy	78%
• surface area	79,000 m <sup>2</sup>
• daily food preparation	4,000 kg of food <sup>30</sup>

### 3.1.2. Hospital management prior to introduction of the pilot program

Each hospital has prepared its own model for waste management. No standards covering this area exist in the Republic of Slovenia and it is left to the establishment's own initiatives and organisation. Waste management at Maribor General Hospital was carried out similarly as in numerous other Slovenian hospitals. Of course, a system for the logical collection of specific types of wastes was introduced which would with an unsuitable type of management cause negative health effects. None-the-less, the majority of waste ended up at municipal landfills. Increasingly greater use of single-use materials only served to increase the quantity of waste. The implementation of new regulations has also led to an increase in the costs of waste management.

It is impossible to foresee the exact amount of waste which will originate in healthcare. The largest quantity of waste is produced in the most demanding medical interventions – operations. Even in this branch, patient treatment leads to the majority and most varied types of waste, especially in intensive care units and therapy and in departments for contagious diseases.

#### 3.1.2.1. Hospital waste management

The following types of wastes are separated on hospital wards:

- Infectious wastes,
- Sharps,
- Glass packaging,
- Cardboard packaging,
- Cytostatic wastes,
- Chemicals containing dangerous substances,
- Medicines which have expired dates,
- Remaining wastes which could be classified as “municipal wastes”.

Throughout the wards, all waste collectors were approximately the same size and were equipped with either black or transparent polythene bags.

Wastes in hospital rooms were collected in one container, namely: paper, plastic, infusion systems, all types of packaging, infusion bottles, municipal waste, cans, tetra packs, non-infectious dressings, organic waste, etc.

Infectious wastes were stored in yellow polythene bags of an appropriate thickness. The bags were affixed to trolleys for performing therapies or on trolleys for implementing treatment to

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<sup>29</sup> Splošna bolnišnica Maribor, 1799 – 1999, Strokovna monografija 2001

<sup>30</sup> Informacijski bilten, Naša bolnišnica (Our hospital), No. 1, 2005

patients such as general care, dressing wounds, giving infusions or transitions, etc. After performing healthcare to patients, the half-filled bags with waste were taken out of the trolley and placed in the containers placed at the nurses' working area or on dirty utilities.

The cleaning lady came three times daily to pick up waste from the hospital wards regardless of whether the bags were full or not, and together with the municipal waste, transported them to the collection site until their transport. This location is an unfenced area in the underground passage under each building.

Sharps were collected in special containers made from hard plastic and placed on trolleys intended for giving intramuscular or intravenous treatment or on working counters in treatment rooms and areas for performing diagnostics.

Protective jackets, gloves and linings used for preparing cytostatic treatments which were not contaminated with cytostatics were stored among the cytostatic wastes.

Cytostatic wastes are collected at their point of origin in transparent polythene bags which are stored and marked with a label saying WARNING CYTOSTATICS. The container for cytostatic wastes was located in areas where cytostatic therapies were prepared. Later, these types of wastes were transported to a special hazardous waste collector.

Dangerous chemical wastes and expired medicines were brought from the wards to the central hospital pharmacy where they were collected and suitable processing was carried out.

Glass packaging was collected in containers placed in the nurses' station. Cardboard packaging was simultaneously brought to the central collection site.

### 3.1.2.2. Operating room waste management

In the most demanding organisational units, such as rooms for intensive care and therapies and in operating rooms, wastes were separated in the same way as in the hospital wards.

The difference lay only in the larger number of containers placed. After each operation, the waste bags were carried from the operating room, cleaned, disinfected and prepared for the next patient. The amount of ensuing waste was dependent on the operative procedure.

Wastes from operating rooms were simultaneously transported with an unsanitary lift to the basement where the cleaning service transported it to the central collection site.

The central collection site at Maribor General Hospital is a fenced-in area of approximately 300 m<sup>2</sup> called the ecological island. It is still in operation today.

The cleaning service staff collected and transported the waste three times daily to the central collection site. Wastes were placed in containers located in the central waste collection area.

There is a 16 m<sup>3</sup> pressing machine for municipal waste located here, a pressing machine for cardboard packaging with a size of 5 m<sup>3</sup>, a container of 1.1 m<sup>3</sup> for glass, a container for diapers 5 m<sup>3</sup> in size and containers of a size of 1.1 m<sup>3</sup> for infectious wastes.

The ecological island is kept locked. The cleaning service and security service of the hospital have keys. Employees from the aforementioned services transported and separated the wastes in containers. They also had a responsible person in charge of order and cleanliness.

There was no time schedule for the consignment of wastes.

Technical capabilities for treating wastes within hospital premises did not exist.

Records were kept only for the infectious wastes processing.

Infectious wastes were driven to Ljubljana by a selected consignee where they were weighed and autoclaved and sent for disposal.

The weighing of wastes and production of record documents was performed by the waste consignee. No controls were performed regarding weighing infectious wastes for they didn't weigh the wastes themselves.

Dangerous chemical wastes and cytotoxic and cytostatic medicines were dispatched for incineration. With regard to the treatment of such wastes, weightings and record-keeping using record documents were performed in cooperation.

Records were kept and supervision using record documents was also performed on several other types of wastes not classified as hospital waste, and were therefore not a subject of this research.

Confirmed record documents were not received from municipal companies for the consignment of municipal waste.

The pressing machine for municipal waste was operated 3 times weekly, however the quantity of wastes prior to transport wasn't checked. Subsequent costs were paid by contract based on the number of removals. Upon paying the invoices, the hospital failed to receive weighing lists or record documents from the municipal company.

The paper and cardboard pressing container was removed twice weekly. The container for glass was removed when required. No payment was received for the collected paper, nor was it necessary to pay for removal of the paper.

Municipal wastes were removed by the contracted public municipal company to a special sorting area outside of the hospital. A special service sorted the municipal waste one more time. Remaining municipal waste was rolled into bales and placed in the abandoned gravel pit.

The City of Maribor does not have an organised treatment for remaining municipal waste. As a result of unsuitable final disposition of municipal waste, diapers were collected separately which the contracted municipal company removed to the Celje landfill.

Infectious wastes were removed three times a week and the container of diapers was picked up twice a week.

Regarding the description of treatment of individual types of waste, the following irregularities were identified:

1. Wastes were not sorted according to their properties.
2. Labelling was insufficient.
3. Containers in several collection sites such as in hospital ward bathrooms, were too large.
4. Bags of waste were not filled and were transported half-full from the wards.
5. The trolley for the transport of wastes did not meet with minimal hygienic technical requirements.
6. Infectious wastes were not transported separately from the other wastes.
7. Wastes were not weighed nor their weight controlled.
8. Record documents were not prepared and were thus not submitted together with wastes to the consignee.
9. Data on weights of municipal wastes, paper and glass were unavailable.
10. The waste management plan was prepared, but not adhered to.
11. No person was employed responsible for the area of waste management.
12. Records on costs of waste management had not been prepared.
13. Training for employees involved in waste handling was not implemented.

### 3.1.3. Example of waste production and management in healthcare

For a better understanding of waste production and management in hospitals, the preparation and administering of infusions to patients will be taken as an example. Also shown will be the path taken by glass or infusion bottles, from their use to their removal from the hospital as waste.

The path purchased materials take, from their use and appearance to their removal as waste will be presented.

In order to be able to use an infusion bottle, the following logistics processes are necessary:

- Purchase:

Infusion bottles on palettes are unloaded from the trucks and brought into the hospital. In the receiving warehouse, the foil (plastic packaging) is removed which as a waste, made from artificial material, is separately collected and is left to the waste management system. Palettes (wooden packaging) are consigned to the supplier.

The boxes containing infusion liquids are stored on shelves.

- Internal transport:

The cardboard boxes each containing ten infusion bottles are brought by the transport service to the hospital wards. The bottles are removed and the boxes are placed at the site where waste cardboard and paper ready for removal is collected.

- Preparation of infusions:

In the nurses' station, in addition to the infusion bottles, the following accessories are prepared: These are the infusion needle, the medicine in a transparent or brown ampoule, the label, the infusion apparatus, the one-time use lining for protection of the bed during the infusion procedure and the cardboard box for disposal of waste generating during the infusion procedure.

The packaging is removed from the syringes, needles and linings for protection. They are thrown in a container for plastic packaging and paper (combined paper and plastic packaging). With the aide of the needles, syringes and medicine in ampoules, the infusion liquid is prepared. Prior to beginning the application, the intended spot of insertion into the bottle is disinfected using a tampon dampened with alcohol. The tampon is placed into the container for municipal waste. The used syringe is placed with municipal waste, the needle among sharps and the ampoule among the glass.

Incompletely emptied ampoules containing antibiotics, cytostatics or other medicines are placed among the dangerous chemical wastes. These types of wastes are separated from other types of wastes.

A label on which the patient's name is visible is affixed to the infusion bottle. Labels are separately collected and removed for disposal upon the patient's release.

The infusion apparatus is taken from the cardboard box and placed in plastic bags. The box is placed in the container for paper and cardboard, and the plastic bags among the plastic packaging.

- Implementation:

The infusion bottle is affixed to the bed stand with the aid of a bracket. After washing the hands and putting on surgical gloves, the doctor or nurse disinfects the infusion site. The paper towel is thrown into the container with paper and tampons used for disinfecting the infusion site and placed into the container for municipal waste. Tape is required for the fixing of the injection needle. When the injection needle has been unpacked, the packaging is placed into the container for plastic packaging. The infusion trolley is rolled into the nurses' station from the patient's room where it is cleaned, disinfected and prepared for the next application. For the cleaning and disinfecting of accessories, textile cloths are used which are washed after use.

- Disconnecting the infusion:

The nurse removes the needle from the patient's arm and places it into the container for sharps. Infusion bottles of glass are thrown among the glass whereas injection bottles of plastic are thrown among the waste plastic packaging and the infusion apparatus among the municipal waste.

The bottle holder is removed from the stand and stored for subsequent use.

- Internal transport of the waste from the hospital ward:

The transport of wastes from wards is performed using transport trolleys three times daily by the cleaning service and removed to the ecological island in the hospital.

- Summary

For a comparable and easy medical treatment, 12-15 diverse products are used which produce 8 different types of wastes:

1. White glass, infusion bottle, ampoule of white glass;
2. Waste paper, cardboard;
3. Paper containing confidential data (patient data) – these are labels;
4. Other wastes, injection needle protector, tampons, surgical gloves, tape, protection from PE materials protecting the bed from being soiled, the tongue of cardboard and ampoule made of coloured glass;
5. Sharps: needles, infusion accessories;
6. Packaging made from artificial materials, foil, bottles made of artificial materials, plastic protective covering for the bed;
7. Dangerous medical wastes: semi-empty ampoules, unused cytostatics and infusion liquids
8. Various: palettes.

### 3.2. Waste Management at the Landeskrankenhaus Universitätsklinikum Graz (LKH University Clinic Graz)

The literature survey we made resulted only in a few published scientific papers. We mentioned some the most relevant for our study.

In the first study the investigation volume, sources, composition and treatment of hospital wastes in five typical city hospitals in Massachusetts was performed. The most cost-effective option of four different treatment and disposal options studied was to combine on-site incineration and microwave technologies. This study identified measures for the effective waste characterization methods for the reduction of treatment and disposal costs of regulated medical wastes.<sup>31</sup>

In another literature the waste-management plan for waste treatment was introduced into the hospital. Within a few months of implementation of the waste management plan, the amount of medical waste was reduced by more than 58% from 609 skips/mo (2000 kg/day) in the year 1999, to 256 skips/mo (850kg/day) in the year 2000; Skips are steel containers filled with infectious waste. This reduction was maintained throughout the year 2001 and led to a 50% reduction on total financial costs (US \$ 17,936) with savings in fuel of US \$ 5262, labour-cost savings of US \$ 8990, and maintenance and spare parts savings of US \$3680.<sup>32</sup>

In the General Hospital of Prague, they introduced the waste treatment and organised waste management especially because of ecological point of view (safe containers, protected against, degradation, obstruction and leakage).<sup>33</sup>

#### 3.2.1. Presentation of the Landeskrankenhaus - Universitätsklinikum Graz

The Landeskrankenhaus - Universitätsklinikum Graz (Rural Hospital – University Clinic Graz) belongs among one of the largest clinical hospitals in Europe. It offers health services to 1.6 million inhabitants. Comparing the surface area, it is much larger than Maribor General Hospital. It released half again as many patients as did MGH, and it has more than twice as many workers as does MGH. LKH UK Graz has 300 hospital beds more than the Maribor General Hospital.

Some statistical data will show the main scope of activities and services of the LKH-Universitätsklinikum Graz which has:

• Clinic	20
• Clinic wards	44
• Organisational units	69
• Employees	6,203
• Hospital beds	1,620
• Releases in 2004	74,993 patients
• Dispensary visits in 2004	322,616 patients
• Hospital treatment days in 2004	538,517
• No. hospitalised	460,549
• Built-up surface area	55,000 m <sup>2</sup>
• Total surface area	480,000 m <sup>2</sup>

Groupings of wastes are performed systematically and are tied to the ONORM S 2104 Abfalle aus dem medizinischen Bereich.<sup>27</sup>

The key legislation regarding waste management is Abfallwirtschaftsgesetz<sup>26</sup> 2002 (AWG 2002). The law defines medical waste with the aim of protecting persons against injuries, infections, poisoning and negative effects on the environment.

<sup>31</sup> Lee BK, Ellenbecker MJ, Moure-Ersaso R. Alternatives for treatment and disposal cost reduction of regulated medical wastes. *Waste Management* 2004; 24; 143-151.

<sup>32</sup> Almuneef M, Memish ZA. Effective medical waste management: It can be done. *American journal of infection control*; 2003; 31; 188-192.

<sup>33</sup> Bencko V, Kapek J, Vins O. Hospital waste treatment and disposal in the general university hospital- Current situation and future challenges. *Indoor and built environment*; 2003; 12; 99-104.



Stipulated legislation must be observed by all employees. Staff endeavour in their work, through their own innovative ideas to reduce the quantity of wastes produced.

Suggestions for improving the handling and management of waste, together with their development ideas are sent to the competent ministries with the wish for an amendment or supplement to legislation.

### 3.2.2. Waste segregation at Landeskrankenhaus - Universitätsklinikum

The Landeskrankenhaus – Universitätsklinikum (hereinafter: LKH UK Graz) separates all wastes at their origin. Wastes are segregated by fractions and separated into:

1. Wastes presenting no danger to the medical environment neither inside nor outside the hospital:
  - household or industrial wastes
  - bulky wastes
  - biological wastes
  - street wastes
  - disinfected wastes (under the condition that they are not dangerous)
  - waste paper, cardboard and other packaging and similar waste
2. Wastes which only present a danger of infection or possible injuries within the medical environment and are not considered dangerous wastes.
  - Wastes posing no danger or injury (dressings, wet dressings, disposable clothing, tampons, single-use accessories, gauze, surgical gloves, syringes for one-time use, catheters, infusion accessories without needles, urinal basins, infusion bags, blood bags even if bloody),
  - Other segregated fractions such as diapers, biological wastes (cut flowers), paper napkins,
  - Wastes which could cause injury (pointed sharp objects such as lancets, scalpels, broken ampoules).
2. Wastes which inside and outside the hospital environment poses a danger (dangerous wastes in the real meaning of the word) and which need to be suitably treated.
  - Microbiotic cultures which are not disinfected.
  - Trash infected by dangerous agents (microorganisms, bacteria and viruses).
3. Hazardous medical wastes
  - Medicines
    - o Medicines containing heavy metals
    - o Cytostatics
  - Disinfection agents
  -
4. Other hazardous wastes
  - Substances containing mercury
    - o Thermometers
    - o Amalgams
  - Photo chemicals
    - o Fixing agents
    - o Developing agents
  - Laboratory wastes and chemical remnants
  - Organic wastes
  - Laboratory animals and animal parts

- Animal faeces
  - o Which are supposed to not pose a threat of infection
  - o Animal fodder which could perhaps pose a threat of infection
- Kitchen wastes
- Electrical and electronic wastes

For segregation of waste, the standard practice ÖNORM S 2100–ÖNORM S 2100 Abfallkatalog is observed.<sup>34</sup>

All together, segregated waste collected comprises 64 different fractions of wastes.

Wastes are collected in containers which can be differentiated by their size and colour. Containers for segregation of wastes by fractions are located in all areas of the hospital. All containers are transparent, marked and visibly recognisable.

Infectious wastes are collected in plastic containers of various sizes which when filled, are sealed air-tight and thus transported. Containers with infectious wastes are labelled with a classification number and the warning “Contagious”. The place and date of origin is also marked. Infectious wastes are stored separately from other wastes until their removal.

All other segregated wastes are collected at a covered and fenced-in area located in close proximity to the front of each clinic.

These areas are outfitted with caissons each having a capacity of 1.1 m<sup>3</sup> for paper, plastic packaging, glass (white and brown coloured separated), municipal wastes and for all remaining types of non-medical waste.

#### Paper wastes

All forms of paper such as paper and cardboard packaging, books, magazines, newspapers and paper for sterilisation are collected at LKH UK Graz.

The stipulation is that these wastes not be mixed with other materials such as aluminium foil, plastic mass et cetera.

Things not suitable for containers containing paper are: paper and glue which is composed of other materials such as aluminium foil or plastic, assembled-composite packaging such as tetrapacks or other packaging materials such as Styrofoam, cellophane and other artificial material, insulation materials, etc.

Paper containing confidential data is collected in the wards or separately in offices. Such paper is removed by an authorised company which is responsible for the treatment of this sort of waste.

#### Glass wastes

Packaging of 60 ml onwards of either white or brown glass is collected among glass packaging. The metal cap of bottles must be removed except from infusion bottles.

It is inappropriate to throw laboratory glass, ampoules, ceramics, porcelain, plates, vases, mirrors, windows and such items into the glass container.

Other glass wastes are collected in segregated containers.

#### Plastics (artificial materials)

Only clean packaging, foil for sterilisation, empty plastic bottles, infusion bottles, Styrofoam, plastic plates and plastic cups may be placed in the container for plastic.

Such items as pipettes, syringes, laboratory accessories, tubes, latex gloves, dirty bags or any contaminated material may not be placed in the container for plastic.

Plastic materials which are not packaging and suitable for incineration are collected separately.

#### Municipal wastes

Among municipal wastes, all municipal waste and related waste according to standard practice ONORM 2104 can be collected.

Contagious wastes, liquid wastes, hazardous wastes, paper, cardboard and all types of packaging may not be placed among municipal wastes.

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<sup>34</sup> ÖNORM S 2100, Abfallkatalog

#### Hazardous wastes

Hazardous wastes which pose a threat within the health establishment include dressings, wet dressings, diapers, disposable clothing, tampons and other materials for one-time use (tampons, surgical gloves, syringes for one-time use without needles, catheters, infusion apparatus without needles, urine accessories, infusion bags, empty used blood bags and other similar items, even if bloody).

Among wastes, which inside the medical area could cause an infection or injury, but are not treated as infectious are diapers, biogenous wastes, paper napkins, needles, lancets, remnants of ampoules if not infected with dangerous agents.

#### Infectious wastes

Wastes which inside and outside of the medical environment represent a threat and thus are in need of special treatment include infectious wastes. These include all wastes which are contaminated with dangerous agents. Already disinfected microbiotic cultures are not included among infectious wastes.

#### Dangerous chemical wastes

Expired medicines, those containing heavy metals, dangerous chemical wastes from laboratories and remnants of cytostatics are included within the collection of dangerous chemical wastes.

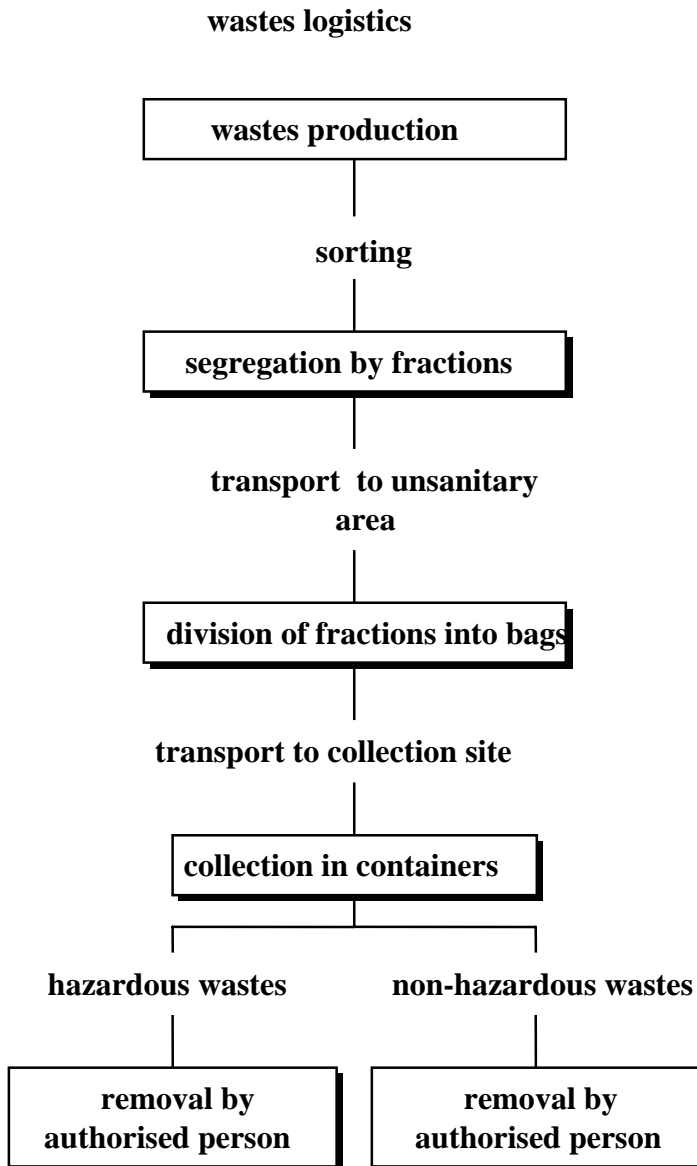
This also includes tampons, dressings and bandages saturated with cytostatics.

Infusion systems, protective aprons and gloves for one-time use are treated as municipal waste, but only in the case when not contaminated with cytostatics.

All solid, liquid and gaseous chemicals which are used either in diagnostics or in experimental work are collected together with chemical wastes.

All medical waste at LKH UK Graz not sent for reprocessing or recycling is incinerated.

### 3.2.3. Logistics of waste management at LKH UK Graz



**Figure 4:** *Logistics of waste management at LKH UK Graz*

### 3.2.4. Measures for reducing waste at LKH UK Graz

Due to the great ensuing costs connected with wastes, a set of criteria was prepared on the basis of which ways were considered to reduce the quantity of all wastes. Dependent on the origin of the wastes, it was decided:

- The large quantities of wastes arising from the use of materials for single-use must be reduced.

The following measures were taken to reduce the quantity:

- Materials for single-use were replaced with materials for multi-use.
- The reuse of disposable materials (upon agreement with producers).
- Standardise the packaging of sets of sterile materials.
- Introduce large quantity packaging.

- Decrease the amount of disinfection agents with regard to actual use but only where appropriate.
- At the administration level:
  - Use recycled paper.
  - Refill original cartridges.
  - Avoid dangerous, unfriendly, or toxic materials.
  - Avoid artificial materials, particularly polyvinyl chloride.
- At the cleaning level:
  - Use environmentally friendly cleaning agents.
  - Exact dosages of cleaning agents

Procedures for reducing the quantity of wastes are divided into qualitative and quantitative reduction of wastes.

- Measures for the qualitative reduction of wastes:
  - Replace polyvinyl chloride (PVC) gloves with latex gloves
  - Purchase infusion systems without PVC.
  - Purchase syringes for one-time use and bottles for redon which are not fabricated from PVC
  - Perform disinfection of services within units for intensive therapy
  - Use digital thermometers
  - Purchase trash bags made from polyethylene.
  - Use paper not containing bleach.
  - Compost biological wastes.
- Measures for the quantitative reduction of wastes:
  - Use linen bed linings instead of paper linings.
  - Use bed covers made of linen instead of using disposable covers.
  - Avoid disposable materials such as containers, packaging, slip-ons for shoes, protective jackets, et cetera.<sup>35</sup>

LKH UK Graz as yet still does not monitor entry data on delivered goods, but they are planning to purchase a new database with which quality entry data will be possible. An information supported system for waste management is also not yet implemented.

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<sup>35</sup> Umwelt Umdenken, LKH Graz, Abfallwirtschaftskonzept 2004

### **3.3. Pilot study – waste segregation at Maribor General Hospital**

Wastes are something more than just trash which must be removed and then forgotten. This is expressed in the increasing number of diverse regulations which are valid for different types of wastes and in the unending development of processes and technologies for the collection, disposal or treatment of wastes.

Statistics displaying the quantity and costs associated with waste management have shown something must be changed within the entire healthcare system in the territory of Slovenia. Hospitals and other health organisations are faced with financial troubles resulting in the search for all possible solutions for lowering costs. The quantities of wastes and costs associated with it grow higher annually.

The current study is involved in the research of quantities of segregated collected wastes, their abandonment and the costs arising within the process of waste management.

The study sets out to define management solutions for the safe disposal of wastes and the reduction costs associated with wastes.

#### 3.3.1. Goals of the pilot project

Prior to the start of the study, the following goals were set:

- determine the actual quantity and composition of wastes,
- reduce the quantity of wastes and level of danger,
- invite all employees, patients and visitors to active participation in segregating wastes at their points of origin,
- require the ecologically-safe treatment of all types of wastes generated in hospitals,
- select the most economical processing, collection and disposal facilities for wastes,
- decrease purchasing costs of entry materials,
- decrease costs arising from waste management,
- set up a complete waste management system supported by recordkeeping of all necessary data,
- achieve environmental awareness of staff, patients and visitors and
- observe Slovenian and European legislation.

#### 3.3.2. The course of the study

The pilot project for segregated waste collection at the point of origin was implemented at the Maribor General Hospital in December 2003.

Waste segregation was set up according to the classification list and proper measures were implemented for collecting, treating, transporting and temporary storage of wastes. Slovenian and European legislation were observed in doing this.

The project was presented to the hospital's management for without their support, this project would never have been able to be effectively implemented. The hospital's management welcomed the project with enthusiasm and support, and it became possible to continue with the commencement of the program.

The organisational units which would take part in the project were defined. In making the selection, specific hospital wards and wastes which originated from activities in these wards were considered. Once selections were made, a meeting attended by management was organised at the chosen wards. After discussion, the willingness of the employees to participate in the project was evaluated. Those wards which welcomed the initiative on the segregation of wastes at their point of origin with enthusiasm and were prepared to cooperate were chosen.

Prior to implementing the research, those chosen to participate in the project were trained. Training took place on each ward separately, in small groups. The legislation on environmental protection and waste management was presented, as well as the costs arising from the existing

waste management system. The project of a system of segregated collection of medical wastes was described in detail. At the same time staff was encouraged and motivated to participate.

The following organisational units were chosen to participate in the program of waste segregation at the point of origin:

- Department of Thoracic Surgery (hereinafter: TS)
- Operating rooms of the Department of General and Abdominal Surgery – Operating Room 7 (hereinafter: OP 7),
- Operating Room 3 (hereinafter: OP 3) and the Septic Operating Room (hereinafter: OP SEPTICS)
- Operating room – Department of Ophthalmology
- Cardiac Surgery operating room.

Prior to beginning the project, a large organisational preparation wishing to implement the program with as little cost as possible was conducted. First old containers were sought in the storage areas of the hospital and in departments where there were excess containers. The containers found were large enough, though old, but useable for our project. Then, a floorplan of the department for each organisational unit was prepared. The number and types of containers for segregating wastes were drawn in these floor plans.

Annex 1: floorplan of the department

Annex 2: floorplan of the operating rooms

Polyethylene bags (hereinafter: PE bags in various colours were purchased and affixed to newly-purchased containers.

A colour scale for individual wastes was defined. The colour for the black municipal waste bags would not be changed.

Green bags were decided for paper collection, white for plastics while the existing yellow was kept for infectious wastes. Cytotoxics and cytostatics were collected in transparent PE bags. All the bags, as mentioned before, were made of polyethylene.

Annex 3: colour coding for segregated waste collection

Written instructions and a colour scale for all the existing types of wastes which were to be separately collected were prepared for the hospital rooms. The instructions, for easier readability, were plasticized and affixed to walls in all spaces where waste was segregated. Thus, there was a colour palette with three types of wastes in the hospital room and a number of containers in the nurses' station for municipal wastes including paper, plastics, glass, infectious wastes and wastes not belonging among medical waste.

For recordkeeping purposes, we prepared internal report forms in which responsible persons entered data on heavy wastes throughout the day.

Annex 4: report form for monitoring the quantity of segregated collected wastes

Scales for weighing wastes were provided by the outside companies. The municipal company placed a container for collecting plastics free-of-charge on the ecological island of the hospital. Containers for glass, paper and cardboard were already there and these required only appropriate labelling.



**Figure 5:** *Ecological island at Maribor General Hospital*

Before starting the project, another meeting was held with all employees to explain the procedures and identify responsible persons for the correct execution of the set goals.

The responsible person for the correct implementation of the project on the ward was the head nurse of the hospital ward.

The goals of the projects were explained separately to patients in each hospital room and they were informed about the meaning of the different coloured PE bags which equipped the containers and the instructions taped to the walls at the collection sites. Containers were placed under the sinks of all hospital rooms. Each room also had three containers equipped with different coloured PE bags.

The project was adopted by the patients with no problem, of course by observing all instructions and constant control by the staff of hospital rooms. Long-term patients informed the new patients about the project.

A person for each organisational unit participating in the pilot project to weigh the wastes and enter the quantity into prepared report forms was chosen. Another person was chosen to be responsible for transport and the proper removal of wastes from marked containers to the ecological island.

### 3.3.3. Description of selected hospital departments

#### 3.3.3.1. Department of Thoracic Surgery

The Department of Thoracic Surgery is an operational department. Demanding operations on the chest cavity are carried out here. Because the rising incidences of cancer translate to a larger number of patients with cancer each year, the operative program is being expanded and filling more beds. There are 7 hospital rooms on the ward with one room reserved for intensive care and therapies with 6 beds. The remaining 6 rooms have a total of 19 hospital beds, totalling 25 beds in the entire ward.<sup>29</sup>

Our decision to include the Department of Thoracic Surgery in the pilot program for waste segregation was based on its characteristics. The ward is relatively small, manageable both on the part of the staff and the hospitalised patients.

The staff's interest in participating in the project was already expressed at the first meeting. A great deal of support for the execution and cooperation in the project was



also shown by the ward's management. In this way, all criteria for selection had been fulfilled.

Various types of wastes originate. The following segregated wastes were collected from hospital rooms:

- municipal waste – in black bags,
- plastic packaging – in white bags and
- paper and cardboard – in green bags.



**Figure 6:** Waste segregation in hospital rooms

Segregated in the nurses' stations were:

- municipal waste (in black bags),
- paper, cardboard (multi-layered, one layer – in green bags),
- plastic packaging (in white bags),
- glass packaging (in cardboard or plastic boxes)
- infectious wastes (in yellow bags),
- sharps (in air-tight containers made of hard plastic),
- cytostatic wastes (in transparent bags),
- dangerous chemical wastes – left-over medicines and expired medicines (in red bags).



**Figure 7:** Waste segregation in preparation spaces



**Figure 8:** Waste segregation on trolleys

At the beginning stages of the project, we collected cardboard packaging separately from waste paper, but due to joint treatment, we decided to discontinue collecting these separately. Wastes were collected three times daily on the ward, namely in the morning, afternoon and evening. Collected quantities of waste were simultaneously weighed and recorded.

### 3.3.3.2. Operation rooms – Department of General and Abdominal Surgery

The Department of General and Abdominal Surgery is also an operational department. Here patients with illnesses originating in the upper part of the stomach, including the lower part of the oesophagus, stomach, duodenum, pancreas, kidneys, gall bladder and spleen and patients with colorectal illnesses – general surgery, proctologic and surgical infections are treated. At the time of the pilot study, approximately 80% of the patients were being treated for cancer.<sup>29</sup>

The ward has three operating rooms, namely OP 7 and OP 3 where pure programmed operative surgery is performed and OP SEPTICS. Both operation rooms number 3 and 7 are located within the complex of ten operating rooms in the operations block, whereas OP SEPTICS is located outside of this area. Here, septic surgery is performed.

Waste collection in op 3 and op 7

At the introductory meeting with operative nurses in operation halls a great deal of interest was shown for the waste segregation project and a willingness to participate. It was found that the operation rooms of the Department of General and Abdominal Surgery were highly-frequented, that diverse operations were performed there, that the willingness of the staff to participate was high and that data necessary for a successful study would be received.

The following segregated wastes were collected in the operating rooms:

- infectious wastes in yellow bags,
- paper and cardboard in green bags,
- municipal wastes in black bags,
- plastic packaging in white bags,
- sharps in air-tight containers made of hard plastic.



**Figure 9:** Waste segregation in operation room OP 7

In the unsanitary space in front of the OP rooms, we collected:

- plastic packaging in white bags,
- glass packaging in cardboard or plastic boxes,
- paper and cardboard in green bags,

- disposable instruments called “steplers” were collected separately. Steplers are plastic instruments, a half-meter in size with a point at the end. After surgery, they are disinfected and placed in thick cardboard haliboxes. Disinfected and with the ends removed, the instruments were disposed of among the municipal waste.



**Figure 10:** *Unsanitary space in operation rooms (OP 3)*

For the proper management of wastes during the period of the study, the head surgical nurse was put in charge of the operating room.

Bags containing wastes were removed from operating room after each surgical procedure. Weighing of the segregated collected waste and recording of ensuing quantities were performed after each operation. The wastes were then transported in an unsanitary lift to the collection site in the basement, from which they were transported to the ecological island by cleaning staff.

#### Waste collection in OP SEPTICS

In the septic operating room, infectious wastes, paper, plastic packaging, glass packaging and municipal wastes were segregated. At the start of the study, cardboard was also collected separately, but as obvious in the photographs below, this soon stopped since the processing of cardboard was similar to that of paper. Glass packaging was placed into boxes made from hard plastic.



**Figure 11:** *Unsanitary area of the septic operating room (OP SEPTICS)*

### 3.3.3.3. Operating room – Department of Ophthalmology

The Department of Ophthalmology is located in an old house within the Ophthalmology complex. The operating room is not built according to contemporary doctrines for such demanding procedures. Regarding the endless improvisation and observance of the high level of asepsis required for operative procedures, the management of wastes is imperative.

More than 70 % of hospitalised patients are operative or injured, with the remainder suffering from major eye diseases. The department has two operating rooms and accompanying unsanitary areas. At the introductory meeting, the willingness to participate was large, particularly as the manager had been replaced, and the new one was willing to participate.

In the operating rooms, the following waste was collected separately:

- paper and cardboard in green bags,
- municipal wastes in black bags,
- sharps in air-tight plastic containers,
- plastic packaging in white bags.



**Figure 12:** Waste collection in the Ophthalmology OP



**Figure 13:** Waste collection in the Ophthalmology OP



**Figure 14:** Waste collection in the Ophthalmology OP

The following wastes were collected in the front unsanitary area of the OP room:

- glass packaging,
- municipal wastes and
- paper.

To ensure the correct separation, weighing of wastes and recordkeeping, responsibility was given to the head surgical nurses in the OP rooms. Containers with wastes were emptied after each surgical procedure and wastes weighed outside of the operating rooms.

### 3.3.3.4. Cardiac Surgery Operating Room

In the last decade, the number of people contracting heart disease and similar has been on the rise, and the fact is that in the developed world, the greatest numbers of people die from heart and artery disease. Modern medicine treats these types of diseases also with surgery which ranks among the most difficult of surgical procedures. Cardiac surgery at Maribor General Hospital is a relatively recent operative activity. The first open-heart surgery with external blood flow was performed at Maribor General Hospital in 1996.

Inclusion of the cardiac surgery operating room was beyond expectations at the start of the project. Because of the demanding surgical procedure, it was feared that the staff would fail to see the seriousness of the problem and not follow the instructions regarding waste segregation.

Later, it was discovered that the cardiac surgery staff had observed the flow of the study in other operating rooms and expressed eagerness to participate in the project. This decision was especially welcomed since it is known that a large amount of wastes are produced during cardiac surgeries. An educational program was prepared and delivered for all employees participating in the project.

The head surgical nurse of the cardiac operating room was assigned responsibility for the correct segregation, recordkeeping and weighing of wastes.

The operating room is located within the operations block. Infectious wastes, paper, plastic packaging and municipal waste were separated in the cardiac surgery operating room. Large containers were chosen for segregating wastes here. All equipped with PE bags of different colours.



**Figure 15:** Waste collection in the Cardiac Surgery OP



**Figure 16:** Cardiac surgery operating room

In addition to the containers shown in the photographs, three more containers were placed at the anaesthetic tables where separated paper, municipal wastes and plastic packaging were collected. In close proximity of the operator and operative nurses, an additional container for infectious wastes was placed and likewise one for the perfusion team for infectious paper and plastic.

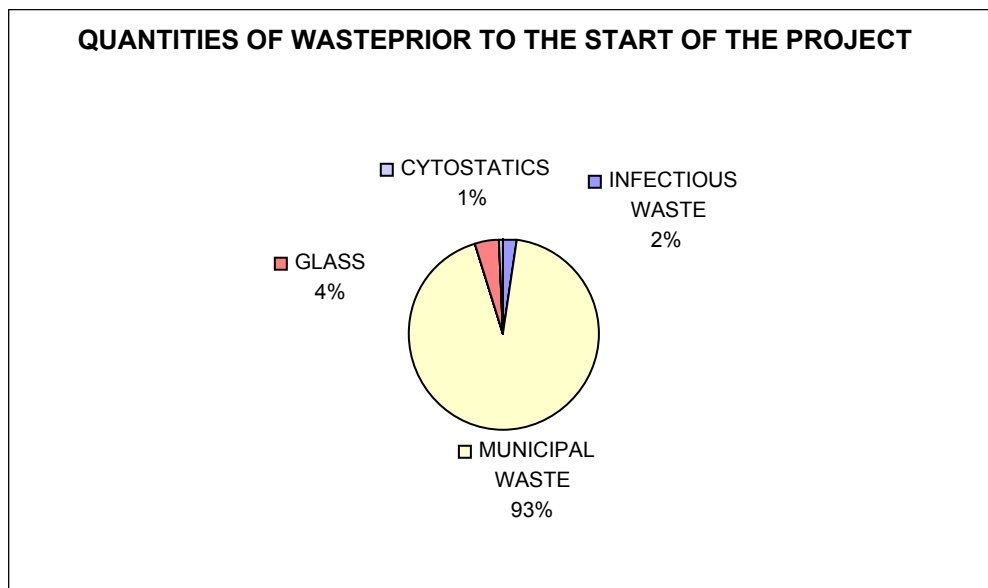
Municipal wastes, paper and glass and plastic packaging were separated in the unsanitary area in front of the operating room.

## 4. RESULTS AND DISCUSSION

The pilot program took place from 12 December 2003 until 31 December 2004. From 12 December 2003 until the end of January 2004, all ensuing wastes in organisational units chosen to participate in the pilot project were weighed. A less than usual number of patients were hospitalised during the Christmas and New year's holidays. Only emergency procedures and fewer scheduled operative procedures were performed. The lower work intensity and smaller number of patients were the reasons for decreased waste in this period.

### 4.1. Department of Thoracic Surgery (TS)

**Graph 1:** *Quantities of waste prior to the start of the project in the Department of Thoracic Surgery*

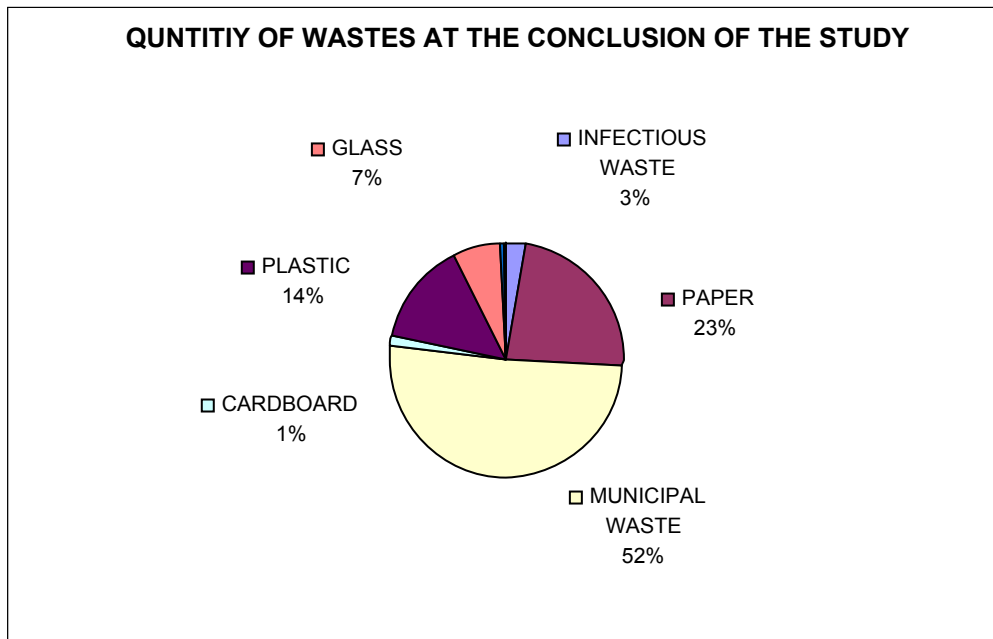


Prior to the study, the Department of Thoracic Surgery collected infectious wastes, cytostatics, unsorted municipal wastes and glass packaging. Infectious wastes were sent for processing, cytostatics for incineration, municipal wastes to landfills and glass packaging was returned to the central hospital.

Non-returnable glass packaging was placed with municipal wastes. Of the total amount of collected wastes, 93 % were municipal wastes, 2 % were infectious, 4 % glass packaging and 1 % cytotoxins.

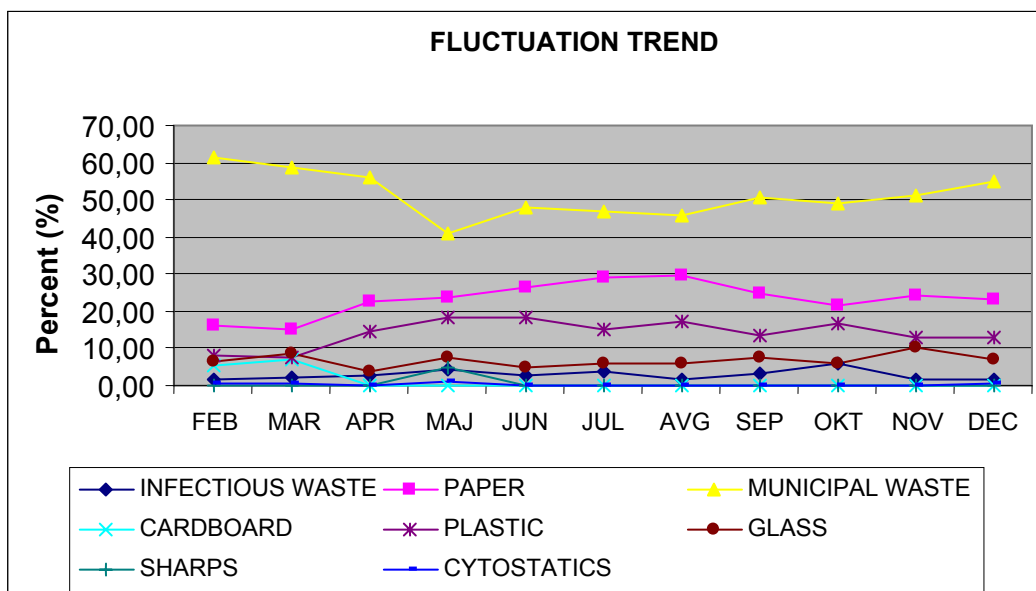
We commenced with segregated waste collection at their point of origin on 28 January 2004.

**Graph 2:** Quantity of wastes at conclusion of the study at the Department of Thoracic Surgery



From February 2004 until the end of December 2004, segregated waste was collected at the Department of Thoracic Surgery. In this period, 52 % of all wastes were municipal wastes, and, of the balance, 24 % was paper and cardboard, 14 % was plastics, 7 % was glass and 3 % was infectious wastes. From the results, it is evident that through segregated collection, an impressive 45 % of wastes were collected for reprocessing, whereas only 52 % were disposed of at landfills.

**Graph 3:** Fluctuation of waste quantities at the Department of Thoracic Surgery



During the pilot study, we determined that the quantity of infectious waste in the Department of Thoracic Surgery fluctuated from 2 % to a maximum of 6 % monthly. The greatest amount of infectious wastes originated in the month of October.

The share of segregated collected paper amounted to 16 % in the beginning of the project, and started to increase in April, and by August amounted to 30 % of all collected wastes. The reason for the lower

quantity of paper at the start was the segregation of paper and cardboard. Cardboard represented 6 % of the waste in February and 7 % of all segregated collected wastes in March. The amount of municipal waste decreased and reached the lowest percentage in May with a share of 41 %. Plastics which represented 8 % of the segregated fractions at the start of the project, reached a share of 18 % in May and June.

The difference in collected quantities of plastics at the start was due to incorrect separation of plastic packaging. Large plastic packaging, such as PE bags, plastic foil and similar was disposed of among municipal wastes. With increased information, the quantity of incorrectly sorted plastics considerably decreased.

Glass represented from 4 % to a maximum of 10 % of the segregated fractions.

Segregated collected sharps were placed in air-tight containers and sent to be treated and disposed of.

Cytotoxic and cytostatic wastes were few. Cytostatic therapies are prepared centrally for the needs of the Department of Thoracic Surgery. The preparation of cytostatics was carried out in an area separated from the remaining activities of the department. There were not many of these types of waste during the period of the study.

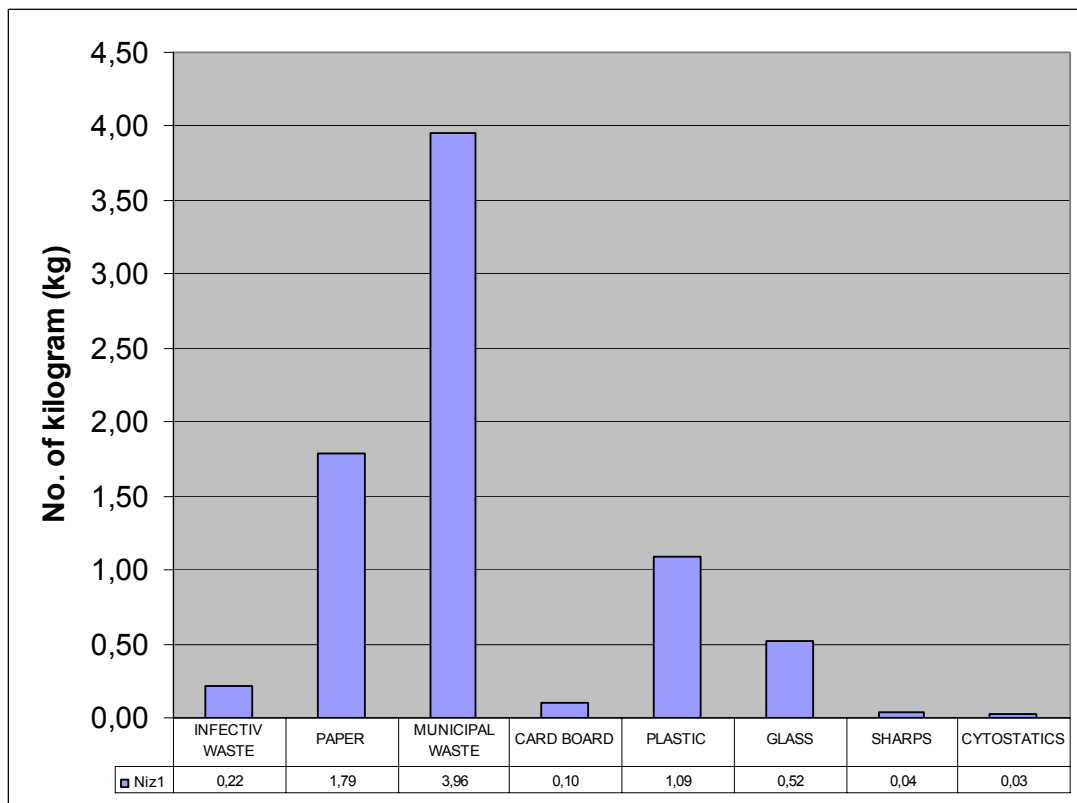
It can be seen, that the quantity of municipal waste had already decreased at the beginning of the study by 50 %, reaching its lowest level in May, amounting to only 41 % of all segregated collected wastes.

The fluctuations in quantities can be attributed to diagnostic and therapeutic requirements of the patients, the work intensity, the quantity of single-use materials used, the number of staff and number of visitors to the ward.

The majority of costs occur from processing of municipal and infectious wastes; while a portion can be linked to cytostatics, it is relatively small. Remaining wastes (paper, plastic, glass) were picked up by a contracted company free-of-charge.

Observing the fluctuation trend for wastes by month, it can be ascertained that the quantity of mixed municipal wastes has decreased. The number of those wastes not producing expenses (paper, glass, plastic) is slightly decreasing. The quantity of infectious wastes and cytostatic wastes has remained roughly the same.

**Graph 4:** Quantity of wastes per patient at the Department of Thoracic Surgery





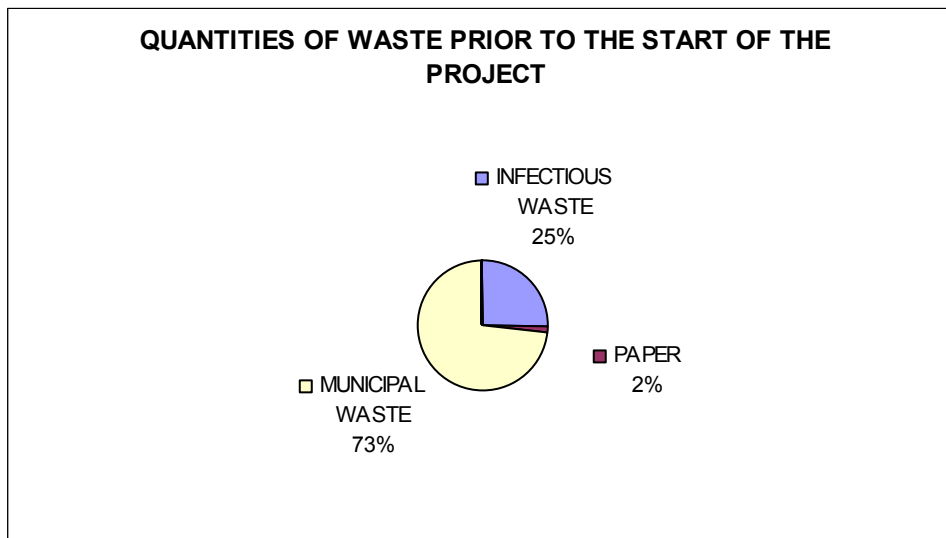
During the pilot study, 728 patients were treated at the Department of Thoracic Surgery from 1 February until 31 December 2004.

The quantity of segregated collected wastes per patient still presented a large share of wastes for which no uses have been found, and, consequently, must be sent to landfills. Thus, an excessive quantity of so-called municipal wastes ensues in the department. This may be due to the inefficient processing of all types of plastics originating in the hospital ward. Among plastics, only plastic packaging wastes were segregated and collected. Clean syringes, infusion tubes, various laboratory accessories, tubes and similar were placed among municipal wastes. A large quantity also originated from infectious dressings, wet dressings and similar. The quantities of infectious wastes are, due to thoracic drainage wastes somewhat larger, but not overly large considering the operative surgical department.

## 4.2. Operating room – Department of General and Abdominal Surgery

### 4.2.1. Operating room no. 7 (OP 7)

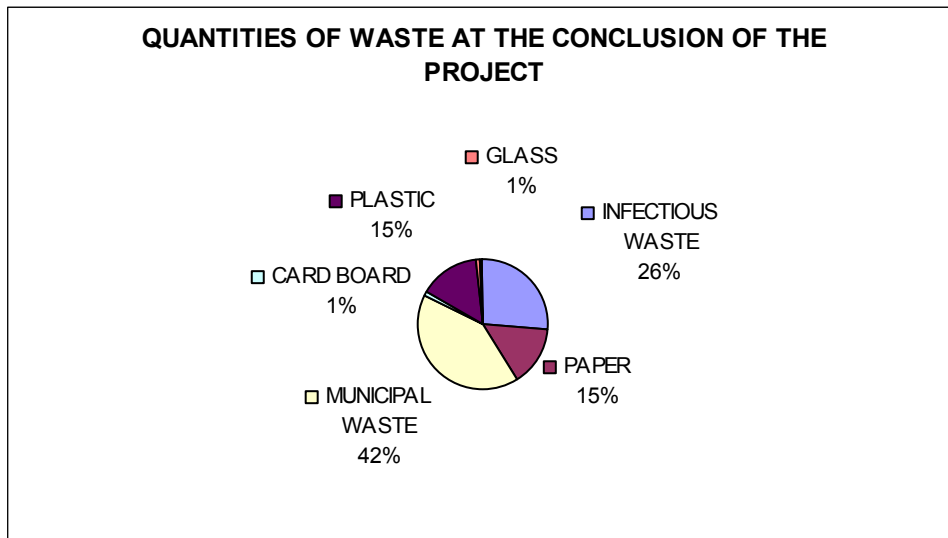
**Graph 5:** *Quantities of waste prior to the start of the project (OP 7)*



At OP 7, operations are performed on the liver, gall bladder, gall fluids, pancreas and stomach. Operative procedures require the participation of 1 surgeon, 1 to 2 assistants, 2 operative nurses, 1 anaesthesiologist, 2 anaesthesiology nurses and 1 general nurse.

Prior to start of the study, 25 % of wastes collected separately consisted of infectious wastes, 73 % unsorted municipal wastes and only 2 % paper.

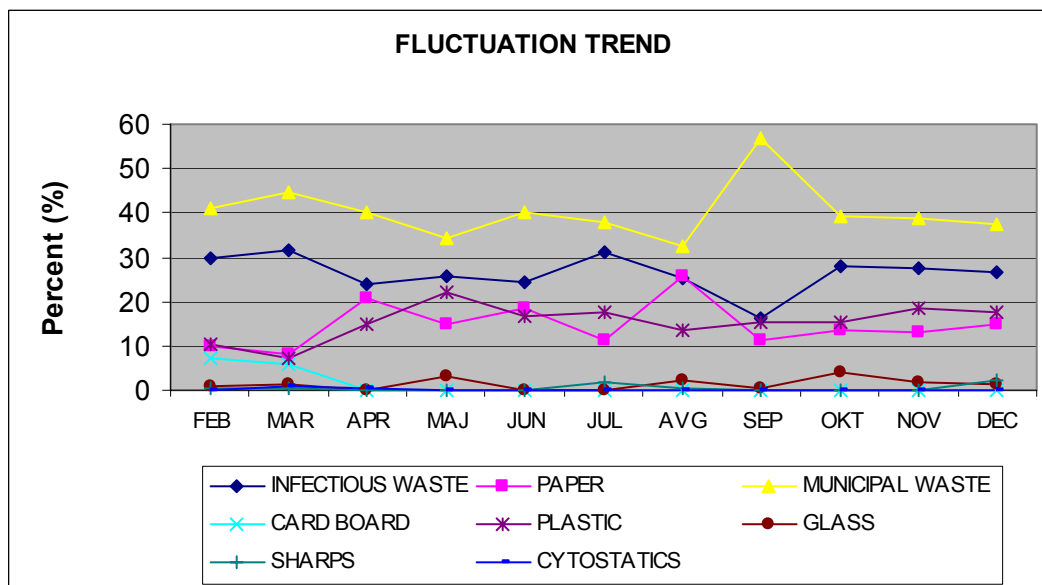
**Graph 6:** Quantities of wastes at the conclusion of the study (OP 7)



During the pilot study, 26 % of the segregated collected waste in OP 7 consisted of infectious wastes, 42 % municipal wastes, 16 % paper and cardboard, 15 % plastic with only 1 % glass. The data show that OP 7 collected 42 % of municipal wastes for deposition to landfills and 26 % infectious wastes which must be processed first and then sent to a landfill. A 32 % share of glass packaging, plastic packaging and paper and cardboard were recycled.

The fluctuation trend of segregated collected wastes shows a fall in the quantity of municipal wastes at the start of the study and a subsequent increase in the quantity of municipal wastes as more disposal materials were used.

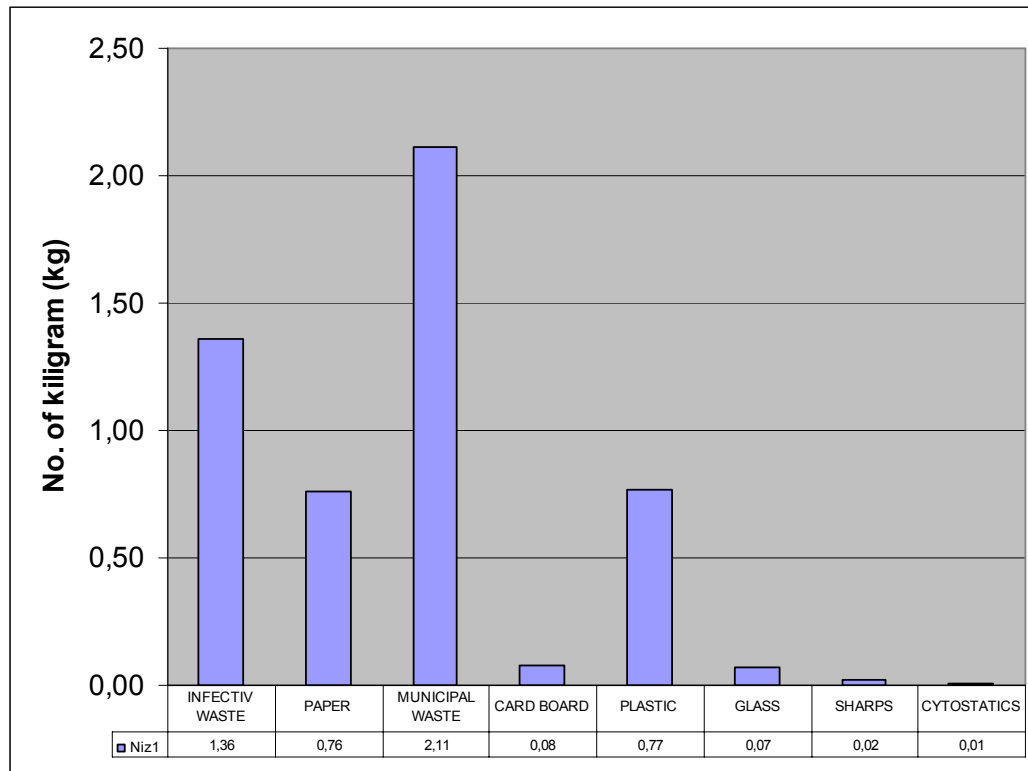
**Graph 7:** Fluctuation of waste quantities (OP 7)



The quantities of infectious wastes ranged from 16 % in September to a maximum of 31 % in July. Municipal wastes exceeded 40 % of all collected wastes in February, March and September. In September, the quantity of municipal wastes rose to 57 %. The reason for this increase was the large use of disposable materials which had been evaluated for all operative procedures. The use of disposable laparoscopic instruments is also increasing in this OP.

The share of segregated collected paper fluctuated from 8 % in March up to 26 % in August, with plastic packaging ranging from 7 % in March to a maximum of 22 % in May. The largest share of glass packaging was recorded in October.

**Graph 8:** Quantities of wastes per patient receiving operative procedures (OP 7)

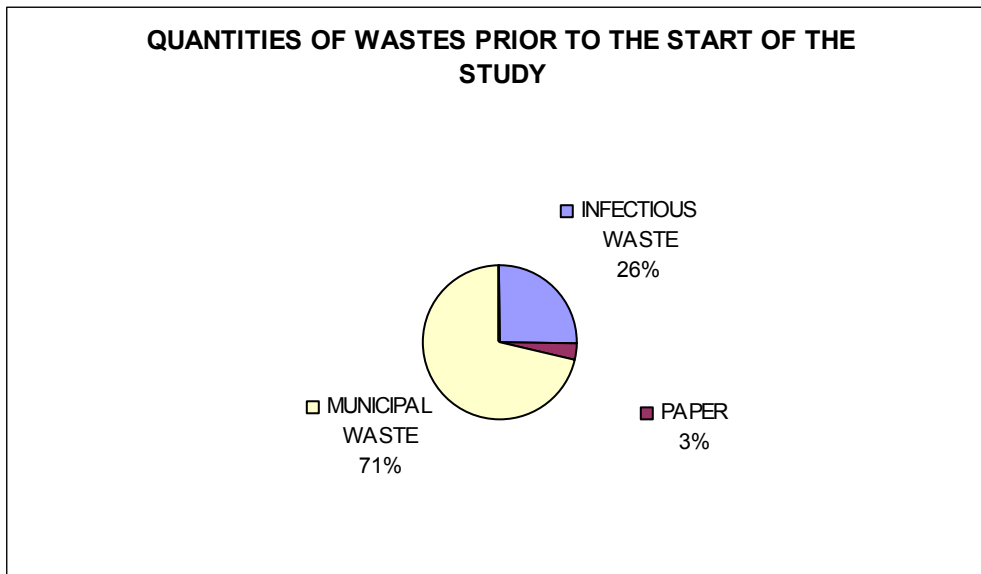


While the study was being carried out, specialists performed 682 procedures on 683 operative patients in the operating room of the Department of General and Abdominal Surgery. If the quantities of wastes are compared, it will be seen that the quantities of wastes from operative procedures are considerably large. A large quantity of infectious wastes and municipal wastes originate in the operating room, primarily on the account of disposable materials used. The quantities of paper and plastic packaging also increased.

#### 4.2.2. Operating room no. 3 (OP 3)

Classic and laparoscopic procedures are performed in operating room 3. The largest number is performed on the intestines, followed by kidney stone removals and operations removing fat. The following people participate in a procedure: 1 surgeon, 1 assistant, 2 operative nurses, 1 anaesthesiologist, 1 anaesthesiology nurse and 1 regular nurse. More doctors can participate in more demanding procedures as assistants.

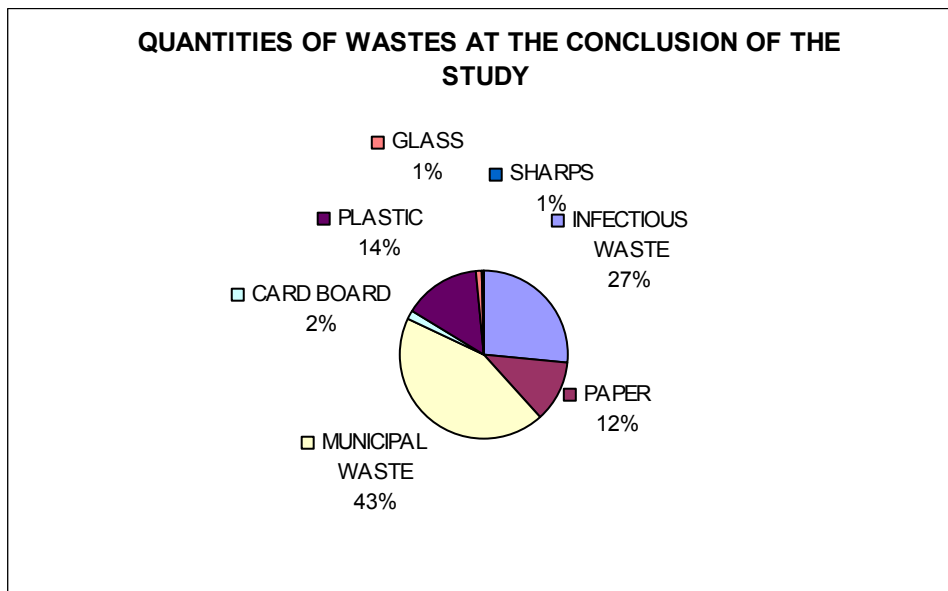
**Graph 9:** Quantities of wastes prior to the start of the study (OP3)



Prior to the beginning of the study, the operating room of the Department of General and Abdominal Surgery OP 3 had collected a 71 % share of municipal wastes, a 26 % share of infectious wastes and a 3 % share of paper.

The correct segregation of wastes during the pilot study is visible from resulting data which show that during the study, only a 1 % greater share of infectious wastes ensued than prior to it's start and that there was a 28 % drop in municipal wastes. Paper prior to the study's begin was not segregated, only cardboard packaging.

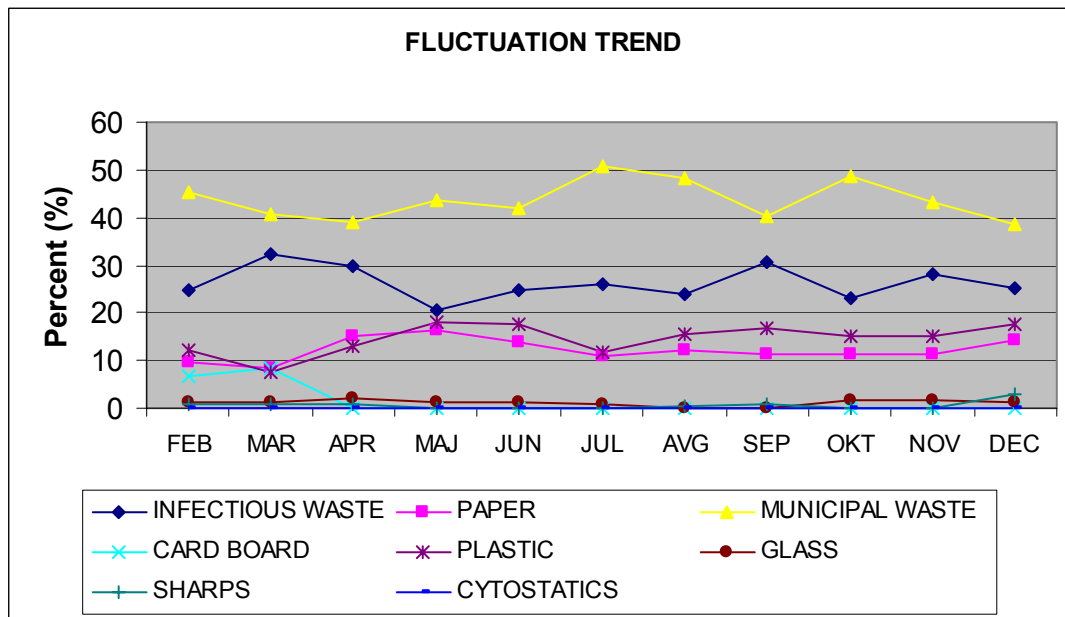
**Graph 10:** Quantities of wastes at the conclusion of the study (OP 3)



In just eleven months, OP 3 collected a 43 % share of municipal wastes, a 27 % share of infectious wastes, a 14 % share of plastic, 14 % share of paper and cardboard, 1 % share of glass and 1 % share of sharps. A 39 % share of wastes was collected and removed by consignees free of charge,

while 43 % of the waste was sent to refills without prior processing and 28 % of the wastes were processed for later disposal.

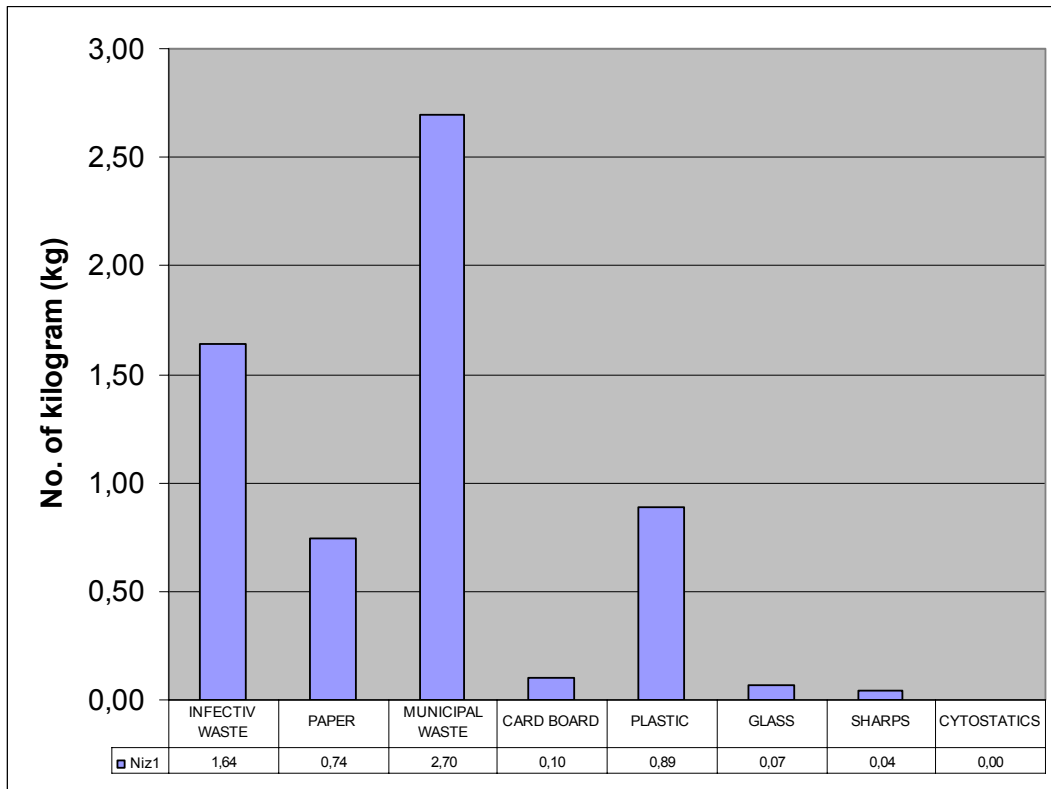
**Graph 11:** *Fluctuation of waste quantities (OP 3)*



During the study, the percent of infectious wastes originating in the operating room ranged from a monthly low of 21 % to a maximum of 32 %. The quantity of municipal wastes was larger in July with a share of 51 %. During the remaining months, the municipal waste share was less than 50 %. The share of segregated collected paper fluctuated between 8 % in March up to 16 % in May and plastics from 8 % in March to 18 % in May. The largest share of glass, 2 %, was collected in April.

The diagram shows that the quantities of municipal wastes increased during the summer months of July and August, otherwise displaying a slight downward trend. The same applies to remaining segregated collected wastes with a slight rise in summer, but generally remaining the same. The quantities of infectious wastes fluctuate much and are dependent on how demanding the procedures are. Single-use materials present a problem by adding to the growth in the quantity of municipal wastes.

**Graph 12:** Quantities of wastes per patient undergoing operative procedures (OP3)

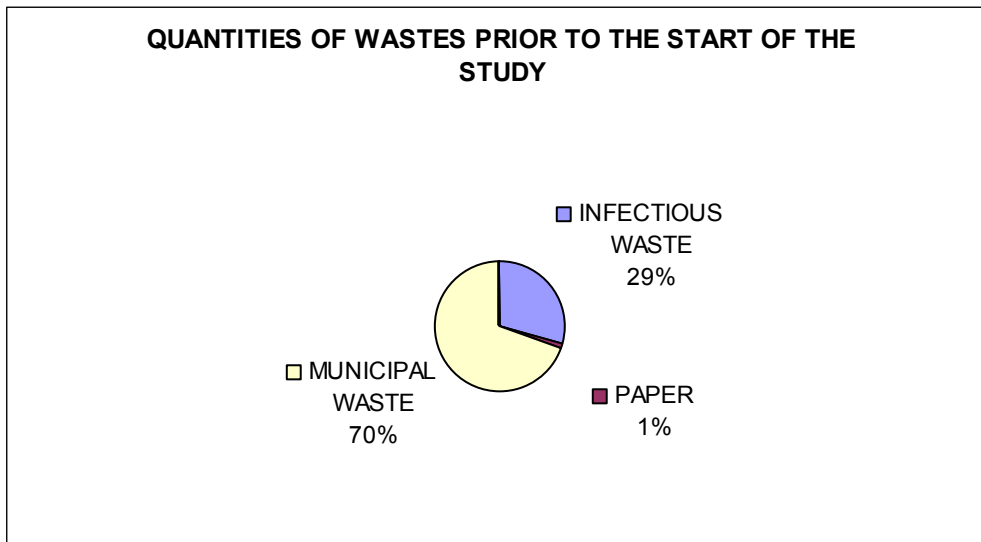


In the operating room of the Department for General and Abdominal Surgery OP 3, 741 operative procedures were performed during the course of the study, with 58 patients more operated on than in OP 7. The quantities of wastes per patient in OP 3 were larger than in OP 7 with smaller procedures being carried out. The quantities of wastes per patient were also larger in OP 3 than in OP 7. The larger quantities of wastes can be traced to materials for single-use. All operative sets are wrapped in paper sheets and paper, covered by foil. Compresses and cover used in OP are also a combination of materials, which is paper covered with foil. All these materials were placed together with municipal wastes resulting in the large quantity of municipal wastes.

#### 4.2.3. Septics operating room (OP SEPTICS)

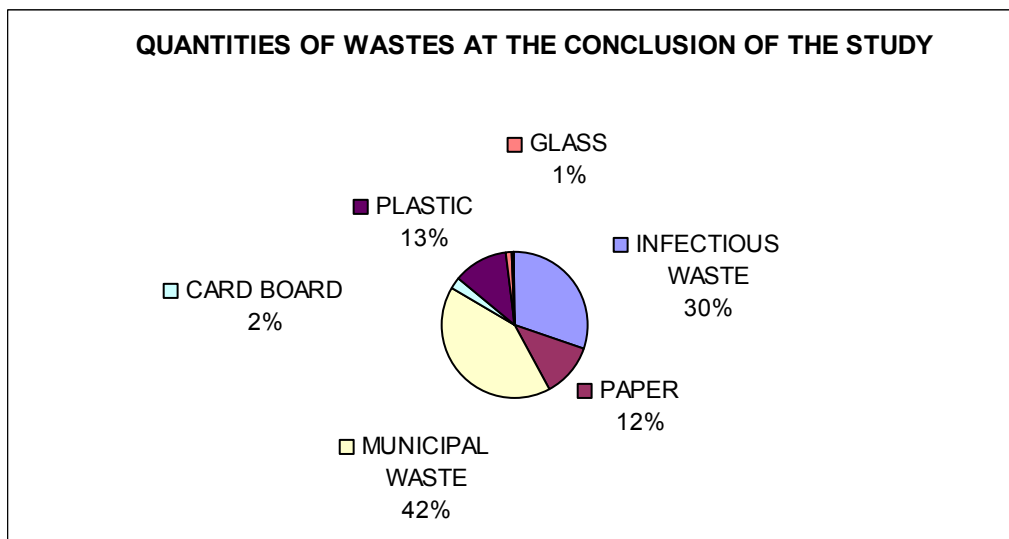
Operative procedures such as inguinal herniorrhaphies, pilonidal sinuses, haemorrhoids, fistulas and such are performed in OP SEPTICS. These operative procedures require the participation of: 1 surgeon, 1 assistant, 2 operative nurses, 1 anaesthesiologist, 1 anaesthesiology nurse and 1 regular nurse. The operating room is located outside of the operating block. In addition to the operating room, there is also an unsanitary area where waste was collected during the pilot project. Infectious wastes, paper and municipal wastes were collected in the septics operating room.

**Graph 13:** Quantities of wastes prior to the start of the study (OP SEPTICS)



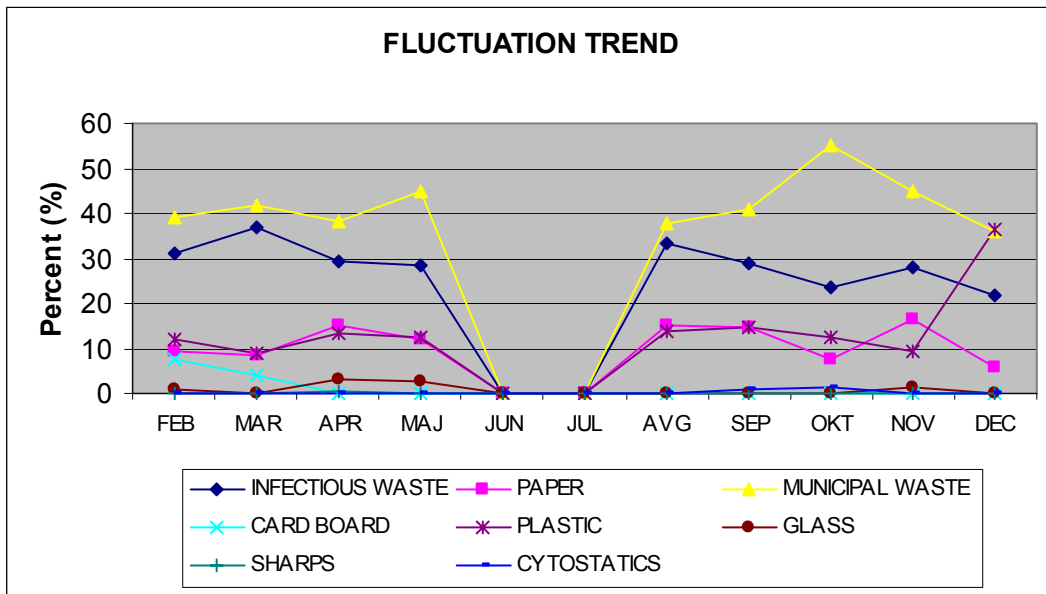
Before the start of the study, OP SEPTICS segregated infectious and municipal wastes and paper. They collected a share of 29 % infectious wastes, 70 % municipal wastes and a 1 % share of paper. Segregated collected paper represented cardboard packaging wastes.

**Graph 14:** Quantities of wastes at the conclusion of study (OP SEPTICS)



During the pilot study, OP SEPTICS collected a 28 % fraction for recycle, namely paper, cardboard, glass and plastic, while 30 % required further processing and later disposal to a landfill and 42 % municipal wastes were disposed of at landfills.

**Graph 15: Fluctuations of waste quantities (OP SEPTICS)**



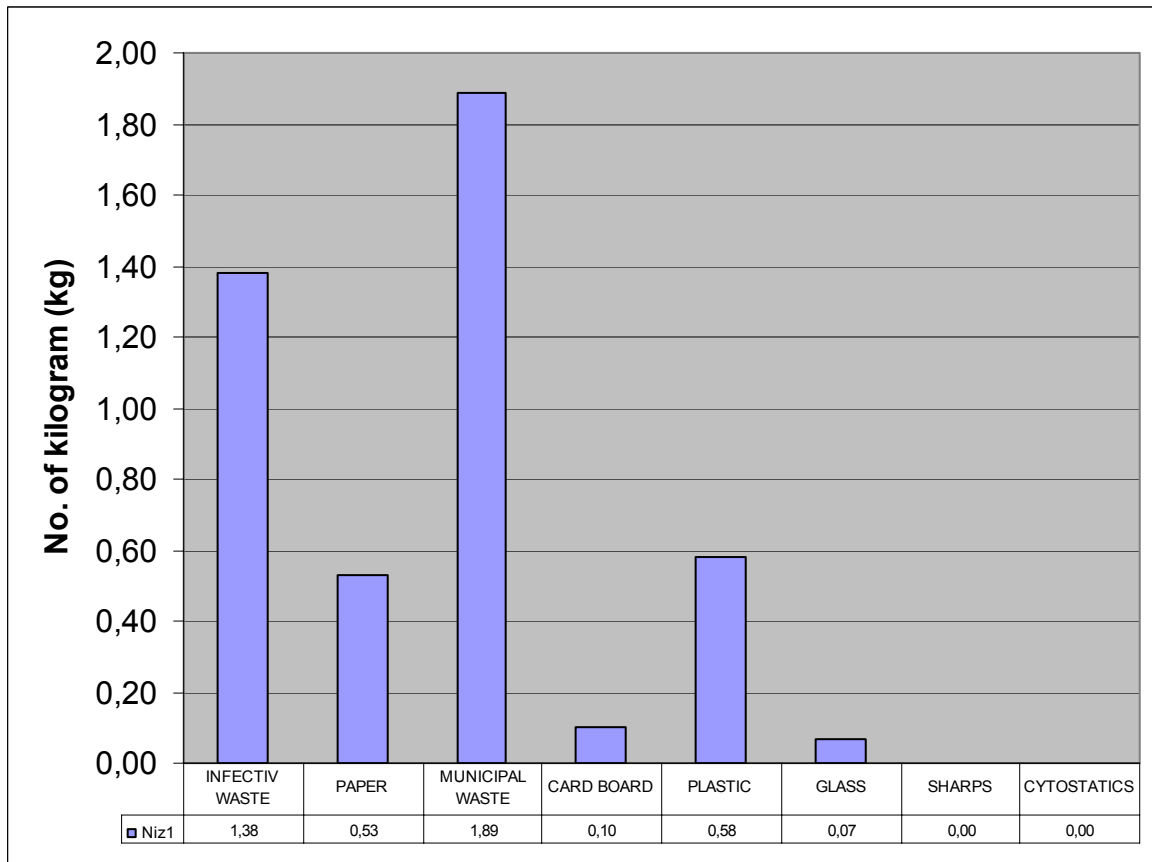
Due to large construction operations, OP SEPTICS ceased operative procedures for two months performing them in other operating rooms of the hospital. Consequently, no segregated collections of wastes were possible in June and July.

In the segregated waste collection project by fraction, infectious wastes fluctuated from a maximum of 22 % in December to a maximum of 37 % in March. The share of municipal wastes was the lowest in April with 38 % and the highest in October with 55 %. The lowest quantity of collected paper was seen in December, with only an 8 % share and the highest in November with a 17 % share. The portion of segregated collected plastic fluctuated between 9 % in November and 36 % in December.

The number of operative procedures was higher at the beginning of the year than in the second half of the year.



**Graph 16:** Quantities of wastes per patient undergoing operative procedures (OP SEPTICS)



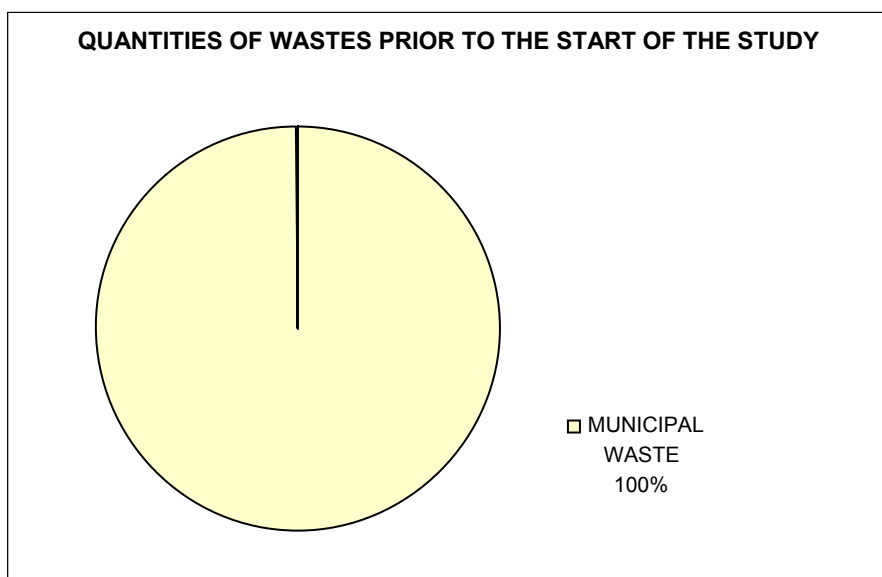
During the course of the study, from 1 February 2004 until 31 December 2004, 413 operative procedures took place in this operating room. The graph shows that the quantities of wastes in the septic operating room are somewhat lower.

Operative procedures are performed throughout the whole day here, which is 24 hours a day. As a result of the constant change of shifts of the operative teams, the quantities of wastes can particularly change greatly during the afternoon and evening hours. These quantities are dependent on the extent of the operative procedure, the size of the operative team and the quantity of disposable materials used.

### 4.3. Operating room – Department of Ophthalmology

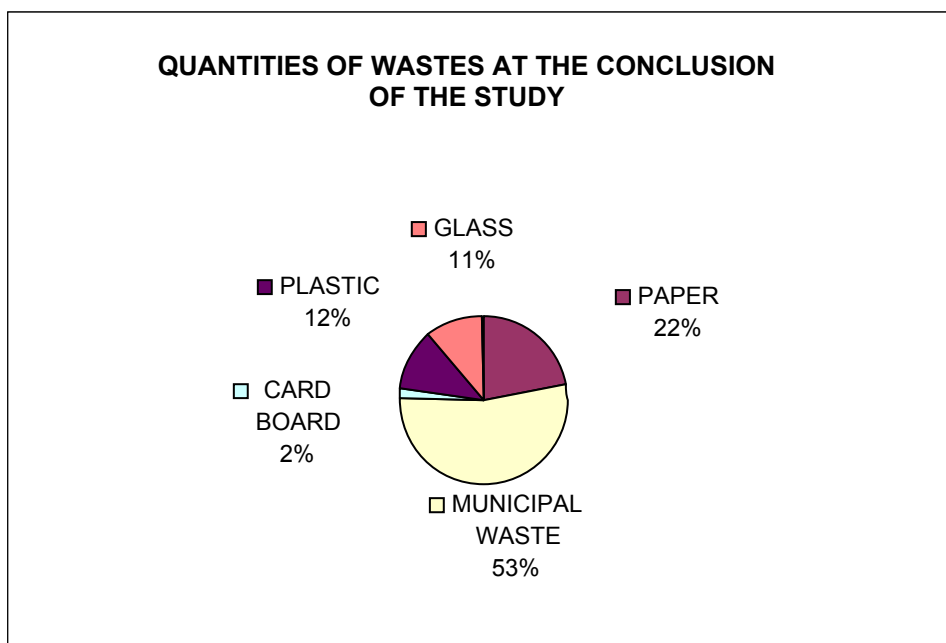
The operating room of the Department of Ophthalmology can be found within the connection of the operating block, directly alongside the Department of Ophthalmology. The majority of operations performed are for cataracts, or grey membranes, operations for glaucoma and various plastics. Prior to the beginning of the project; all wastes were collected in containers located in the operating room. Little or no infectious waste is produced here. What little waste produced is placed together with sharps is collected in the appropriate container in the ward and removed daily at the conclusion of the operative program.

**Graph 17:** Quantities prior to the start of the study at the Ophthalmology OP



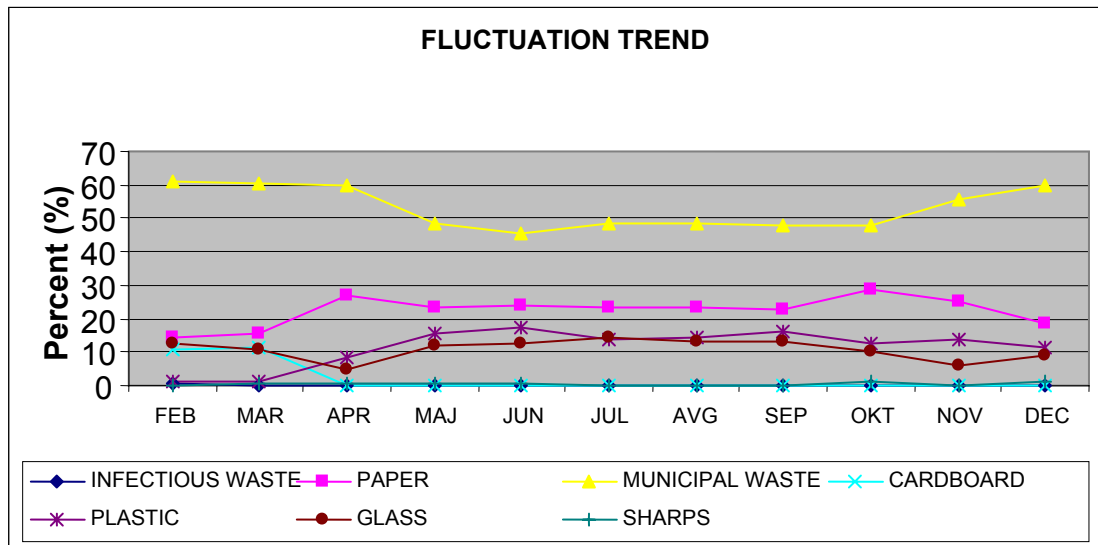
The following people participate in operative procedures: 1 surgeon, 1 assistant, 1 operative nurse and 1 general nurse. The anaesthesiologist and anaesthesiology nurse rarely come to the operating room for anaesthesia is not frequently used in procedures.

**Graph 18:** Quantities of wastes at the conclusion of the study at the Ophthalmology OP



The pilot program achieved exceptional results in the Ophthalmology OP. During the study, 53 % of the segregated municipal waste was collected and landfilled. A 47 % share was able to be recycled.

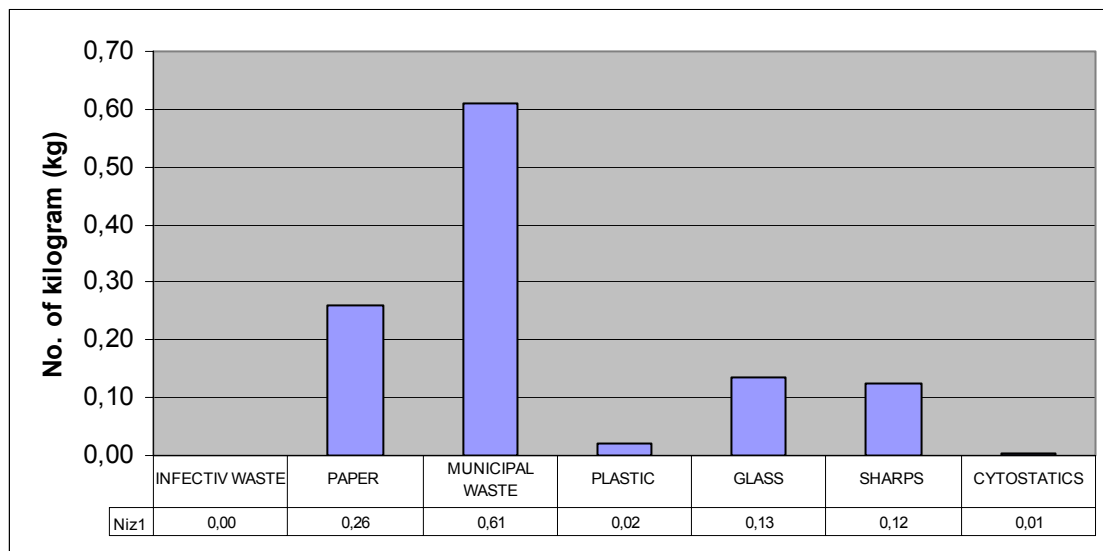
**Graph 19:** Fluctuation of waste quantities at the Ophthalmology OP



At the end of the pilot project, the percentage of segregated collected municipal wastes fluctuated between 14% in February and 29% in October. The municipal wastes collected represented a 45 % share in June and 61% February, whereas plastics fluctuated between 1 % (February) and 17% (June) and glass between 14%.

The large quantities of municipal wastes can be attributed to materials for single-use, gloves, syringes, infusion systems, tampons and cassettes used in operations on cataracts or grey membranes. The entire operative field in this OP is covered with disposable materials. This is also the reason that the quantity of municipal wastes grew slightly whereas the amounts of remaining fractions slightly decreased.

**Graph 20:** Quantity of wastes per patient at the Ophthalmology OP



There were 1912 eye operations performed in the period from the beginning of February until the end of December.

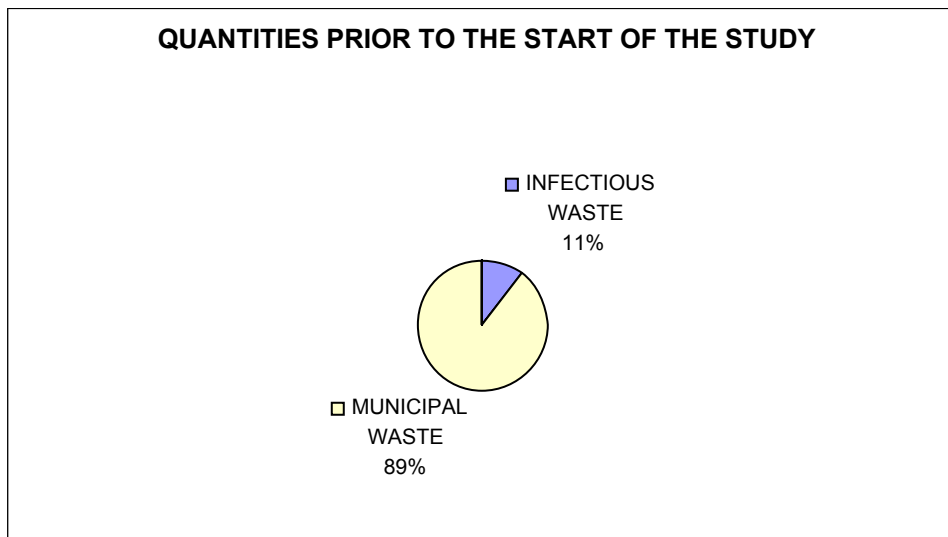
No infectious wastes were produced in the Ophthalmology OP. Other segregated collected wastes were essentially less than in other OPs in the operating block which is understandable seeing that eye operations do not require a large use of materials.

The difference in quantities (and countries) with regard to collected wastes are large and consequently, a savings in resources is observed.

#### 4.4. Cardiac Surgery Operating Room

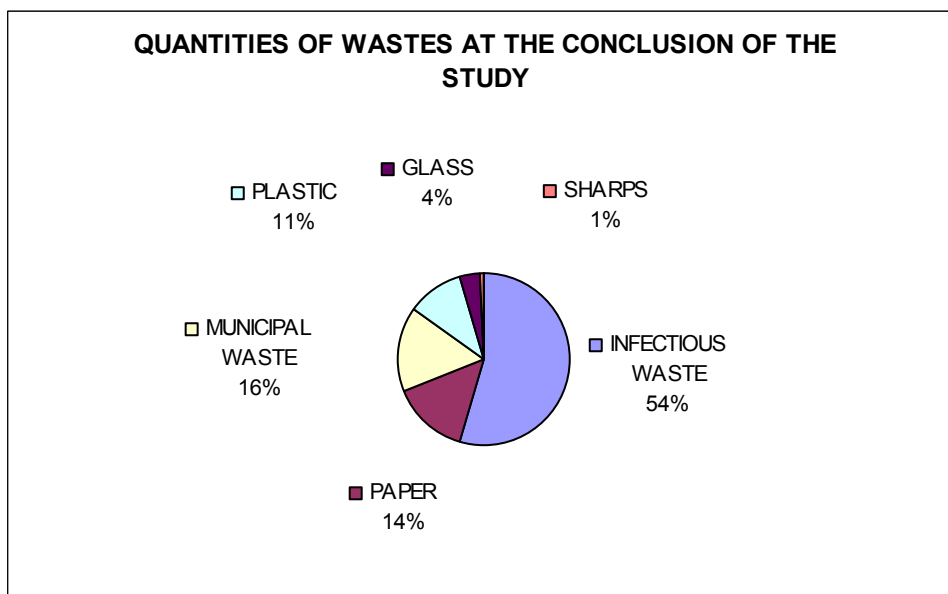
The Cardiac Surgery operating room is located within the operating block. Staff required for these types of procedures include: 1 cardiac surgeon, 2 assistants, 3 operative nurses, 2 perfusionists, 2 anaesthetics nurses and 1 general nurse, amounting to a total of 13 people. The aforementioned staff performs one open-heart surgery daily. In addition to open-heart surgery, they also perform unplanned operational procedures which include revision and arterial surgery. Depending on the demands of the operative procedure, more wastes are produced in this OP.

**Graph 21:** Quantities of waste prior to the start of the project in the Cardiac OP



Prior to the start of the pilot study, wastes were not separated. The quantity of non-segregated wastes in cardiac surgery OP was large with regard to operational procedures. Thus, prior to beginning the study, 11 % infectious wastes were produced which after autoclaving were sent to a landfill and an entire 89 % of municipal wastes were directly sent to landfills.

**Graph 22:** Quantity of wastes at conclusion of the study at the Cardiac OP



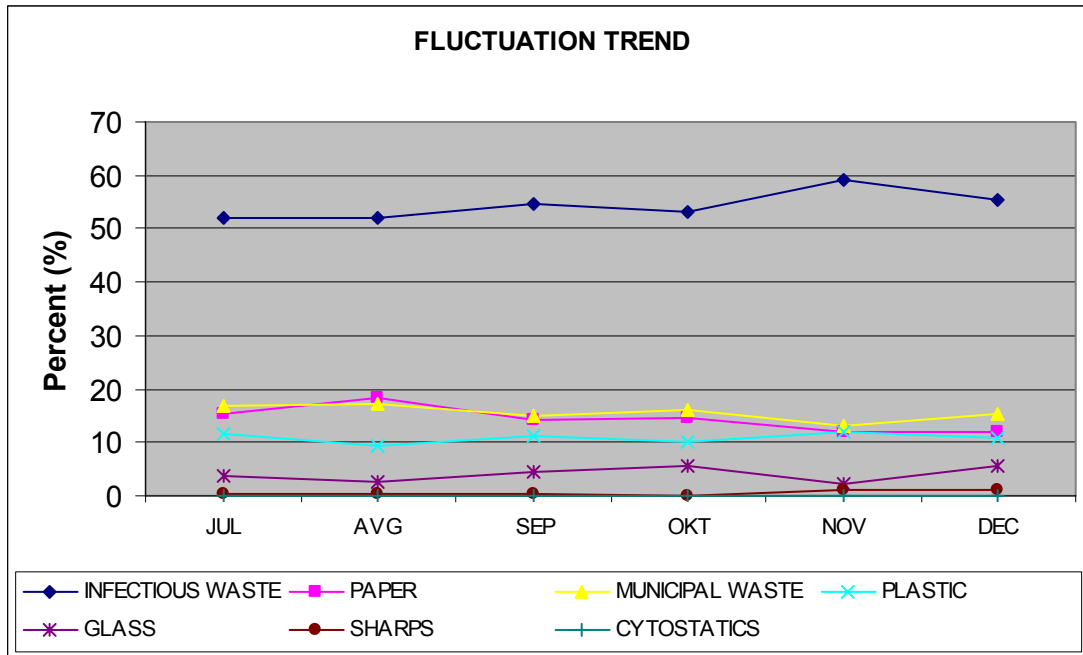
Of all arising wastes in the cardiac surgery OP, 55 % were first autoclaved (infectious wastes and sharps), 29 % recycled and only 16 % disposed of at landfills. Compared to the period prior to

implementation of the project, the share of wastes which were reprocessed (paper, plastic, glass) grew by one-third.

Single-use materials are not the sole materials used in this OP. The set for covering the operative field is a combination of cotton and disposable operating linens. The weight of a set amounts to 13 kg. Additionally a number of sets of instruments are used with a set for extracorporeal circulation being only one of many. Each set is wrapped in paper. Infectious wastes represent 54 % of all ensuing wastes. The heaviest infectious waste is the system for external blood circulation and a device which filters patients' blood – the celsever.

The cardiac surgery OP is a good example of how a large amount of money can be saved by separating wastes at their place of origin.

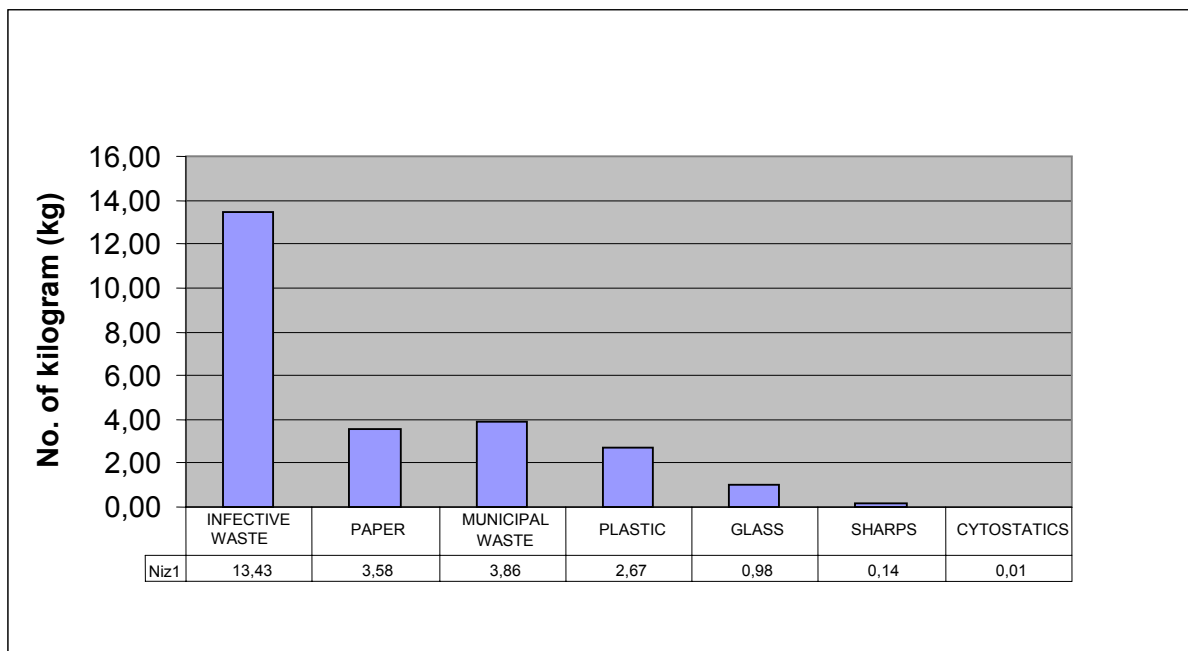
**Graph 23:** *Fluctuation of waste quantities at the Cardiac OP*



The quantity of wastes remained equal throughout the months with only the proportions of wastes changing. The share of paper fluctuated between 12 % (November) and 18 % (August), municipal wastes between 13 % (November) and 17 % (August), plastics between 9 % (August) and 12 % (July, November) and glass between 2 % (August, November) and 6 % (October, December). Infectious wastes represented the largest share of segregated collected wastes with a maximum of 59 % (November) and minimum of 52 % (July, August).

With regard to municipal wastes, a slight fall was noted, as well as a slight growth in infectious wastes with remaining fractions fluctuating within the same levels.

**Graph 24:** Quantity of wastes per patient undergoing operative procedures - Cardiac OP



The pilot study for the segregation of wastes at their place of origin lasted six months in the cardiac surgery OP.

The operating field is not covered entirely by disposable materials during operative procedures, but also with washable materials which can be reused.

The quantities of wastes originating from one operative procedure are in comparison with quantities of wastes in other Ops, considerably greater. Thus, for example, approximately 70 pads can be used during only one cardiac procedure.

#### 4.5. Problems in planning and implementing segregated waste collection

One of the main obstacles for the quality planning of a system of segregated waste collection is that exact quantities and types of wastes can't be foreseen in medicine. Only those which, as shown by the pilot study, are strongly dependent on the types of materials used, can be anticipated. It is undeniable that materials for single-use considerably increase the quantities of those wastes for which a suitable use has not been found. Thus, these are disposed of as municipal wastes.

The second problem arises with the manner of ordering materials. Health institutions order all materials through public tenders, always selecting the cheapest bidder. This method, unfortunately doesn't guarantee the products of high quality. The consequence of which is an inexcusable increase in wastes.

The hospital, at the time of the study, didn't have a designed logistics system for supply of materials, nor were there information supported programs for recordkeeping on the production of wastes from purchase to final disposal. Consequently, recordkeeping was always somewhat delayed. Additionally no standards for use of materials in individual operative procedures had been developed. This was affirmed during the period of the study, particularly since the quantities of wastes for similar operative procedures differed.

Procedures and surgeries which medical staff performed on patients is following a new trend, which to a large degree demand a greater amount of materials with subsequent increase in the production of larger quantities of diverse types of wastes.

The segregation of wastes would be more precise if the same employees always worked in the same organisational unit. When on call, the teams change shifts and all employees are not equally motivated and don't follow all the instructions.

It was also observed that doctors at the beginning of the project hadn't followed instructions regarding waste segregation. Surgeons from foreign countries took it upon themselves to search for containers

for the segregation of wastes which aided in making our operative staff aware of the seriousness of the problem.

We often experienced problems with patients, especially with those who were more handicapped. Their poor health sometimes posed as an obstacle to placing wastes in appropriate containers,

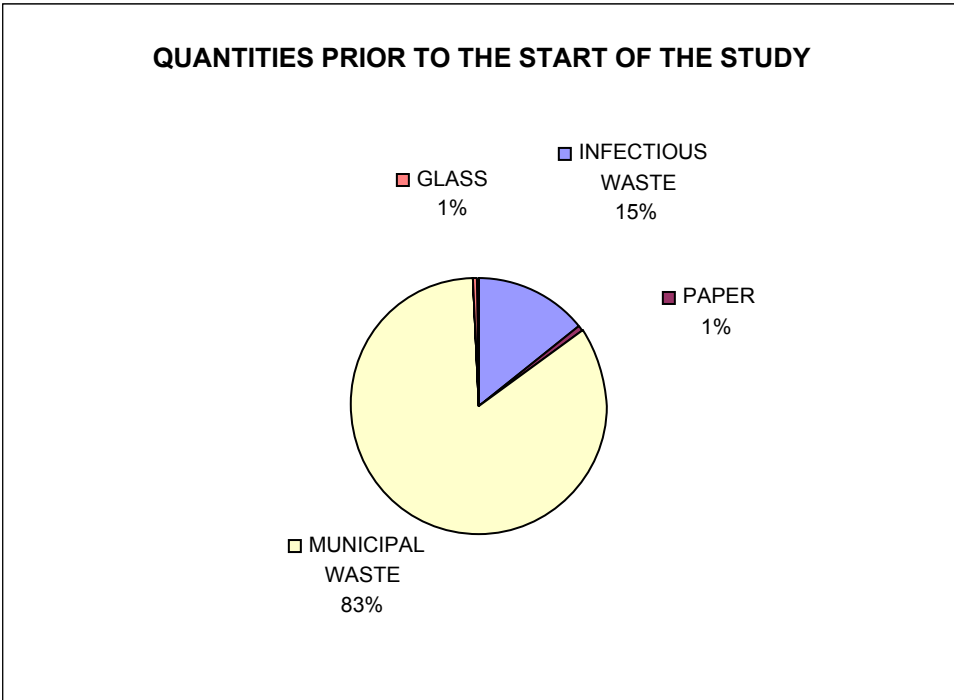
This problem also occurred during visiting hours. Visitors paid no heed to the instructions for waste segregation, We discovered that it wasn't enough to merely distribute informative materials or leaflets, but also to accompany the visitors during visiting hours and through conversation, motivate them to feel our dedication to the decrease of the quantities of waste and their related costs, as well as a positive attitude towards the environment.

Considerable amounts of time were devoted to the constant education and motivation of staff working or entering the organisational units during the course of the project.

A great deal of time was focused also on the acquaintance and education of patients and visitors. Expert control over all organisational units included in the pilot project was performed on a daily basis.

#### 4.6. Review of segregated collected wastes

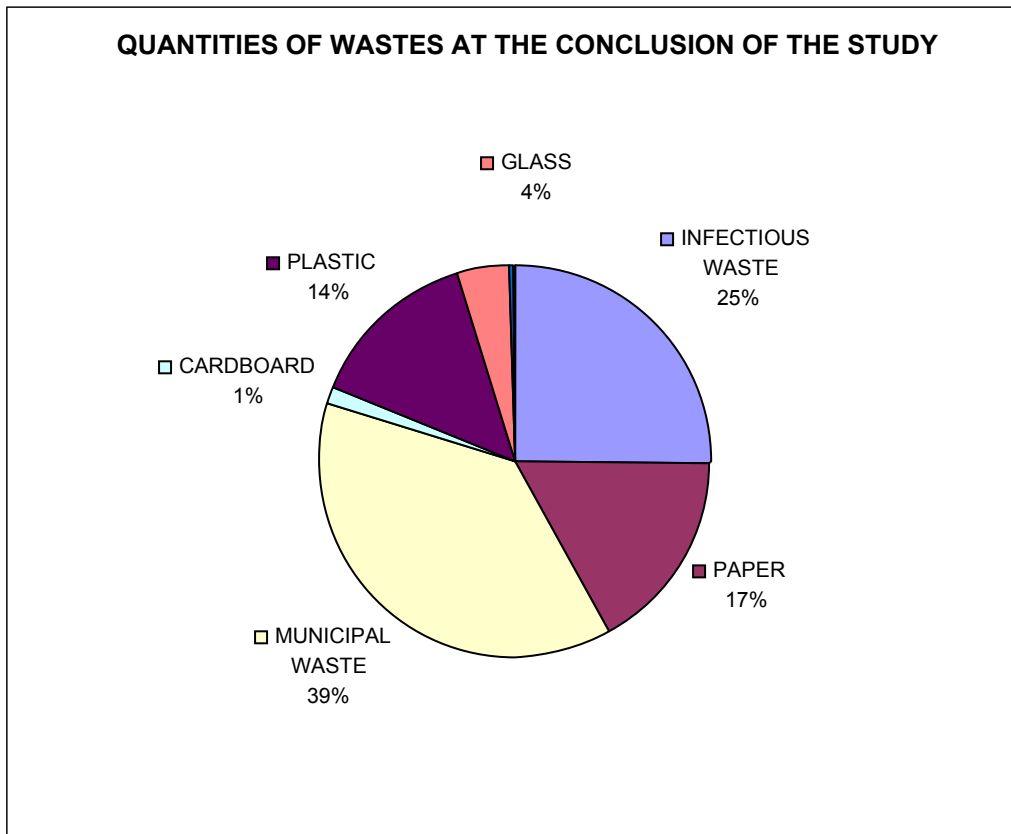
**Graph 25:** Grouped amounts of all wastes prior to commencement of the pilot study (All departments)



Prior to commencing the research, 83% of the wastes collected in all organisational units participating in the project were removed to landfills as municipal waste.

Only 15% had been infectious wastes needing treatment with only 2% of these wastes adequate for recycle.

**Graph 26:** Total quantities of segregated collected wastes at the conclusion of the pilot study (All departments)



During implementation of the pilot study, only 39 % of the separately-collected wastes were intended for direct disposal to landfills, 25 % were first autoclaved prior to disposal and 36 % were remitted for recycling.

Little paper ensues in the OP, with almost no cardboard. Large cardboard packaging is not brought into the operating block, but is unpacked at the entrance of the block. Only materials needed for one operative procedure are brought into OP with a minimum amount of packaging. The majority are assembled materials such as paper covered with plastic or plastified coats. Such collected paper is disposed of among municipal wastes.

Plastic wastes quantity-wise were few in the OP in comparison with other departments which included infusion bottles and plastified beverage bottles used by patients.

Glass packaging represented a small portion. A large amount was returned as returnable packaging to the hospital's pharmacy.

The quantity of used materials is in general dependent on the operators and on the extent of the operative procedure. Certain surgeons required more material than envisioned, using additional sterile sets.

Infectious wastes represent an increasingly growing problem in all organisational units. The quantities of these types of wastes are always too large. The amounts are also increasing on the account of using disposable materials and many times due to errors in separating wastes.

The study has shown that the quantity of infectious wastes remains too high and not enough fractions are being collected which can be reprocessed. These results refer to the flow of the pilot study in operative departments and OPs. Certainly, a greater amount of wastes occur in such organisational units, infectious wastes in particular.

The chief aim of the research was to decrease the quantity of municipal wastes through segregated collected fractioning which as supported by this pilot study.



It was determined that the number of transports of wastes from organisational units could also be decreased, namely from three runs to only one per day. The number of PE bags used can be decreased, as well as labour costs regarding the transport of wastes.

Regardless of all the problems encountered during the project, the quantity of wastes disposed of at landfills decreased by half due to segregated collected fractioning.

This represents sufficient proof on the basis of which Maribor General Hospital will continue endeavours to collect wastes at their points of origin in all organisation units of the hospital.

#### **4.7. Measures for improving the state of waste management**

In order to improve the management of wastes, it is of extreme importance that the process from the purchase of materials to their final use be followed. All locations for the segregated collection of all types of wastes in the establishment should be transparently marked. With regard to acquaintance of staff and visitors with all the materials used in health establishments, with a little discipline the correct segregation of wastes with the intention of lowering environmental burdening and rationalisation of costs can be achieved.

An effective information system allowing for the supervision of material flows and optimisation of their use must be designed.

In order to carry out the pilot project of separation of materials throughout the entire hospital, a large share of organisation was required. First, persons had to be named who would directly manage waste management on the level of the entire hospital.

The purchase of a sufficient number of containers for the segregation of wastes by fractions would be of primary importance. The containers should be as easy to maintain as possible and should be transparent for each type of waste separately. Their size is dependent on the envisioned quantity of ensuing wastes in the organisational units. Further, systematic supervision of all employees regarding separation of wastes and marking bags of wastes is needed prior to the waste leaving the organisational units.

The following measures are necessary on the level of the entire hospital:

1. Preparation of basic documents on waste management which are based on the internal acts of the establishment, namely:
  - o Waste Management Plan which should encompass all forms of wastes
  - o Work instructions (waste management in individual organisational units)
  - o Reports (e.g. collection, annual);
2. Employment of a responsible person to lead logistic management of wastes at Maribor General Hospital;
3. Employment of a person to supervise operative tasks regarding waste management;
4. Archiving of legally prescribed records and archives of documents (for each individual calendar year for a period of 5 years);
5. Review of the contents of bags of waste;
6. Ensure the regular transport of wastes from departments;
7. Ensure safe transport of wastes from departments;
8. Introduction of weighing of wastes ensuing in health activities, particularly hazardous wastes;
9. Placement of containers for all fractions in the area of the ecological island;
10. Conclusion of agreements with companies for individual types of wastes;
11. Constant monitoring of changed quantities of wastes and costs of ensuing wastes;
12. Ensure adequate qualification of staff;
13. Education of patients and visitors in the separation of wastes and
14. Development of standards for the uses of materials for defined procedures.

#### **4.8. Measures for decreasing quantities and problems associated with wastes**

A system for the identification of sources of wastes, their reduction and how to attain these goals must be designed for the Maribor General Hospital.

In the future, it will be necessary to think about not only on a qualitative level, but also on the quantitative reduction of wastes. Regarding qualitative reduction of wastes, it is sensible to use such measures as medical gloves made of latex instead of PVC, the use of infusion tubing, syringes and bottles which don't contain PVC, the use of digital thermometers, the use of polyethylene bags for

collecting wastes, the use of office paper not containing bleach, decrease the use of single-use materials to name only a few.

On a quantitative level, medical wastes could be reduced through the use of washable, water-proof materials which breathe instead of disposable paper covers. Instead of wrapping instruments in three layers, perhaps containers could be used in operating rooms. A rationalisation of costs could include the preparation of suitable sets of instruments for surgical procedures, decreasing individual packaging and reducing the amount of packaging required. Staff in the operations block should not use accessories and containers for single-use when not absolutely necessary. Plastic protective clothing for visitors should not be used if not absolutely necessary within a medical viewpoint. Medical staff should use protective disposable gloves only in those procedures which are necessary and founded.

To the greatest extent, the amount of materials for single-use should be dramatically reduced and replaced with materials which could be reused more times.

#### 4.9. Display of costs of wastes

##### 4.9.1 Total quantities of wastes at Maribor General Hospital for 2004

Regarding the size of Maribor General Hospital and in order to get a better picture of ensuing quantities of wastes in the hospital, the following tables are represented. These display the quantities of ensuing municipal wastes, infectious wastes, cytostatics, expired medicines, paper and glass. Also shown are average monthly and daily quantities of ensuing wastes.

With regard to the share of hospital beds occupied on the various wards, it can be deduced that an average of 1026 patients received medical care each day, with a 78 % hospital bed occupancy.<sup>30</sup>

**Table 1:** Quantities and types of wastes in 2004 for Maribor General Hospital

Wastes	Municipal wastes in kg	Infectious wastes in kg	Cytotox., cytostat., medicines in kg	Paper and cardboard in kg	Glass packaging in kg	Expired medicines in kg
Quantity of produced wastes in 2004	1,221,150	63,354	220	44,540	15,600	90
Average monthly quantity	101,762.50	5,279		3,711	1,300	
Average daily quantity	3,392	173		122	42	
Quantity per patient per day	3.30	0.17		0.11	0.040	

Prior to commencement of the study, the hospital separately collected only infectious wastes, cytotoxic and cytostatic medicines and expired medicines.

From the table it can be seen that on average 3.30 kg was produced per patient per day, which is certainly too high an amount. Among municipal wastes, the hospital also included packaging, absorptive materials, metals, wood, composte materials and others contributing to a great quantity of municipal wastes. This results in a relatively small amount of collected wastes which can be reprocessed or recycled (paper, glass, plastic, metals...).

Public municipal waste companies which perform reprocessing of such wastes on a contractual basis again sort, bale and dispose of the remainder in gravel pits.

Infectious wastes are autoclaved and later disposed of as municipal wastes.

Costs arising from the reprocessing of municipal and infectious wastes are high and represent a challenge regarding their reduction.

These costs represent secondary raw materials which are covered by packagers, producers, exporters within the waste packaging management system and thus free of charge. The same is true for plastic, paper, metal and assembled packaging which the end user can remit to the consignee free of charge.

From the abovementioned, it clearly follows that it is necessary to manage the process of waste packaging treatment in a way so that as much waste is collected separately which can be reprocessed or recycled, simultaneously not producing additional costs or those with which a trade can be made.

#### 4.9.2 Costs of wastes at Maribor General Hospital

The majority of costs tied to waste management arises from the disposal of so-called "municipal wastes" which the Public Municipal Company Snaga transports to a sorting centre, sorting the wastes so as to separate still useful fractions, transporting the remainder to Dogoše for baling. Baled wastes are temporarily stored in an abandoned gravel pit since the City Municipality of Maribor doesn't own its own landfill. Collected municipal wastes are also charged an environmental tax for disposal of wastes. All these costs for collecting packaging and other materials suitable for recycling or respectively reprocessing can be avoided. Some of the segregated collected wastes even represent an interesting trade element which can be sold (metals, paper...).

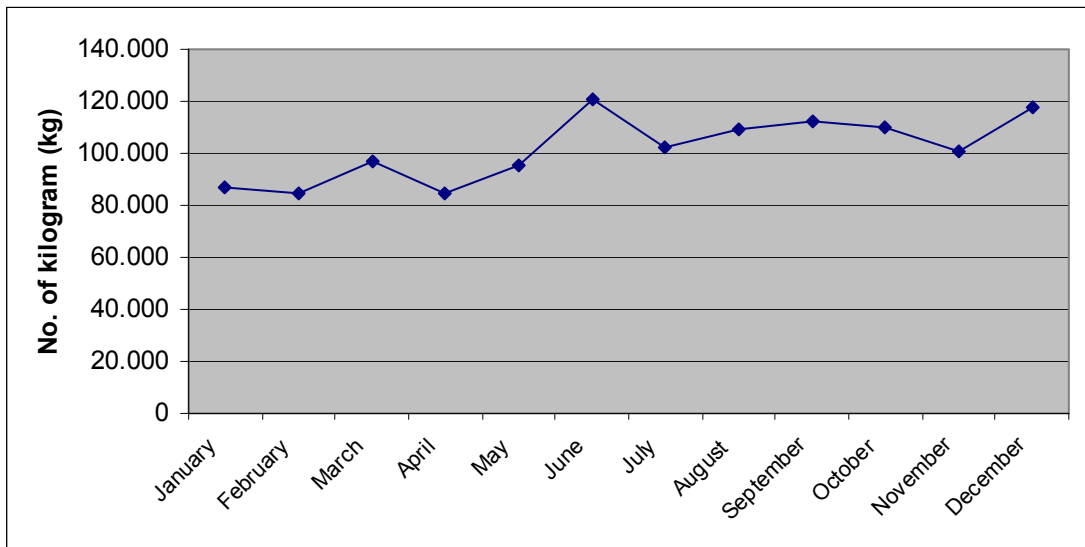
The table and graphs below show costs which arose through the consigning of individual types of wastes to authorised consignees. The cost of consignment do not include costs produced by personnel handling these wastes on the territory of Maribor General Hospital, nor the costs of containers, bags, internal transportation of wastes, etc.

**Table 2:** *Fluctuation of quantities and costs of municipal wastes for 2004*

Month	Quantity of produced waste in kg	Value in SIT
January	86,800	2,088,565.60
February	84,700	2,038,035.79
March	96,600	2,324,371.40
April	84,700	2,038,035.79
May	95,550	2,299,106.49
June	120,400	2,897,042.61
July	102,550	2,467,539.20
August	109,550	2,635,971.91
September	112,000	2,694,923.36
October	110,250	2,652,815.18
November	100,450	2,417,009.39
December	117,600	2,829,669.53
TOTAL	1,221,150	29,383,086.24

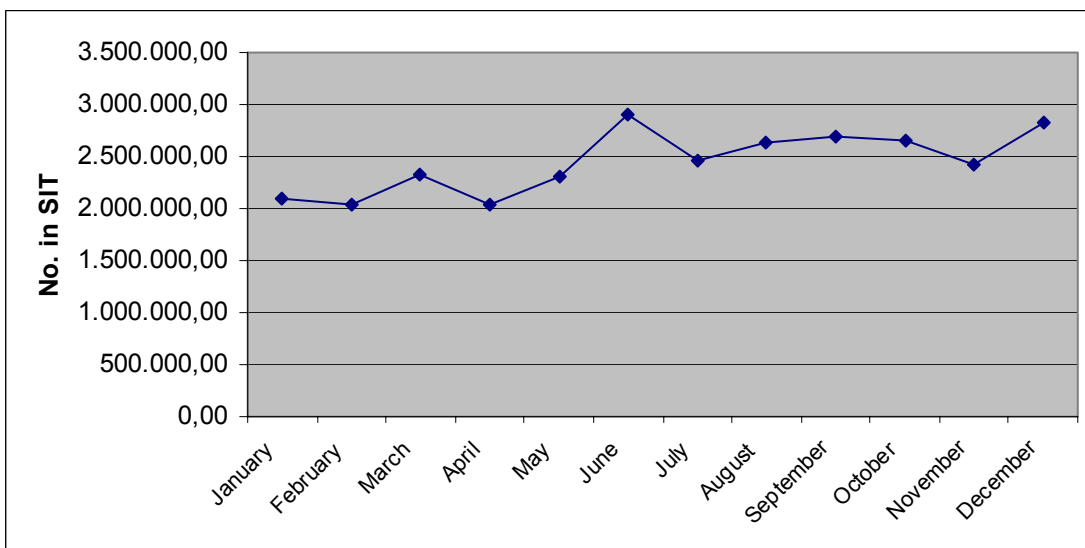
The trend in movements of quantities and costs of ensuing wastes in 2004 are visible in the tables and graphs. The prices include the removal of wastes and taxes for environmental burdening. The price of transport is a lump sum with regard to the volume of the trailer and not the quantity of waste in it.

**Graph 27:** Fluctuations of quantities of municipal wastes at Maribor General Hospital in 2004



National tax and consignment costs are included in the costs of municipal wastes.

**Graph 28:** Costs associated with municipal wastes at Maribor General Hospital in 2004



The amount of municipal wastes is slightly growing due to the use of single-use materials. A large amount of diverse packaging finds its way to the hospital which, if properly managed, could be reprocessed free of charge.

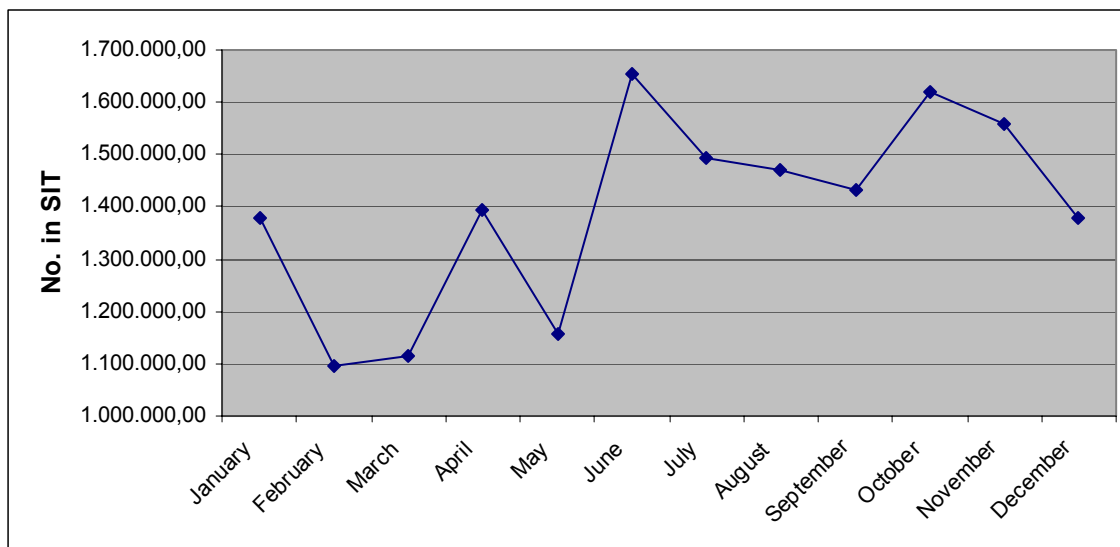
**Table 3:** Fluctuations *in quantities and costs of infectious wastes in 2004*

Classif. No.	Month	Quantity of produced waste in (kg)	Value in SIT (removal, disinfection, tax)
18 01 03*	January	5,235.00	1,377,564.34
18 01 03*	February	4,159.00	1,095,683.77
18 01 03*	March	4,231.00	1,116,258.81
18 01 03*	April	5,281.00	1,395,117.40
18 01 03*	May	4,369.60	1,155,527.83
18 01 03*	June	6,249.55	1,655,726.41
18 01 03*	July	5,625.55	1,494,406.34
18 01 03*	August	5,541.25	1,471,619.96
18 01 03*	September	5,394.05	1,432,819.88
18 01 03*	October	6,101.50	1,620,408.61
18 01 03*	November	5,871.60	1,559,151.09
18 01 03*	December	5,295.30	1,377,287.41
	TOTAL	63,354.40	16,751,571.85

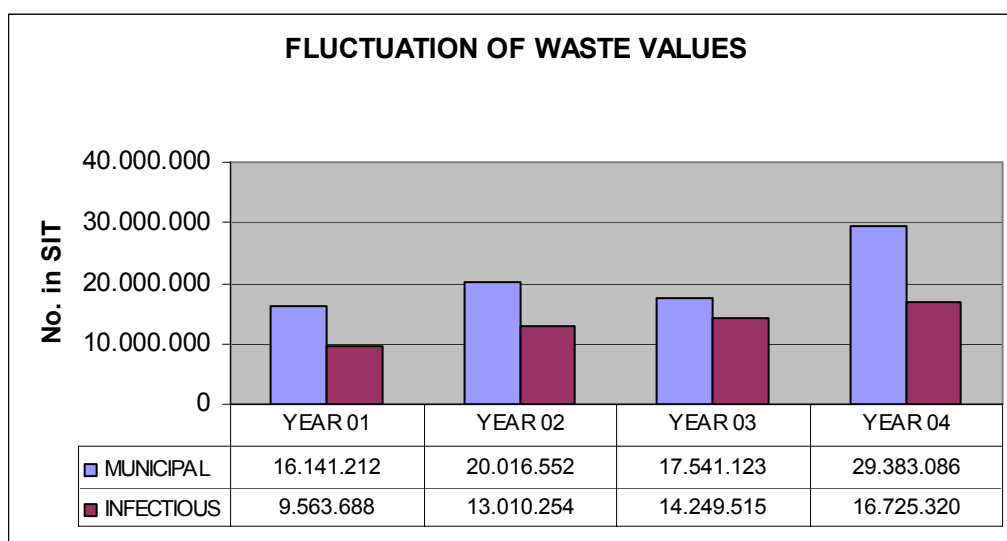
Costs of consignment, autoclaving and disposal of wastes are included in the costs.

The quantities of infectious wastes fluctuate, but looking at the quantities throughout the year, it can be seen that the quantities are increasing. At the end of the year, quantities began to slightly decrease due to the decrease in the number of procedures performed in December due to the holidays.

**Graph 29:** *Fluctuation of costs for infectious wastes in 2004*



**Graph 30: Comparison of costs for wastes at Maribor General Hospital**



From the table, it is evident that costs associated with municipal and infectious wastes are rising. In 2004, due to baling of municipal wastes, the cost for municipal wastes has greatly increased.

**Table 4: Costs per individual types of waste**

WASTES in SIT	MUNICIPAL	INFECTIOUS	CYTOTOXIC MEDICINES
Processing costs	29,383,086	16,751,571	78,760
PVC bags – cleaning service	7,824,000		
PVC bags – Maribor Gen. Hosp.	3,728,637	1,202,559	8,000
Sharps container		2,354,271	
Halibox collector		870,100	
Monthly labour costs	2,340,000		
TOTAL	43,275,723	21,178,501	86,760

When calculating the costs of individual types of wastes, all material costs linked to the segregation of wastes have been included. These are PE bags, containers for sharps and haliboxes for infectious wastes.

Also taken into account was the direct cost of labour for the amount of waste collected and transported to the ecological island of Maribor General Hospital in 8 hours.

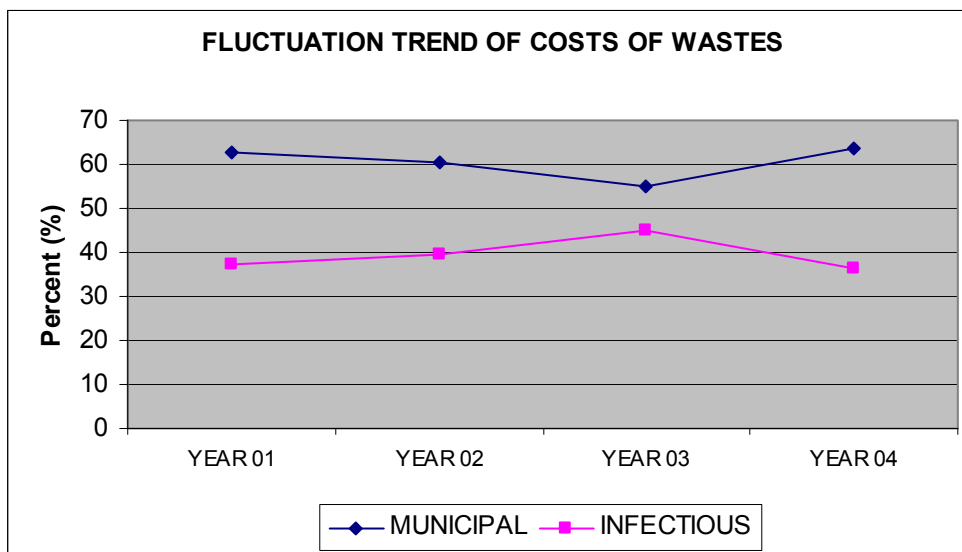
All other wastes originating from the performance of health activities was not included in the price of reprocessing wastes at the hospital.

When showing waste management costs, not all invisible waste management costs are included. These costs regard:

- Internal business regarding wastes and their related costs,
  - Organisation of a temporary storage space,
  - Purchase of containers for storage
  - Cleaning costs,
  - Personnel and related costs of labour, education and qualification,
  - Costs of protective equipment for personnel transporting wastes.
- Change method of waste management and disposal to outside consignees
- Costs of environmental tax and excises
- Preparedness for possible extraordinary situations
- Insurance
- Acquisition of permits and long-term commitments to the environment

- Possible fines for improper waste management.<sup>36</sup>

**Graph 31:** Fluctuation of costs of Maribor General Hospital by year



We have observed a slight fall regarding movement of costs whereas the price for reprocessing municipal wastes is growing.

#### 4.9.3 Total quantities and costs at LKH UK Graz in 2004

The following quantities of all wastes, including non-medical is displayed for LKH UK Graz for 2004:

Hazardous wastes	total quantity: 235 tons
126 tons hazardous medical wastes	420 000 €
2.2 tons radioactive wastes	100 000 €
41 tons chemical wastes from RTG	15 000 €
TOTAL...235 tons	582 000 €
Non hazardous wastes	total quantity: 2987 tons
1400 tons municipal wastes	390 000 €
100 tons packaging and plastic	free of charge
490 tons of old paper (including paper containing confidential information)	2 300 €
400 tons food rests	36 000 €
TOTAL...2987 tons	470 000 €

All together there were 3,222 tons of waste, the management costs of which amounted to 1,052,000 €.<sup>37</sup>

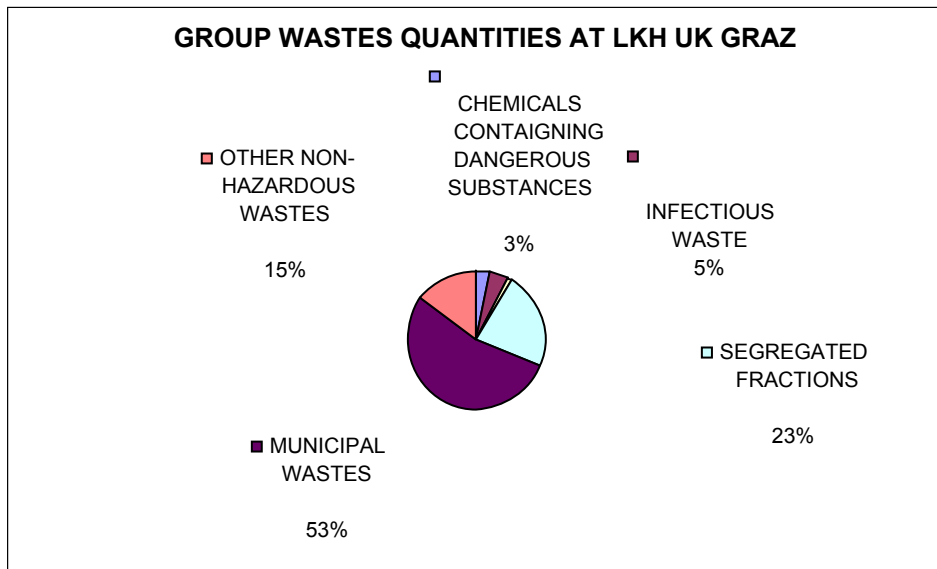
To illustrate the magnitude of the quantities it should be mentioned that 1,400 tons of hazardous wastes represent the quantity of wastes which approximately 10,500 residents would produce, whereas the 100 tons of plastic packaging and plastic and 490 tons of old paper would be produced by roughly 6,600 residents!

Interesting is also the fact that one could produce 180,000 KW hours of electricity or 316,000 KW hours of heat from the 400 tons of uneaten food.

The figure below shows the quantity of wastes which LKH UK Graz collected separately in 2004 from hospital departments.

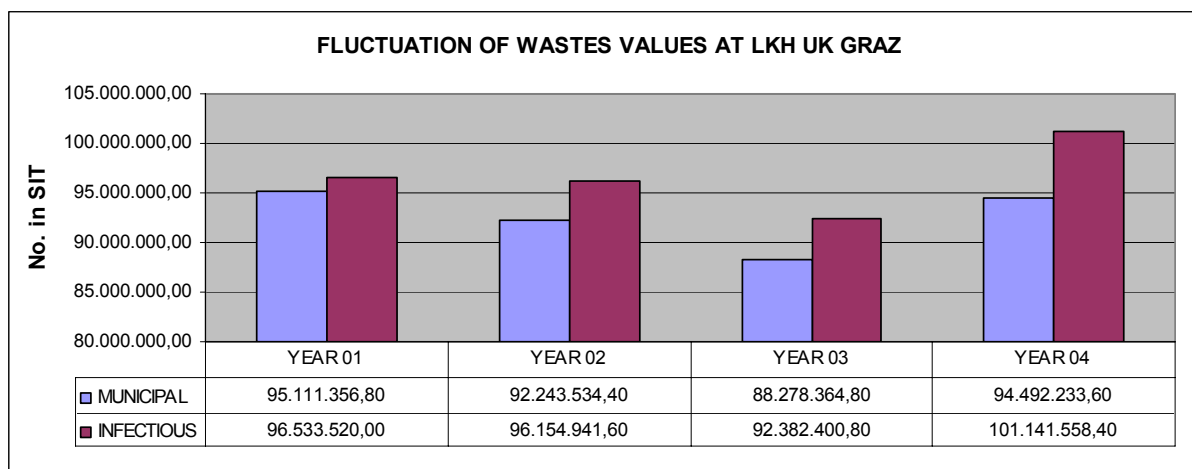
<sup>36</sup> Pribaković Borštnik, A., Zornik, M., Žagar, T., Odgovorno okoljsko delovanje; Slovenski inštitut za kakovost in meroslovje; Ljubljana 2004, pp.39-45.

**Graph 32: Total quantities of wastes at LKH UK Graz**



From the graph it is evident that at LKH UK Graz, they collected separately 53 % municipal wastes, 23 % segregated fractions (paper, plastic, glass, cardboard), 5 % infectious wastes, 3 % dangerous chemicals and 15 % other dangerous wastes.

**Graph 33: Comparison of costs by year at LKH UK Graz**



From 2001 to 2003, the quantity of municipal and infectious wastes decreased.<sup>37</sup>

In 2004 the quantities of municipal wastes increased by 7 % whereas the quantity of infectious wastes increased by 9.4 %. The reason was the increased number of treatment days and larger number of hospitalised patients.

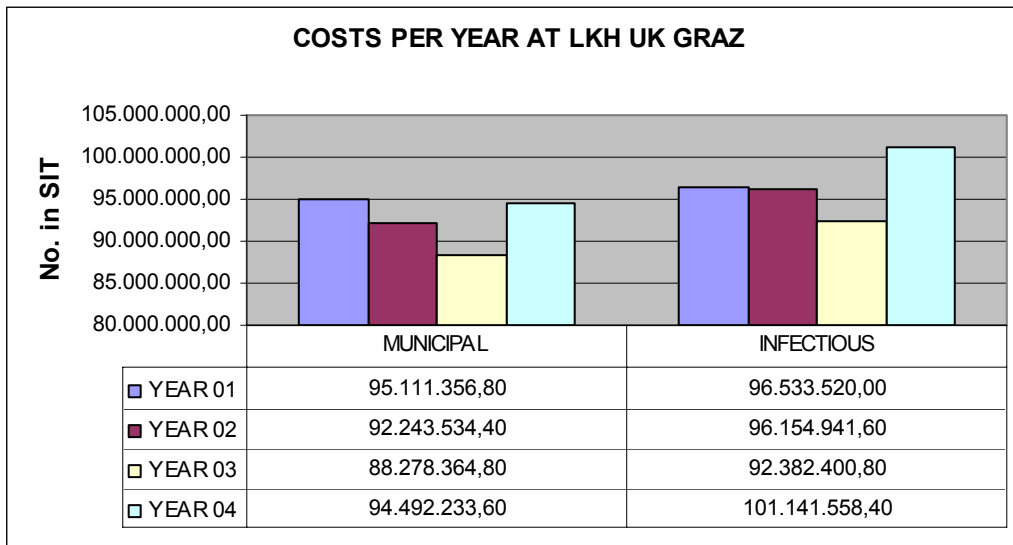
The number of treatment days increased from 529,584 in 2003 to 538,517 in 2004.

This is an increase of 8933 treatment days, meaning an increase of 1.6% in 2004. In 2003, the number of hospitalised patients was 454,568 and in 2004, 460,549. There were 5,981 patients in 2004, or 1.45 % more hospitalised patients than in 2003.

<sup>37</sup> Umwelt Umdenken, LKH. Graz, Abfallwirtschaftskonzept 2003



**Graph 34:** Comparison of costs by fraction at LKH UK Graz

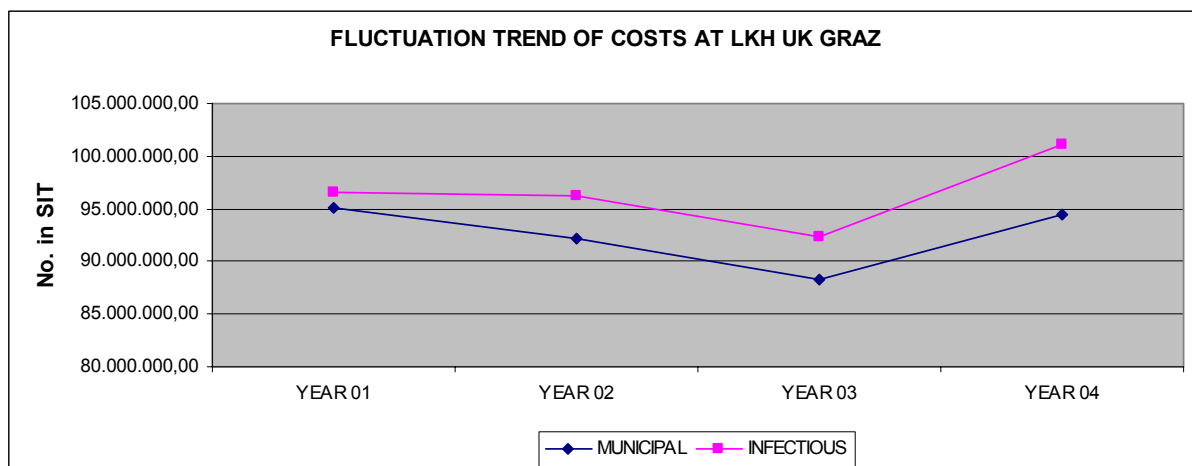


From 2001 to 2003, costs due to municipal and infectious wastes decreased, whereas in 2004, costs rose due to a larger quantity of these wastes.

A comparison of the quantities and costs of handling and managing wastes with the Maribor General Hospital is almost impossible.

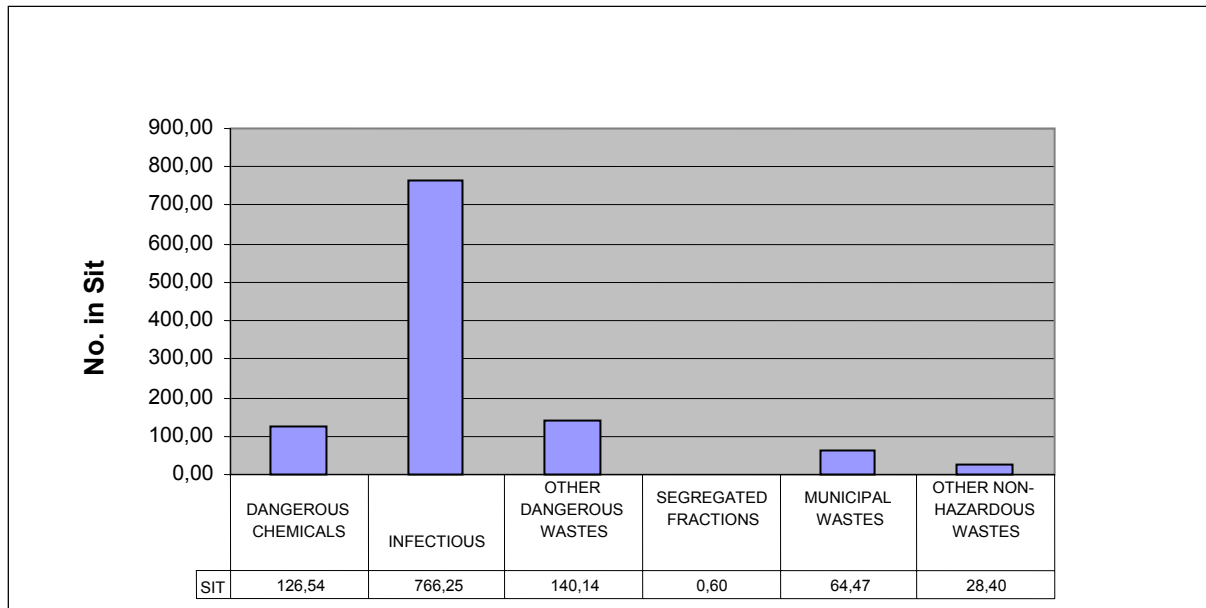
LKH UK Graz has a logistics system developed for the segregation of all types of wastes which originate at the hospital. When looking at costs at LKH UK Graz, it is found that costs, in contrast with Maribor General Hospital have fallen regarding all types of wastes. LKH UK Graz endeavours to improve the existing situation so as to lower costs even more. Thus, they have created criteria for reducing wastes and the costs associated with them.

**Graph 35:** Fluctuation of costs by year



Costs of reprocessing wastes are dependent on the type of waste.

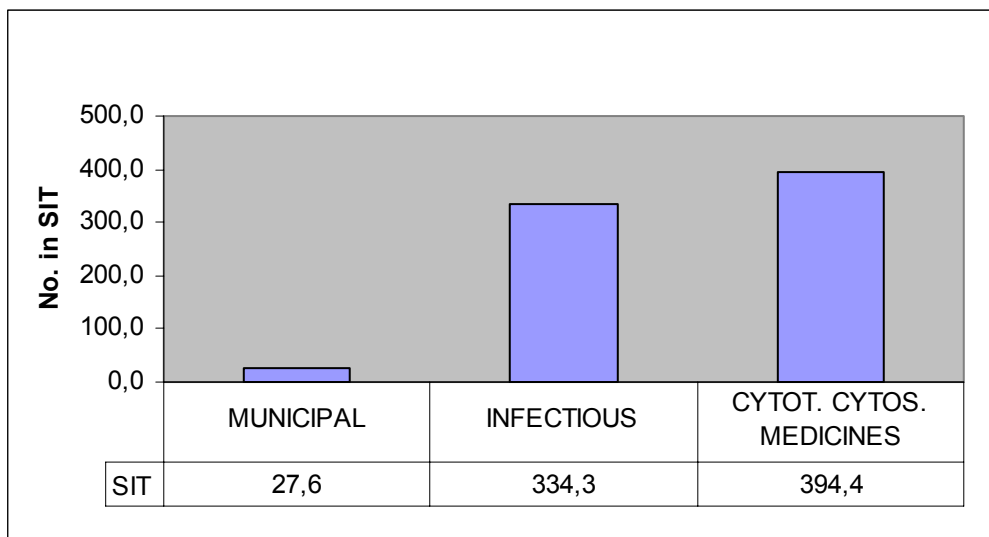
**Graph 36:** Cost per kilogram of produced waste at LKH UK Graz



The largest cost at UKH UK Graz is represented by the costs of reprocessing infectious wastes and the lowest costs can be attributed to segregated fractions.

At Maribor General Hospital, the largest cost is represented by the destruction of dangerous chemical wastes sent to incineration. Another large cost arises from autoclaving and the disposal of infectious wastes.

**Graph 37:** Cost per kilogram of produced waste at Maribor General Hospital

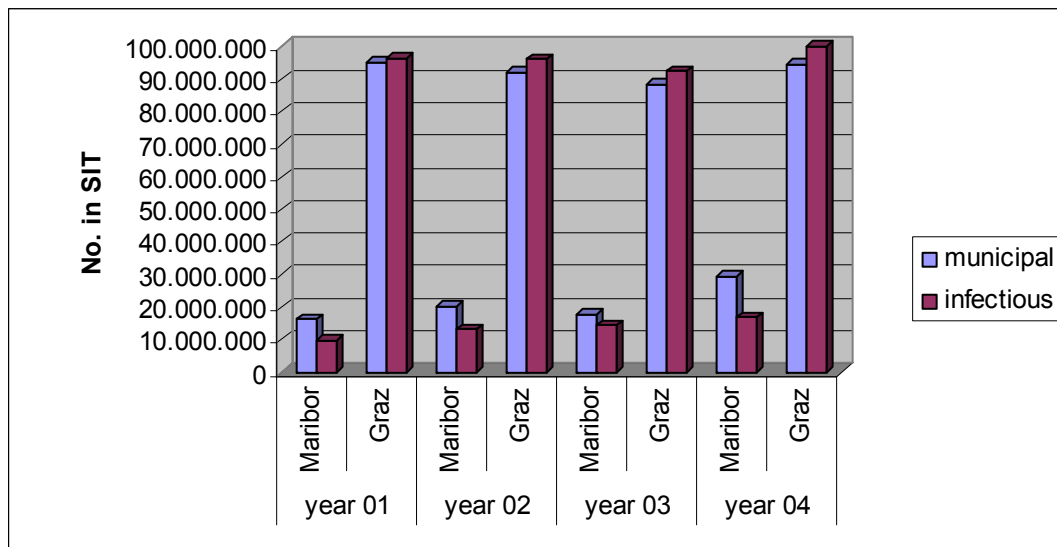


4.9.4 Comparison of waste management costs of Maribor General Hospital and LKH UK Graz

**Table 5:** Comparison of costs at Maribor General Hospital and LKH UK GRAZ

Wastes	YEAR 01		YEAR 02		YEAR 03		YEAR 04	
	Maribor	Graz	Maribor	Graz	Maribor	Graz	Maribor	Graz
Municipal	16,141,212	95,111,356	20,016,552	92,243,534	17,541,123	88,278,365	29,383,086	94,492,234
Infectious	9,563,688	96,533,520	13,010,254	96,154,942	14,249,515	92,382,401	16,725,320	101,141,558
TOTAL	25,704,900	191,644,876	33,026,806	188,398,476	31,790,638	180,660,766	46,108,406	195,633,792

**Graph 38:** Comparison of costs at Maribor General Hospital and LKH UK Graz



The figures in Table 5 and the graph above show that costs from waste management were much higher at LKH UK Graz than at Maribor General Hospital. LKH UK Graz performs more examinations and services, with larger clinics and a large number of hospitalised patients than Maribor General Hospital.

## 5. CONCLUSION

With the increasing pollution of the human environment, healthcare professionals, particularly due to inappropriate handling of wastes, have realised that a lot must be changed in this area. Deliberating improvement led to the decision to realise the pilot project for the segregation of wastes at their point of origin.

In any case, a good example of effective waste management is certainly Austria.

LKH UK Graz is well aware of environmental burdens produced by wastes and the costs associated with them.

With the aide of the pilot study, it was determined that in comparison with Austria, the treatment and management of medical waste differs considerably at Maribor General Hospital. The greatest difference in the system of waste management was certainly the quantity of segregated collected waste.

Until now, Maribor General Hospital had segregated only those fractions for which it was legally responsible. These include infectious wastes, sharps, cytostatics, dangerous chemical wastes and several other types of non-medical wastes.

Segregation of wastes in Austria is comparable to the segregation of wastes implemented during the pilot study at Maribor General Hospital. The difference was in the processing of wastes and segregation of several fractions originating in healthcare as a consequence of work operations and is not strictly medical wastes.

In Austria, incineration facilities are designed as thermal, energetic, co-generational facilities where combustible wastes are used as an energy source for the simultaneous acquisition of heat and electrical energy. Nevertheless, the goal of LKH UK Graz is to segregate wastes into as many fractions as possible so that as many substances can be reprocessed – recycled and decrease to a minimum, the incineration of wastes. This kind of waste management produces considerably less costs and requires a high degree of dedication and awareness from the staff and all others who produce wastes at LKH UK Graz. The results of this kind of program are seen in the annual decrease in the quantities of wastes and costs produced.

Maribor General Hospital, due to the decreasing amount of money received from the State, is increasingly more orientated to the reduction of operating costs. Thus, a system must be set up for the correct treatment and management of wastes which represent one of the most significant environmental and cost bases.

If improvement of the process of treatment and management of wastes in such a large institution as a hospital is desired, the knowledge, understanding and motivation of the employees must be increased. An understandable policy, formed criteria and standardised procedures which make up the foundation for the implementation of measures in the area of waste management.

Knowledge of the connection between purchased items and subsequent wastes is an interesting area for the hospital, for it is possible to show which possibilities exist regarding the treatment of waste in the area of waste management, leading to possibilities to reduce costs.

An information supported system to supervise entry materials and the quantitative valuation of products containing harmful substances is the basis for the creation of strategies for the effective cessation of use of such products. Therefore, it is possible to decrease the amount of substances polluting the environment which include such substances as PVC and mercury.

The hospital should set requirements for suppliers and demand environmentally friendly products. In this way, the hospital's public image would be improved leading to the greater satisfaction of both the patients and staff.

The pilot study at Maribor General Hospital has shown that a large number of things still need to be changed to achieve the set goals and to attain the logistics level of waste management in our neighbouring country Austria.

Passing on the experience and knowledge attained during the pilot study's implementation to all organisational units of the hospital.

Although each hospital is unique, the stated example could serve as an aid for creating improvements which would create opportunities for the institution and contribute to the reduction of costs.

## 6. SUMMARY

Waste is our reality and we have to deal with its negative effects also in healthcare. The basic principle of handling waste in healthcare is to resolve waste problems at their source, design preventive measures and respect the rule of returning to nature.

More and more, healthcare officials are realising the necessity of changing their relationship to the environment. Environmental awareness must be raised, both that of the staff and that of the patients. That is why, one of the following goals of handling waste is also the education and training of the staff. Handling and managing of waste in healthcare is a major project and all the employees have to understand that with their proper handling of wastes they protect the environment and not increasing their wages.

This pilot study has shown us, that with little discipline and no greater costs as usual, we can do a lot. The quantity of municipal wastes have decreased because of the separation of paper, glass, metal and plastics. Also through monitoring of the quantity of generated wastes and determination of their actual status, the infectious wastes have decreased.

To sum up, it is necessary to regulate the final procession of wastes and to build a proper incineration plant, which will energetically take advantage of wastes.

## POVZETEK

Odpadki so naša stvarnost, z njihovimi negativnimi učinki se moramo soočiti tudi v zdravstvu in ga čim bolj reševati.

Temeljno načelo ravnanja z odpadki v zdravstvu, je reševanje problematike odpadkov na izvoru, načelo preventive in načelo vračanja naravi.

Eden izmed načinov pristopa k uveljavitvi ciljev ravnanja z odpadki je izobraževanje, usposabljanje in informiranje zaposlenih.

Ločevanje odpadkov v zdravstvu je velik projekt, v katerem morajo sodelovati vsi zaposleni, ki se morajo zavedati, da ločujemo odpadke zato, da varujemo okolje in ne za dodatno plačilo.

S pilotsko študijo smo dokazali, da z malo discipline in ne prevelikimi stroški lahko veliko naredimo. Količine komunalnih odpadkov so se zmanjšale na račun ločeno zbranega papirja, stekla in plastike. Ob stalnem preverjanju količin in vsebine košev z ločeno zbranimi odpadki, so se zmanjšale tudi količine kužnih odpadkov.

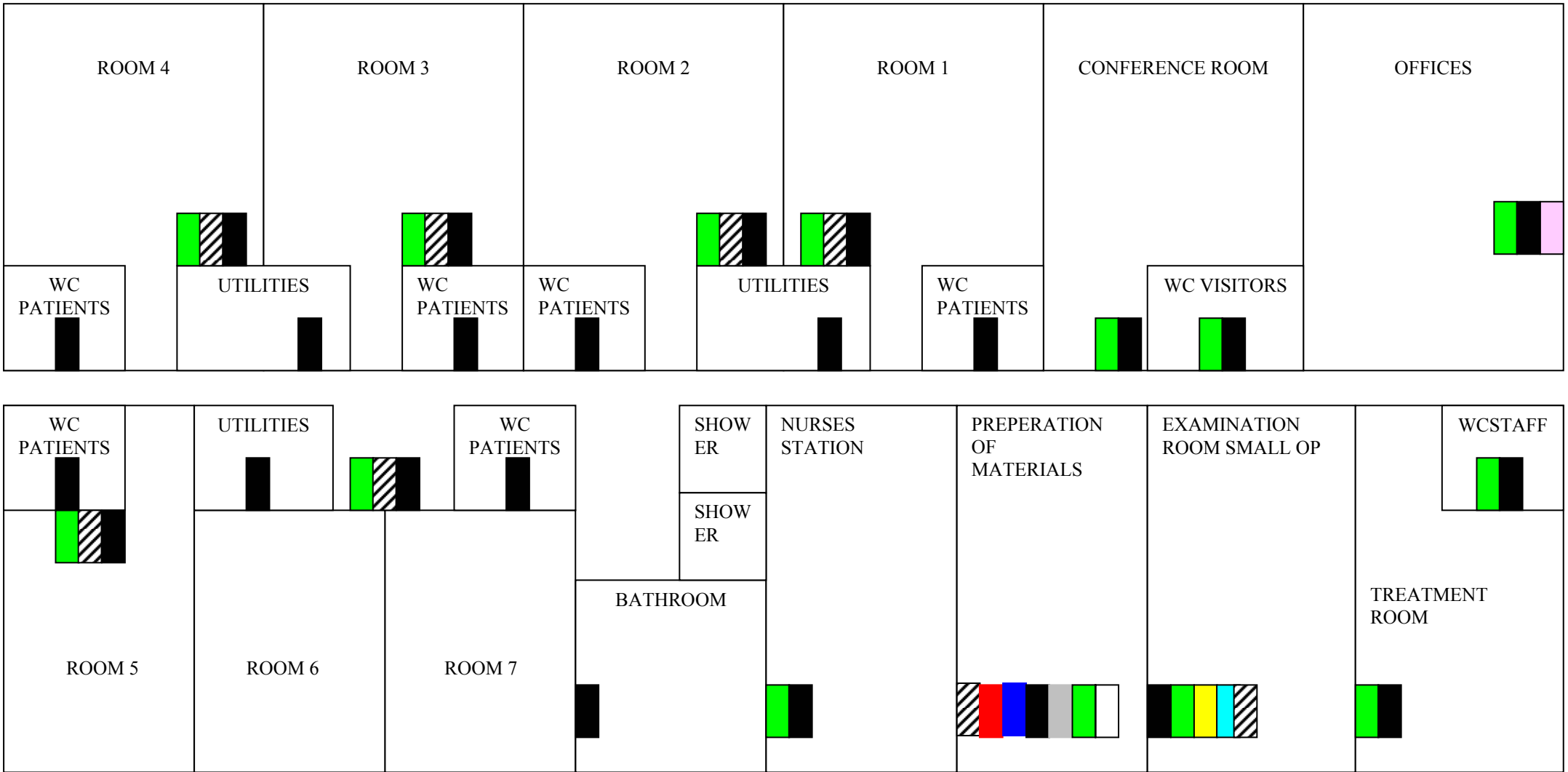
Na nivoju države, bo potrebno urediti končno procesiranje odpadkov, zgraditi sežigalnico, ki bo odpadke energetsko izrabila.









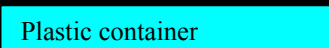
## 7. LITERATURE AND SOURCES

- <sup>1</sup>Environmental Protection Act (Official Gazette of the RS, No. 39/06  
Zakon o varstvu okolja (Ur. l. RS št. 39/06)
- <sup>2</sup>Rules on the management of waste (Official Gazette of the RS, No. 84/98; modifications and amendments - Nos. 45/00, 20/01, 13/03  
Pravilnik o ravnanju z odpadki (Ur. l. RS št. 84/98, 45/00, 20/01, 13/03)
- <sup>3</sup>Rules on the management of waste generated by health services and related research activities (Official Gazette of the RS, No. 47/04)  
Pravilnik o ravnanju z odpadki, ki nastanejo pri opravljanju zdravstvene dejavnosti in z njo povezanih raziskavah (Ur. l. RS št.47/04)
- <sup>4</sup>Decree on management of packaging and packaging waste (Official Gazette of RS, No. 84/06)  
Uredba o ravnanju z embalažo in odpadno embalažo (Ur. l. RS št. 84/06)
- <sup>5</sup>Decree on the landfill of waste (Official Gazette of the RS, No. 32/06;  
Uredba o odlaganju odpadkov (Ur. l. RS št.32/06)
- <sup>6</sup>Order on the management of separately collected fractions in the public service of urban waste management (Official Gazette of the RS, No. 21/01)  
Odredba o ravnanju z ločeno zbranimi frakcijami pri opravljanju javne službe ravnanja s komunalnimi odpadki (Ur. l. RS št. 21/01)
- <sup>7</sup>Decree on environmental tax for environmental pollution caused by waste disposal (Official Gazette of RS, Nos. 129/04, 68/05, 28/06)  
Uredba o okoljski dajatvi za onesnaževanje okolja zaradi odlaganja odpadkov (Ur. l. RS št. 129/04, 68/05, 28/06)
- <sup>8</sup>Contagious Diseases Act (Official Gazette of RS, No. 69/95, 112/04,33/06)  
Zakon o nalezljivih boleznih (Ur. l. RS št. 69/95, 112/04,33/06)
- <sup>9</sup>Health Inspection Act (Official Gazette of RS, Nos. 36/04, 47/04 – official consolidated text)  
Zakon o zdravstveni inšpekciji (Ur. l. RS št. 36/04, 47/04)
- <sup>10</sup>Rules on the incineration of waste (Official Gazette of RS, Nos. 32/00, 38/00, 53/01, 81/02)  
Pravilnik o sežiganju odpadkov (Ur. l. RS št. 32/00, 38/00, 53/01, 81/02)
- <sup>11</sup>Rules on the classification, packaging and labelling of dangerous substances (Official Gazette of RS, No. 35/05)  
Pravilnik o razvrščanju, pakiranju in označevanju nevarnih snovi (Ur. l. RS št. 35/05)
- <sup>12</sup>Rules on the classification, packaging and labelling of dangerous preparations (Official Gazette of RS, No. 67/05)  
Pravilnik o razvrščanju, pakiranju in označevanju nevarnih pripravkov (Ur. l. RS št.67/05)
- <sup>13</sup>Rules on the conditions for preparation of the programme for the prevention and management of hospital infections (Official Gazette of RS, No. 74/99)  
Pravilnik o pogojih za pripravo in izvajanje programa preprečevanja in obvladovanja bolnišničnih okužb (Ur. l. RS št. 74/99)
- <sup>14</sup>The Rules on storage, consignment, transport and disposal of unusable blood and blood preparations (Official Gazette of RS, No. 100/02)  
Pravilnik o skladiščenju, oddaji, prevozu in odstranjevanju neuporabljene krvi in krvnih pripravkov (Ur. l. RS št. 100/02)
- <sup>15</sup>Decree on transboundary shipment of waste (Official Gazette of RS, No. 101/04, 46/05)  
Uredba o čezmejnem pošiljanju odpadkov (Ur. l. RS št. 101/04, 46/05)
- <sup>16</sup>Resolution of the National Environmental Protection Programme 2005-2012 (Official Gazette of RS, No. 2/06)  
Resolucija o nacionalnem programu varstva okolja 2005 – 2012 (Ur. l. RS št. 2/06)
- <sup>17</sup>Act Ratifying the Basle Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Official Gazette of RS, No. 15/93, 23/04)  
Zakon o ratifikaciji Baselske konvencije o nadzoru prehoda nevarnih odpadkov preko meje in njihovega odstranjevanja (Ur. l. RS št. 15/93, 23/04)
- <sup>18</sup>Convention on climate changes, Rio de Janeiro, 13 June 1990
- <sup>19</sup>Protocol on the reduction of greenhouse gas emissions, Kyoto, 21 October 1998
- <sup>20</sup>Directive on Waste (75/442/EEC & amendment 91/156/EEC, 91/692/EEC, 96/350/EC)  
List of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste 2000/532/EC
- <sup>21</sup>Hazardous Waste Directive (91/689/EEC)

- <sup>22</sup> Council Directive on Landfills (1999/31/EC)
- <sup>23</sup> Council Directive on the Incineration of waste 2000/76/EC
- <sup>24</sup> Decision Setting up a network for the epidemiological surveillance and control of communicable diseases in the Community (2119/98/ EC)
- <sup>25</sup> Pruss A., Giroult E., Rushbrook P. Safe management of wastes from health-care activities, World Health Organization, Geneva 1999
- <sup>26</sup> Abfallwirtschaftsgesetz 2002, Bundesgesetzblatt Fur Republik Osterreich (AWG 2002), issued 30.12.2004
- <sup>27</sup> ÖNORM S 2104 Abfälle aus dem medizinischen Bereich, (Medical Wastes), 1.2.1999
- <sup>28</sup> A. Viler Kovačič, Ravnanje z odpadki, GV Založba, Ljubljana 2001,p.11-175.
- <sup>29</sup> Splošna bolnišnica Maribor, 1799 – 1999, Strokovna monografija, p.5-25.
- <sup>30</sup> Informacijski bilten, Naša bolnišnica (Our hospital), No. 1, 2005, p.1-30.
- <sup>31</sup> Lee BK, Ellenbecker MJ, Moure-ErsasoR. Alternatives for treatment and disposal cost reduction of regulated medical wastes.Waste Management 2004; 24; 143-151.
- <sup>32</sup> Almuneeff M, Memish ZA. Effective medical waste mamagement: It cane be done. American journal of infection control ;2003; 31; 188-192.
- <sup>33</sup> Bencko V, Kapek J, Vins O. Hospital waste treatment and disposal in the general university hospital- Current situation and future challenges. Indoor and built environment; 2003; 12; 99-104.
- <sup>34</sup> ÖNORM S 2100, Abfallkatalog
- <sup>35</sup> Umwelt Umdenken, LKH Graz, Abfallwirtschaftskonzept 2004
- <sup>36</sup> Pribaković Borštnik, A., Zornik, M., Žagar, T.,Odgovorno okoljsko delovanje; Slovenski inštitut za kakovost in meroslovje; Ljubljana 2004, p.39-45.
- <sup>37</sup> Umwelt Umdenken, LKH. Graz, Abfallwirtschaftskonzept 2003

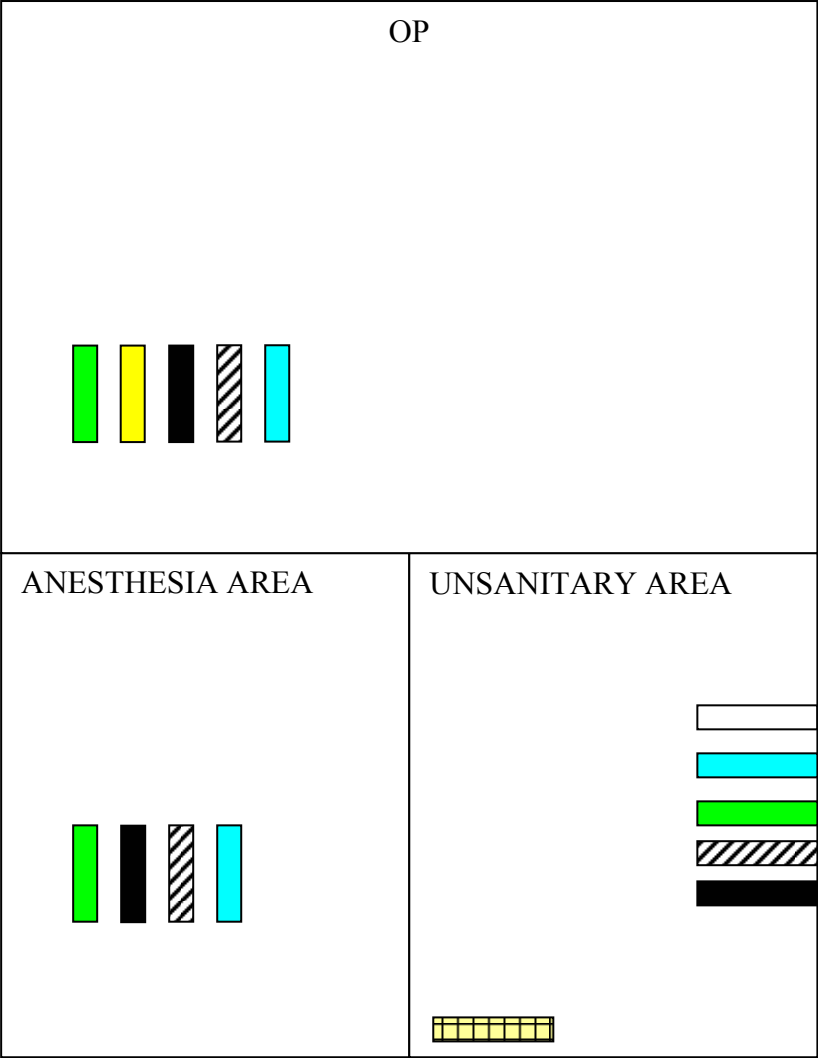
ANNEX 1:  
FLOORPLAN OF THE DEPARTMENT OF THORACIC SURGERY





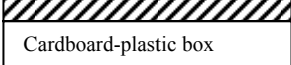
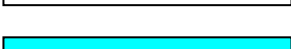
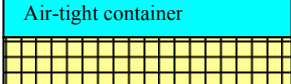


	HAZARDOUS WASTES		CARDBOARD		GLASS
	INFECTIOUS WASTES		PLASTIC PACKAGING		CYTOSTATICS
	MUNICIPAL WASTES		PAPER		
	SHARPS				



**ANNEX 2:  
FLOORPLAN OF OPERATING ROOM**



	PAPER
	INFECTIOUS WASTES
	MUNICIPAL WASTES
	PLASTIC PACKAGING
	GLASS
	SHARPS
	STEPLER

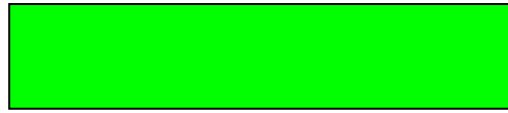
Additional labels for waste types shown in the floorplan:

- Cardboard-plastic box (white box with black border)
- Air-tight container (cyan bar)

ANNEX 3:  
COLOURED LABELS FOR SEGREGATED WASTE COLLECTION



INFECTIOUS WASTES



PAPER



MUNICIPAL WASTES



CARDBOARD



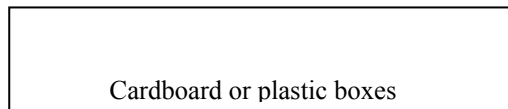
TRANSPARENT

CYTOTOXICS



WHITE

PLASTICS

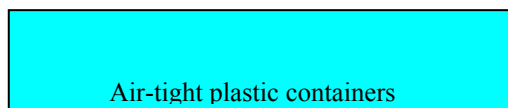


Cardboard or plastic boxes

GLASS

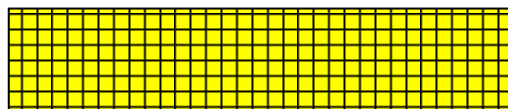


DANGEROUS CHEMICAL WASTES











Air-tight plastic containers

SHARPS



STEPLER

**ANNEX 4:**  
**CHART FOR DAILY RECORDKEEPING OF WEIGHINGS OF WASTES**

Barva vreče	Vrsta odpadka	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
	KUŽNI ODPADKI																															
	PAPIR																															
	KOMUNALNI ODPADKI																															
	KARTON																															
	PLASTIKA																															
	STEKLO																															
	NEVARNI KEMIJSKI ODPADKI																															
	OSTRI PREDMETI																															
PROZORNA	CITOSTATIKI																															
HALIBOX	STEPLERJI																															
ŠKATLA	BATERIJE																															
ŠKATLA	DOZE POD PRITISKOM																															

**ANNEX 5:**

**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantities of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
Dept.		Department of Thoracic Surgery																	
Bag Color	Type of waste	Dec-Jan			February			March			April			May			June		
		waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions
	INFECTIOUS	16,20	2%	10%	9,20	2%	6%	13,00	2%	8%	12,90	3%	8%	22,80	4%	14%	12,20	3%	8%
	PAPER	0,00	0%	0%	84,90	16%	7%	93,10	15%	7%	105,10	23%	8%	131,90	23%	10%	112,50	26%	9%
	MUNICIPAL	615,80	93%	21%	327,60	61%	11%	359,10	59%	12%	260,20	56%	9%	228,70	41%	8%	205,70	48%	7%
	CARDBOARD	0,00	0%	0%	29,80	6%	41%	42,90	7%	59%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%
	PLASTIC	0,00	0%	0%	43,40	8%	5%	47,60	8%	6%	68,40	15%	9%	102,51	18%	13%	78,70	18%	10%
	GLASS	27,10	4%	7%	35,00	7%	9%	53,30	9%	14%	17,90	4%	5%	40,90	7%	11%	21,10	5%	6%
	SHARPS	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	27,40	5%	100%	0,00	0%	0%
	TRANSPIRE CYTOSTATIC	4,00	1%	22%	3,60	1%	20%	2,30	0%	13%	0,50	0%	3%	7,10	1%	39%	0,00	0%	0%
	<b>TOTAL</b>	<b>663,10</b>	<b>100%</b>	<b>12%</b>	<b>533,50</b>	<b>100%</b>	<b>9%</b>	<b>611,30</b>	<b>100%</b>	<b>11%</b>	<b>465,00</b>	<b>100%</b>	<b>8%</b>	<b>561,31</b>	<b>100%</b>	<b>10%</b>	<b>430,20</b>	<b>100%</b>	<b>8%</b>

July			August			September			October			November			December			total	% total quantities of wastes for whole year
waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions		
17,70	4%	11%	8,90	2%	6%	18,50	3%	12%	29,20	6%	19%	6,70	2%	4%	6,72	1%	4%	<b>157,82</b>	3%
142,90	29%	11%	174,10	30%	13%	139,60	25%	11%	108,90	22%	8%	103,30	24%	8%	107,60	23%	8%	<b>1303,90</b>	23%
230,20	47%	8%	268,30	46%	9%	285,70	51%	10%	245,10	49%	8%	220,40	51%	8%	252,70	55%	9%	<b>2883,70</b>	51%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	<b>72,70</b>	1%
74,60	15%	9%	102,65	17%	13%	77,20	14%	10%	84,60	17%	11%	56,00	13%	7%	59,20	13%	7%	<b>794,86</b>	14%
28,00	6%	7%	35,50	6%	9%	42,90	8%	11%	30,90	6%	8%	42,90	10%	11%	31,40	7%	8%	<b>379,80</b>	7%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	<b>27,40</b>	0%
0,50	0%	3%	0,20	0%	1%	0,60	0%	3%	1,00	0%	5%	0,00	0%	0%	2,40	1%	13%	<b>18,20</b>	0%
																		<b>0,00</b>	
493,90	100%	9%	589,65	100%	10%	564,50	100%	10%	499,70	100%	9%	429,30	100%	8%	460,02	100%	8%	<b>5638,38</b>	100%

**ANNEX 6:**

**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
Dept.	General Surgery OP 7																		
Bag color	Type of waste	Dec-Jan			February			March			April			Maj			June		
		waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions
	INFECTIOUS	80,9	25%	9%	112,1	30%	12%	132,6	31%	14%	93	24%	10%	78,75	26%	8%	63,7	25%	7%
	PAPER	5,7	2%	1%	37,7	10%	7%	34,75	8%	7%	81	21%	16%	45,50	15%	9%	48,3	19%	9%
	MUNICIPAL	233,5	73%	16%	153,9	41%	11%	189,4	45%	13%	156,2	40%	11%	106,20	34%	7%	103,65	40%	7%
	CARDBOARD	0	0%	0%	27,5	7%	52%	25,15	6%	48%	0	0%	0%	0,00	0%	0%	0	0%	0%
	PLASTIC	0	0%	0%	39,6	11%	8%	30,7	7%	6%	57,1	15%	11%	68,20	22%	13%	43,8	17%	8%
	GLASS	0	0%	0%	2,8	1%	6%	5,3	1%	11%	0	0%	0%	9,20	3%	19%	0	0%	0%
	SHARPS	0	0%	0%	1,65	0%	13%	1	0%	8%	0	0%	0%	0,00	0%	0%	0	0%	0%
	ANSPARE CYTOSTATIC	0	0%	0%	0	0%	0%	4	1%	78%	1,1	0%	22%	0,00	0%	0%	0	0%	0%
	<b>TOTAL</b>	<b>320,1</b>	<b>100%</b>	<b>0%</b>	<b>375,25</b>	<b>100%</b>	<b>11%</b>	<b>422,9</b>	<b>100%</b>	<b>12%</b>	<b>388,4</b>	<b>100%</b>	<b>11%</b>	<b>307,85</b>	<b>100%</b>	<b>9%</b>	<b>259,45</b>	<b>100%</b>	<b>7%</b>
	MUNICIPAL	233,5	73%	17%	146,1	39%	11%	176,6	42%	13%	135,6	35%	10%	104,00	34%	8%	102,05	39%	8%
HALIBOX	STEPLERS	0	0%	0%	7,8	2%	9%	12,8	3%	15%	20,6	5%	25%	2,20	1%	3%	1,60	1%	2%

Annual Summary																			
July			August			September			October			November			December			total	% total quantities of wastes for whole year
waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions		
72,46	31%	8%	86,58	25%	9%	56,42	16%	6%	86,16	28%	9%	91,50	28%	10%	55,63	26%	6%	<b>928,90</b>	26%
26,52	11%	5%	88,64	26%	17%	39,47	11%	8%	41,57	14%	8%	44,05	13%	8%	31,53	15%	6%	<b>519,03</b>	15%
87,63	38%	6%	111,32	33%	8%	200,65	57%	14%	120,71	39%	8%	129,24	39%	9%	79,10	38%	6%	<b>1438,00</b>	41%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	<b>52,65</b>	1%
41,04	18%	8%	45,96	13%	9%	53,57	15%	10%	46,63	15%	9%	61,44	19%	12%	36,82	18%	7%	<b>524,86</b>	15%
0,00	0%	0%	8,12	2%	17%	1,90	1%	4%	12,45	4%	26%	5,50	2%	12%	2,40	1%	5%	<b>47,67</b>	1%
3,82	2%	30%	1,58	0%	12%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	4,65	2%	37%	<b>12,70</b>	0%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	<b>5,10</b>	0%
																		<b>0,00</b>	
231,47	100%	7%	342,20	100%	10%	352,01	100%	10%	307,52	100%	9%	331,73	100%	9%	210,13	100%	6%	<b>3528,91</b>	100%
80,03	35%	6%	108,62	32%	8%	199,65	57%	177%	112,51	37%	8%	121,01	36%	9%	68,74	33%	5%	<b>1354,91</b>	38%
7,60	3%	9%	2,70	1%	3%	1,00	0%	12%	8,20	3%	10%	8,23	2%	10%	10,36	5%	12%	<b>83,09</b>	2%

**ANNEX 7:**

**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004

Dept.		General Surgery OP Septics																	
Bag color	Type of waste	Dec-Jan			February			March			April			May			June - July		
		waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions
	INFECTIOUS	83,6	29%	15%	121,1	31%	21%	125,7	37%	22%	116,45	29%	20%	84,5	28%	15%	0	#DEL/0!	0%
	PAPER	3	1%	1%	36,1	9%	17%	27,9	8%	13%	60,1	15%	28%	35,1	12%	16%	0	#DEL/0!	0%
	MUNICIPAL	197,9	70%	25%	153,5	39%	20%	141,8	42%	18%	151,8	38%	19%	133,6	45%	17%	0	#DEL/0!	0%
	CARDBOARD	0	0%	0%	29,6	8%	69%	13	4%	31%	0	0%	0	0%	0%	0	0	#DEL/0!	0%
	PLASTIC	0	0%	0%	46,7	12%	20%	30,2	9%	13%	53,2	13%	22%	36,4	12%	15%	0	#DEL/0!	0%
	GLASS	0	0%	0%	4	1%	15%	0,3	0%	1%	12,8	3%	48%	8	3%	30%	0	#DEL/0!	0%
	SHARPS	0	0%	0%	0	0%	0%	0	0%	0%	1,3	0%	100%	0	0%	0%	0	#DEL/0!	0%
	ANSAPARE CYTOSTATIC	0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	#DEL/0!	0%
	HALIBOX STEPLERS																		
	<b>TOTAL</b>	<b>284,5</b>	<b>100%</b>	<b>15%</b>	<b>391</b>	<b>100%</b>	<b>21%</b>	<b>338,9</b>	<b>100%</b>	<b>18%</b>	<b>395,65</b>	<b>100%</b>	<b>21%</b>	<b>297,6</b>	<b>100%</b>	<b>16%</b>	<b>0</b>	<b>#DEL/0!</b>	<b>0%</b>

August			September			October			November			December			total	% total quantities of wastes for whole year	
waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions			
19,07	33%	3%	30,7	29%	5%	18,78	23%	3%	40,87	28%	7%	14,81	22%	3%	<b>571,98</b>	<b>30%</b>	
8,63	15%	4%	15,4	15%	64%	6,05	8%	3%	24	17%	11%	4	6%	2%	<b>217,28</b>	<b>12%</b>	
21,53	38%	3%	43,1	41%	6%	44,45	55%	6%	65,39	45%	8%	24,53	36%	3%	<b>779,7</b>	<b>41%</b>	
0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	<b>42,6</b>	<b>2%</b>	
7,87	14%	3%	15,54	15%	7%	10,07	13%	4%	13,28	9%	6%	24,86	36%	10%	<b>238,12</b>	<b>13%</b>	
0	0%	0%	0	0%	0%	0	0%	0%	1,8	1%	7%	0	0%	0%	<b>26,9</b>	<b>1%</b>	
0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	<b>1,3</b>	<b>0%</b>	
0	0%	0%	1	1%	50%	1	1%	50%	0	0%	0%	0	0%	0%	<b>2</b>	<b>0%</b>	
57,1	100%	3%	105,74	100%	6%	80,35	100%	4%	145,34	100%	8%	68,2	100%	4%	<b>1879,88</b>	<b>100%</b>	

**ANNEX 8:**  
**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
Dept.	General Surgery OP 3			February			March			April			Maj			June			
Bag color	Type of waste	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions
	INFECTIOUS	123,7	26%	10%	110,7	25%	9%	161,7	32%	13%	81,9	30%	7%	69,15	21%	6%	73,40	25%	6%
	PAPER	14,2	3%	3%	42,5	9%	8%	42,2	8%	8%	41,5	15%	8%	55,30	16%	10%	41,50	14%	8%
	MUNICIPAL	345,3	71%	17%	202,4	45%	10%	204,2	41%	10%	107,5	39%	5%	145,7	43%	7%	124,03	42%	6%
	CARDBOARD	0	0%	0%	30,4	7%	42%	42,35	8%	58%	0	0%	0%	0,00	0%	0%	0,00	0%	0%
	PLASTIC	0	0%	0%	53,6	12%	8%	38,7	8%	6%	35,9	13%	5%	60,85	18%	9%	52,00	18%	8%
	GLASS	0	0%	0%	5	1%	10%	7,2	1%	14%	6,3	2%	12%	4,30	1%	8%	3,90	1%	8%
	SHARPS	0	0%	0%	3,1	1%	11%	4,8	1%	16%	2,45	1%	8%	0,00	0%	0%	0,55	0%	2%
	CYTOSTATIC	0	0%	0%	0	0%	0%	0	0%	0%	0	0%	0%	0,00	0%	0%	0,00	0%	0%
	<b>TOTAL</b>	<b>483,2</b>	<b>100%</b>	<b>11%</b>	<b>447,7</b>	<b>100%</b>	<b>10%</b>	<b>501,15</b>	<b>100%</b>	<b>11%</b>	<b>275,55</b>	<b>100%</b>	<b>6%</b>	<b>335,30</b>	<b>100%</b>	<b>7%</b>	<b>295,38</b>	<b>100%</b>	<b>6%</b>
	MUNICIPAL	345,3	71%	19%	190,5	43%	10%	182,8	36%	10%	95,3	35%	5%	118,85	35%	6%	110,05	37%	6%
	HALIBOX STEPLERS	0	0%	0%	11,9	3%	7%	21,4	4%	12%	12,2	4%	7%	26,85	8%	16%	13,98	5%	8%

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
July			August			September			October			November			December			total	% total quantities of wastes for whole year
waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions		
113,69	26%	9%	108,72	24%	9%	157,43	31%	13%	96,87	23%	8%	135,05	28%	11%	105,35	25%	9%	<b>1.213,96</b>	27%
47,36	11%	9%	55,51	12%	10%	57,92	11%	11%	47,39	11%	9%	54,92	11%	10%	59,74	14%	11%	<b>545,84</b>	12%
222,33	51%	11%	218,28	48%	11%	205,96	40%	10%	203,93	49%	10%	208,15	43%	10%	161,39	39%	8%	<b>2.003,87</b>	44%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	<b>72,75</b>	2%
51,56	12%	8%	69,97	15%	11%	85,49	17%	13%	63,38	15%	10%	72,85	15%	11%	73,31	18%	11%	<b>657,61</b>	14%
3,38	1%	7%	0,00	0%	0%	0,00	0%	0%	6,22	1%	12%	9,00	2%	18%	6,06	1%	12%	<b>51,36</b>	1%
0,40	0%	1%	1,20	0%	4%	3,88	1%	13%	0,00	0%	0%	0,00	0%	0%	13,00	3%	44%	<b>29,38</b>	1%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	#DEL/0!	0,00	0%	#DEL/0!	0,00	0%	#DEL/0!	<b>0,00</b>	0%
																		<b>0,00</b>	0%
<b>438,72</b>	<b>100%</b>	<b>10%</b>	<b>453,68</b>	<b>100%</b>	<b>10%</b>	<b>510,68</b>	<b>100%</b>	<b>11%</b>	<b>417,79</b>	<b>100%</b>	<b>9%</b>	<b>479,97</b>	<b>100%</b>	<b>10%</b>	<b>418,85</b>	<b>100%</b>	<b>9%</b>	<b>4.574,77</b>	100%
213,08	49%	12%	206,60	46%	11%	188,60	37%	10%	174,03	42%	10%	200,57	42%	11%	151,03	36%	8%	<b>1.831,41</b>	40%
9,25	2%	5%	11,68	3%	7%	17,36	3%	10%	29,90	7%	17%	7,58	2%	4%	10,36	2%	6%	<b>172,46</b>	4%

**ANNEX 9:**

**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
Dept.		Department of Ophthalmology - OP																	
Bag color	Type of waste	Dec-Jan			February			March			April			May			June		
		waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions
	INFECTIOUS	0,00	0%	0%	1,40	1%	93%	0,10	0%	7%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%
	PAPER	0,00	0%	0%	27,20	14%	6%	31,10	15%	7%	38,10	27%	9%	43,00	24%	10%	47,40	24%	11%
	MUNICIPAL	204,00	100%	19%	117,30	61%	11%	121,10	60%	11%	85,10	60%	8%	88,60	49%	8%	90,10	45%	9%
	CARDBOARD	0,00	0%	0%	20,20	10%	47%	22,80	11%	53%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%
	PLASTIC	0,00	0%	0%	2,00	1%	1%	2,40	1%	1%	11,60	8%	5%	28,70	16%	13%	34,50	17%	15%
	GLASS	0,00	0%	0%	24,00	12%	11%	22,00	11%	10%	7,00	5%	3%	21,30	12%	10%	25,40	13%	12%
	SHARPS	0,00	0%	0%	0,50	0%	7%	1,30	1%	18%	0,70	0%	10%	0,65	0%	9%	1,15	1%	16%
	<b>TOTAL</b>	<b>204,00</b>	<b>1,00</b>	<b>0,10</b>	<b>192,60</b>	<b>1,00</b>	<b>0,10</b>	<b>200,80</b>	<b>1,00</b>	<b>0,10</b>	<b>142,50</b>	<b>1,00</b>	<b>0,07</b>	<b>182,25</b>	<b>1,00</b>	<b>0,09</b>	<b>198,55</b>	<b>1,00</b>	<b>10%</b>

Total quantity of wastes from 12.12.2003-27.01.2004 and segregated collected fractions from 28.1.-30.6.2004																			
July		August			September			October			November			December			total	% total quantities of wastes for whole year	
waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes			% monthly seperated fractions
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	1,50	0%
46,90	23%	11%	51,80	24%	12%	42,40	23%	10%	69,00	29%	16%	60,00	25%	14%	38,10	19%	9%	426,00	22%
98,60	49%	9%	106,90	49%	10%	90,20	48%	9%	114,40	48%	11%	134,40	56%	13%	122,10	60%	12%	1054,40	53%
0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	43,00	2%
28,30	14%	13%	31,60	14%	14%	29,80	16%	13%	30,20	13%	13%	32,70	14%	15%	23,53	12%	10%	225,13	11%
29,10	14%	14%	28,70	13%	13%	24,80	13%	12%	24,00	10%	11%	14,00	6%	7%	18,50	9%	9%	214,80	11%
0,20	0%	3%	0,50	0%	7%	0,30	0%	4%	2,30	1%	32%	0,00	0%	0%	2,00	1%	27%	7,30	0%
203,10	100%	10%	219,50	100%	11%	187,50	100%	10%	239,90	100%	12%	241,10	100%	12%	204,23	100%	10%	1972,13	100%



**ANNEX 10:**  
**ANNUAL STATISTICS OF GROUPED QUANTITIES OF WASTES IN KILOGRAMS AND PERCENTAGES BY MONTH**

Total quantity of wastes from 15.3.2004 - 30.4.2004 and segregated collected fractions from 1.7.2004 - 31.12.2004																									
Dept.		Cardiac OP																							
		15.3. 2004- 30.4.2004			July			August			September			October			November			December					
Bag color	Type of waste	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	waste quantities in kg	% total quantities of wastes	% monthly seperated fractions	total	% total quantities of wastes for whole year	
	INFECTIOUS WASTES	97,78	11%	4%	413,00	52%	15%	449,04	52%	17%	482,06	55%	18%	415,56	53%	16%	496,43	59%	19%	415,70	55%	16%	2.671,79	54%	
	PAPER		0%	0%	122,00	15%	17%	158,00	18%	22%	125,69	14%	18%	115,39	15%	16%	101,65	12%	14%	88,66	12%	12%	711,39	14%	
	MUNICIPAL WASTES	823	89%	107%	133	17%	17%	149,00	17%	19%	133,47	15%	17%	126,70	16%	16%	110,28	13%	14%	116,06	15%	15%	768,51	16%	
	CARDBOARD	0	0%		0,00	0%		0,00	0%	#DEL/0!	0,00	0%	#DEL/0!	0,00	0%	#DEL/0!	0,00	#VREDN!	#VREDN!	0,00	0%	#DEL/0!	0,00	0%	
	PLASTIC		0%		92,00	12%		80,00	9%	15%	98,28	11%	18%	80,48	10%	15%	100,31	12%	19%	80,99	11%	15%	532,06	11%	
	GLASS		0%	0%	30,00	4%	15%	21,00	2%	11%	39,18	4%	20%	43,30	6%	22%	18,60	2%	10%	42,22	6%	22%	194,30	4%	
	SHARPS		0%		3,00	0%		3,20	0%	11%	3,82	0%	13%	1,10	0%	4%	10,37	1%	35%	7,81	1%	27%	29,30	1%	
	CYTOSTATICS		0%	0%	1,40	0%	100%	0,00	0%	0%		0%	0%	0,00	0%	0%	0,00	0%	0%	0,00	0%	0%	1,40	0%	
	<b>TOTAL</b>	920,78	100%	19%	794,40	100%	16%	860,24	100%	18%	882,50	100%	18%	782,53	100%	16%	837,64	100%	17%	751,44	100%	15%	4.908,75	100%	