Preliminary analysis for the introduction of sustainable waste management in Mexican hospitals

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Management summary

This investigation focuses on waste management in Mexican hospitals. A Dutch foundation will set up a pilot project in 2007 in a hospital in Mexico to improve the situation regarding medical waste. This research concentrates on RPBI (dangerous biological-infectious waste) and on domestic waste produced by hospitals.

The main question of the research is: *"Does hospital waste management regarding RPBI and domestic waste produced by Mexican hospitals differ at three different types of hospitals and how can waste management be improved?"* In order to find answer to this question, 12 hospitals (of 3 different types: 6 social, 5 public and 1 private) were visited to get an overview picture of the current situation. Important stakeholders were interviewed and the hospital sites were visited.

Before the fieldwork some bottlenecks were proposed. These proposed bottlenecks were compared with the reality in order to investigate whether they were correct or not. The predictions were that poor waste management could be related to: Lack of or inappropriate waste management plan; lack of appropriate facilities inside the hospital: storage rooms, incineration and a separation system and materials for this system; lack of sufficient training program for the personnel; lack of knowledge of the personnel about legal instructions and consciousness risks of waste; lack of internal and/or external supervision and lack of legislation.

In general the hospitals were aware of the existence of the law about RPBI. However, none of the hospitals did have a waste management plan that was specified for that hospital. All the investigated hospitals had a storage room that met most of the requirements of the law. The quality of the rooms varied among the different hospitals. Since law forbids incinerating waste at the hospital plant, all the hospitals had a contract with a private company for collecting the waste. However, 8 of the 12 investigated hospitals occasionally or structurally had a lack of separation materials like colored bags and containers. Only 2 hospitals separated domestic waste as well.

When it comes to training of the personnel, no differences can be found between the types of hospitals. !/3 of the investigated hospitals gives their personnel training at a structural basis, and only half of the hospitals uses posters at all the departments to inform the personnel about the separation system.

No great differences were seen between the 3 types of hospitals in knowledge of the personnel of rules and risks. However, in all the investigated hospitals waste that was disposed in a wrong bag was seen. All the hospitals lacked internal supervision and external supervision is performed poorly by the two involved ministries. The last bottleneck, lack of legislation, was not met, although details in the law could probably improved, like requirements for training of the personnel.

The main conclusion is that in general the quality of waste management regarding RPBI and domestic waste differs not much at the three types of hospitals. Private hospitals are not per se better than public or social hospitals and particularly differences between the social and public hospitals are small. The main problem is the training for the personnel and, linked to that, awareness about risks and importance of adequate separation of waste. Hospitals that had an "idea champion" proved to be more successful in an appropriate waste management. Hospitals should provide their personnel with adequate training to create knowledge and awareness about the risks of waste and the idea champion should get the enough freedom and resources to this.

Resumen del proyecto

Esta investigación se enfoca en la gestión de residuos en los hospitales Mexicanos. Una fundación Holandesa desarrollará un proyecto piloto en 2007 en un hospital en México para mejorar la situación relacionada con los residuos hospitalarios. Esta investigación se concentra en los residuos peligrosos por infección biológica (dangerous biological-infectious waste - RPBI siglas en Inglés) y en los residuos domésticos producidos en los hospitales.

La principal pregunta de la investigación es: *"¿Es la gestión de residuos RPBI y domésticos producidos por hospitales Mexicanos diferente en tres tipos de hospitales y como puede esta gestión ser mejorada?"* En orden de encontrar una respuesta a esta pregunta, 12 hospitales (de 3 diferentes tipos: 6 sociales, 5 públicos y 1 privado) fueron visitados para obtener un diagnóstico de la situación actual. Actores relevantes fueron entrevistados y las instalaciones de los hospitales fueron visitadas.

Antes del trabajo de campo se propusieron algunas restricciones o hipótesis. Estas hipótesis fueron comparadas con la realidad en orden de investigar si eran correctas o no. Las predicciones fueron que un pobre manejo de los residuos hospitalarios podría deberse a: Ausencia de un apropiado plan para la gestión de los residuos; carencia de instalaciones apropiadas dentro del hospital: Cuartos de almacenamiento, sistemas de incineración y separación de materiales; ausencia de suficiente entrenamiento de personal; carencia de conocimiento del personal acerca regulaciones legales y nivel de conciencia sobre los riesgos de estos residuos; ausencia de supervisión interna y/o externa y finalmente, ausencia de legislación.

En general los hospitales fueron concientes de la existencia de la Ley sobre RPBI. Sin embargo, ninguno de ellos tenía un plan de manejo de residuos que fuera especifico para el hospital. Todos los hospitales indagados tienen un cuarto de almacenamiento que cumple el requerimiento de ley. La calidad de los cuartos varía entre los mismos. Puesto que la ley prohíbe la incineración de basuras en sus instalaciones, todos los hospitales tienen contratado con una compañía privada para la recolección de los residuos. Sin embargo, 8 de los 12 hospitales ocasionalmente o estructuralmente tenían deficiencias en la separación de materiales como por ejemplo el uso de bolsas de colores o diferentes contenedores. Solamente dos hospitales separaban basura doméstica.

En lo que se refiere a capacitación del personal, no se encontraron diferencias entre los tres tipos de hospitales. Un tercio de los hospitales investigados entrena a su personal a un nivel estructural, y solamente la mitad de los hospitales usa afiches en sus departamentos para informar al personal sobre el sistema de separación.

No se encontraron grandes diferencias en los tres tipos de hospitales en relación al conocimiento del personal de reglas y riesgos. Sin embargo, en todos los hospitales investigados fue visto que residuos fueron puestos en bolsas erróneas. En todos los hospitales hay ausencia de supervisión interna y la supervisión externa es realizada de manera insuficiente por los dos ministerios a cargo del tema. La

última hipótesis relacionada con la ausencia de legislación no fue identificada, aunque detalles en la ley pueden mejorarse, como los requerimientos para entrenamiento de personal.

La principal conclusión es que en general la calidad de la gestión de los residuos RPBI y la basura domestica no difiere mucho en los tres tipos de hospitales. Los hospitales privados no son per se mejores que los públicos o los sociales y diferencias particulares entre los tres son menores. El principal problema es relacionado con la capacitación de personal y esto se suma a la conciencia acerca de los riesgos y la importancia de hacer una adecuada separación de los residuos. Los hospitales que tienen una "idea campeona" u objetivo al respecto demostraron ser mas exitosos ejecutando el manejo de los residuos. Los hospitales tienen que darle al personal capacitación adecuada para obtener conocimiento y conciencia sobre los riesgos de la basura y la idea campeona tiene que tener libertad y recursos suficientes para realizar eso.

Table of contents

1 Introduction

Concerning the internationally agreed agenda for sustainable development of the United Nations, Agenda 21, the 21st century is the era for profound adaptations of all institutions of society, to guarantee "development that meets the needs of the present without compromising the ability future generations to meet their own needs" (WCED, 1987, also known as the Brundtland report).

As the health care sector stands in the middle of society, bringing together all kinds of aspects and actors of this society, this sector cannot be excluded from sustainable development. How is the situation in the health care sector in Mexico? Are Mexican hospitals ready for the 21st century?

This research was initiated by Stichting Huize Aarde (SHA). This Dutch foundation aims to stimulate, without any particular political, economical or religious position, a more balanced sustainable relationship between humans and their physical environment. Besides this goal, the organization wants to contribute to the United Nations Agenda 21 for sustainable development.

From the year 2000 SHA has been focusing on the health care sector, with the aim of introducing a sustainable culture in this sector. In order to achieve this goal, SHA set up the Programa Hospitales Verdes (Green Hospitals Program) in Latin American countries. This program involves the health care sector in sustainable development by stimulating environmental management in pilot hospitals, as part of quality management.

The pilot projects work with a bottom-up method, to get the personnel involved in environmental management, rather than adding rules from above. As the personnel of the hospital should support change, during the projects, participation of the staff itself is very important. Also important is communication and cooperation with external stakeholders, like other hospitals, industry, universities, governments and social groups.

In Venezuela, a Hospitales Verdes project was set up in 2001. In 2007 the SHA is planning to initiate another pilot project in a hospital of the *Instituto Mexicano del Seguro Social* (IMSS), in Coatzacoalcos (Veracruz state) in Mexico. The IMSS is an organization that hosts hundreds of hospitals in Mexico, serving more than 60 million patients. The central question of the project is whether hospitals of the IMSS are capable to play a leading role in the transition to a sustainable culture in the health care sector in Mexico. Before the projects starts, basic information is needed about the actual policy and situation of the IMSS in general and its hospitals. This bachelor thesis is a pre-research that wants to draw this picture by making a preliminary analysis: what is the current situation of waste management in Mexican hospitals? By waste management the collecting, segregation, transportation and disposal of waste is meant. With this pre-research the foundation will be in a better position to set up a successful pilot project to improve the disposal situation in an IMSS hospital.

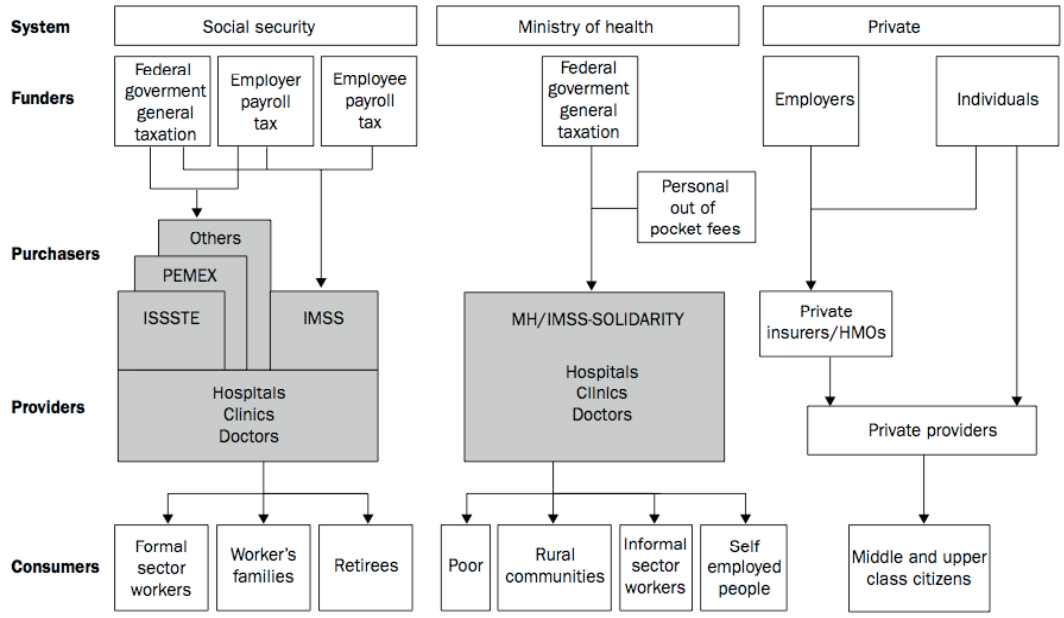
2 Context: stakeholders involved

This chapter describes the stakeholders that are important for this investigation. It outlines the differences between three types of Mexican hospitals that were studied. It also describes external actors that play a role in waste management in hospitals: the regulatory institutions, companies for recollection and disposal, and the dumpsites. Regulatory institutions influence the waste management in hospitals in a top-down way: the personnel of the companies for recollection and the waste-pickers at the dumpsites on the other hand are being influenced. Bad management of waste in hospitals has consequences for the last 2 stakeholder groups. When waste is not separated and disposed in the prescribed way, this might have consequences for the health of these people. That is why the health of these stakeholders is being influenced by the waste management process inside the hospital. This chapter maps these stakeholders in the process of managing waste in hospitals, i.e. RPBI and domestic waste (explained in paragraph 3.2).

2.1 Hospitals

Three different types of hospitals exist in Mexico: social, public and private hospitals (Barraza-Lloréns et al, 2002). These hospitals operate in three different parallel health systems, each one with their own society groups and ways of funding. Hospitals from each of these groups were studied in this research (6 social, 5 public and 1 private hospital). This paragraph outlines the differences between the 3 types of Mexican hospitals to explain the context of the research. Figure 1 shows an overview of the Mexican hospital system.

Figure 1 Health Care system in Mexico



Source: THE LANCET, Frenk et al., November 15, 2003

The first group of hospitals is the group of social hospitals, called the social security system in Figure 1. This system (i.e. these hospitals) is for people who are formally employed, which is about half of the Mexican population (Barraza-Lloréns et al, 2002). Their care is provided by different social security organizations, which mostly have their own health facilities (e.g. hospitals, pharmacies etc.). Their funds are paid for 1/3 by workers salaries, for 1/3 by the employers and for 1/3 by government (Ewen, 2004). Each of these organizations serves their own group of employed people, depending on their activities. The by far largest organization, the IMSS (*Instituto Mexicano del Seguro Social),* is for people who are employed in general. Other social security organizations are much more smaller. ISSSTE (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado)* is for state and federal personnel and serves approximately 4 million patients. The PEMEX (*Petróleos Mexicanos)* is for employees of the national oil company. Some small others exist as well (Fleury, Belmartino et al (ed), 2000).
As mentioned before, all these organizations are social institutions. In this research, only social hospitals of IMSS institution were investigated, since the pilot project will take place in a hospital of this institution.

The second group of hospitals is the group of public hospitals. About half of the population is uninsured. This group of people is very varied, from very poor to wealthy self-employed professionals (Fleury et al, 2000). Public hospitals are for the poor part of the population that is uninsured, cannot attend the above-mentioned social hospitals nor can pay for private care. A lot of the care for the rural poorest people is provided by the organization Solidaridad. The rest of the public health care is provided by the Ministry of Health (Secretaria de Salud, SSA). Solidaridad and the Ministry of Health services are financed almost entirely by general tax, with a small proportion of 3,4% by the patient (Ewen, 2004).
Most physicians that work in the private sector also work part-time in a public hospital. By this, they contribute to the providing of health care to the very poor. Despite this system, a lot of public hospitals are under equipped and understaffed (Barraza-Lloréns et al, 2002).

The third and last group of hospitals is the private sector. According to Evan (2004), approximately 20% of the population visits private hospitals. 96% of the costs are out-of-the-pocket, which makes that only the middle and highest class of society can visit private hospitals. Most hospitals in the private sector are for-profit organizations, although there is a small non-profit sector (idem). This third group owns about 30% of hospital beds, provides 32% of medical consultations and employs about 34% of the doctors (Fleury et al, 2000).

2.2 Regulatory institutions

Two different ministries cooperate to supervise the process of managing RPBI and domestic waste in hospitals[1]. The first one is the Ministry of Health (*Secretaría de Salud* - SSA). The Federal Commission of Protection against Sanitary Risks (*Comisión Federal para la Protectión contra Riesgos*

[1] Law about RPBI: NOM-087-SEMARNAT-SSA1-2002, article 9.1

Sanitarios - COFERPRIS) is a deconcentrated organ of the SSA with technical, administrative and operative autonomy. This organ is, on behalf of the SSA, in charge of the evaluation, verification and supervision of the correct identification, separation and storage of the RPBI and domestic waste in, among others, hospitals[2] according to the law about RPBI (NOM-087-SEMARNAT-SSA1-2002, explained in chapter 4).

The second ministry is the Ministry of Environment and Natural Resources (*Secretaría de Media Ambiente y Resursos Naturales* – SERMARNAT). The Federal Environmental Protection Agency (*Procuraduría Federal de Protección al Ambiente* - PROFEPA) is a deconcentrated organ of the SEMARNAT that is also in charge of the supervision of exact fulfillment of the law about RPBI.

These two ministries design laws and supervise the hospitals and medical centers. COPERPRIS is in charge of supervising the situation inside the hospital. They visit the hospitals to judge the situation. If the situation is not as it should be, the hospital gets a warning and has a limited time to improve. After this period of time the hospital will be visited another time.
PROFEPA is also in charge of the supervision of exact fulfillment of the law about RPBI, but on companies and institutions outside the hospital. They supervise e.g. the companies that collect the RPBI like MedAm C.A. de C.V., described in paragraph 2.4.[3]

2.3 Dumpsites

Two types of dumpsites for domestic waste exist in Mexico: clandestine and official dumpsites[4].
The former ones hardly have any supervision. Everyone can dump waste at this type of dumpsite. There are people sorting the waste (so called waste-pickers (Pescod, 1998) or 'pepenadores' in Spanish), including children and elderly people, to sell the plastics, paper, glass etc. This kind of activity is a business in itself; a lot of money is being earned here and there is serious mafia going on. It may be clear that this type of dumpsite and the collection activities are forbidden. However, some hospitals use them (and thus ignoring the normal, official way of collection), because they may accomplish forbidden activities and because these dumpsites are less expensive. The lack of supervision and control of the regulatory institutions make it easier to disobey laws, especially in the suburban areas[5].

The official dumpsites have strict supervision and it is not possible to dump waste without permission.
Waste pickers play a role at these dumpsites too, but they do not collect the waste at the dumpsite but at the place where the trucks gather. Afterwards the waste that is not sellable or reusable is transported to the dumpsite. However, in both situations the work of the waste-pickers is very dangerous. They often do not use protective gear such as gloves. Generally only normal domestic waste is collected at

[2] Diario Oficial de la Federación, 14 September 2005 (first section, third clause)
[3] Information from different interviews in the hospitals
[4] Interview with dr. J.J. Valentin Hérnandez and ing. S. Pérez García, COFERPRIS (31 July 2006, Destrito Federal, Mexico)
[5] Interview with dr. J.J. Valentin Hérnandez and ing. S. Pérez García, COFERPRIS (31 July 2006, Destrito Federal, Mexico)

these dumpsites. However, when waste in hospitals is not disposed in the prescribed way, it is possible that infectious waste (like RPBI, needles etc.) end up at these dumpsites as well, creating health risks for the waste-pickers and their families. This is what usually happens[4].
Although the government supervises these dumpsites, conditions are not always sustainable. They are often in open air (see figure 2), without any protection for the environment. Since 10 years it is obligatory to use a protective layer in the ground. However, it will take some time before all the dumpsites have such a layer, contaminating the environment in the meanwhile[6].

Figure 2: A dumpsite owned by the municipality

The entrance of an official dumpsite owned by the municipality. On the left side of the picture is a hut where the supervisor stays. It is not possible to dump waste without permission. There is no protection for the environment: the dumpsite is in open air and no fence protects the waste from being blown away by the wind.

Source: own archive

2.4 Companies for collection and disposal

When it comes to collection of waste from hospitals, 3 types of companies exist: companies that collect radioactive waste, domestic waste and RPBI.
The first type of company collects the radioactive waste, X-ray films, waste from the X-ray machine etc. They are bounded by strict rules. An example is Deforx S.A. de C.V., situated in Destrito Federal. They bring the waste to the National Institute of Nuclear Research (*Instituto Nacional de Investigaciones Nucleares* – ININ), situated in Ocoyoacac, Mexico. This institution disposes this kind of waste and is the only one in the country that does so. However, since this investigation focuses on domestic waste from hospitals and RPBI, this type of company falls out of the range of this research and is only described here to create a complete picture of stakeholders involved in collecting waste from hospitals.

The second type collects domestic waste from hospitals. This can be a private or a public company owned by the municipality. The company collects the waste, normally once a day, and brings the waste to one of the dumpsites outside the city. Hospitals pay per service, not per kilogram[7].

The third type of company collects the Dangerous Biological-Infectious Waste (*Residuos Peligrosos*

[6] Interview with dr. J.J. Valentin Hérnandez and ing. S. Pérez García, COFERPRIS (31 July 2006, Destrito Federal, Mexico)
[7] Information from different interviews in the hospitals

Biológico Infecciosos – RPBI, further explained in paragraph 3.2), usually 3 times a week. These are mostly private companies. They use 3 ways of disposing RPBI. The first one is autoclave, in which the waste is sterilized with high temperatures, and the non-dangerous waste is then dumped. The second one is incinerate the waste. The third one is Electro Thermo Deactivation, in which the waste is being treated with waves like a microwave, and then dumped in a normal dumpsite for domestic waste that is not dangerous. Waste of the B1 category (human anatomical waste, explained in paragraph 3.2) needs to be incinerated by law; the rest can be treated in one of the three ways[7]. An example of this type of company is MedAm S.A. de C.V., which operates in the entire country and owns more than 80% of the market in some states with an average of 70% in all states[8]. They collect waste from public hospitals, social hospitals like IMSS, ISSTE, PEMEX etc. and private hospitals and transport it to the different plants for further treatment. Another task of this type of company is to give courses to the personnel about RPBI waste. These courses contain information about the separation system and the risks of waste[9].

2.5 Summary

Different stakeholders are involved in managing hospital waste. The first group is the hospital. Three different types of hospitals exist in Mexico: social, public and private hospitals. The first group is for that part of the population who is formally insured; the second group for those who are not and the third is the private sector.

Two regulatory institutions play a role in waste management in hospitals: the Ministry of Health (sub organ: COFERPRIS) and the Ministry of Environment and Natural Resources (sub organ: PROFEPA). Both have tasks in supervising the hospitals.

The third group of stakeholders is the dumpsites and the families that live on the dumpsite to collect the waste. In Mexico official and clandestine dumpsites exist and on both collection of waste by these families takes place.

Companies that collect the waste play an important role as well. There are companies that collect radioactive waste, domestic waste and RPBI.

[8] Interview with bach. J.P. Alvarez Morphy, MedAm, S.A. de C.V. (27 July 2007, Destrito Federal, Mexico)

[9] Interview with bach. María José Sanchez-Aedo Liñero of the 'Dirección de Operaciones', Hospital Santa Monica (7 July 2006, Destrito Federal, Mexico)

3 Research design

3.1 Goals and research questions

The goal of this research is to assess the current situation regarding environmental management of dangerous biological-infectious (RPBI) and domestic waste in hospitals of 3 different classes in Mexico. Stichting Huize Aarde will use the results of this pre-research for a planned pilot project in an IMSS hospital for improving waste management. It will lead to a better understanding of the bottlenecks that occur in hospitals concerning waste management. This improved understanding creates some suggestions for possible improvements of waste management in the IMSS hospital and must lead to an implementation plan for a successful pilot project. If the pilot project is a success, the method will be adopted in other IMSS hospitals as well. Since the IMSS is serving more than 60 million patients, this will be of great social importance for the Mexican society. Not only internal stakeholders, but also external parties benefit from a good waste management. The waste management of the hospital has great influence on the health of the people involved, making this research more valuable.

The main question is: *Does waste management for RPBI and domestic waste produced by hospitals differ at three different types of Mexican hospitals and how can this waste management in hospitals be improved?*

Based on the following specified questions, interviews were developed and information was gathered in the fieldwork. These questions serve also as a guideline for the field observations.

1. What are the waste management procedures at the different hospitals?

2. Do the hospitals have a policy for waste management, what are its contents and how is this being implemented and communicated?

3. Do the hospitals have sufficient and appropriate facilities to implement sustainable waste management?

4. Is the personnel well trained in waste handling? Are they conscious of the possible risks of waste?

5. Who is directly concerned with internal and external supervision of waste management of the hospitals? How is this supervision being executed?

6. What is the current legislation about hospital waste?

7. What are the external stakeholders in hospital waste management and what are their tasks?

Question 7 has already been answered in the chapter 2. The other questions will be answered in the

chapter 4. To some of these questions a bottleneck (i.e. a possible problem) was assigned. In paragraph 3.4 these bottlenecks are explained.

3.2 Definition of health care waste

The World Health Organization defines health care waste (HCW) as "[…] all the waste produced by a medical institution (public or private), a medical research facility or a laboratory" WHO, 2004: 8). During the 6th meeting of the Bases Convention in Geneva in 2002, health-care waste was again classified. The complete list is given here, to illustrate the various types of waste that a hospital produces. However, waste categories in italic underlined font are the focus of this research. With some changes of the WHO, according to their goals, the classification is as follows (WHO, 2004):

A. Non-risk health care waste

A1: Recyclable waste
A2: Biodegradable waste
A3: other non-risk waste

Group A waste types are without any risk like paper, plastic, metal and glass (A1), left over food and garden waste (A2) and all the other waste produced without any risk (A3). This investigation focuses among others on waste of the A1 type.

B. Health care waste requiring special attention

B1: Human anatomical waste
B2: Sharps
B3: Pharmaceutical waste
- B31: Non-hazardous pharmaceutical waste
- B32: Potentially hazardous pharmaceutical waste
- B33: Hazardous pharmaceutical waste

B4: Cyto-toxic pharmaceutical waste
B5: Blood and body fluids

Group B health care waste needs special attention in treatment, storage and transportation. Examples are tissues, removed organs and placentas (B1), needles, glassware, ampoules and lancets (B2), pharmaceutical waste (B3), cyto-toxic pharmaceuticals (B4) and dressing materials, syringes without needles and bandages (B5). This research focuses on the RPBI (*Residuos Peligrosos Biológico Infecciosos)*, which is dangerous biological-infectious waste. In the rest of this report, this type of waste will be referred to as RPBI. The Mexican law, NOM-087-ECOL-SSA1-2002[10], describes RPBI in article 5.13 as those materials that are generated during medical service which contain biological-infectious

[10] http://www.salud.gob.mx/unidades/cdi/nom/087ecolssa.html

agents defined in that law, and that can cause harm to health and environment[11]. RPBI is category B1, B2 and B5 of the above list.

C: Infectious and highly infectious waste

C1: infectious waste

C2: Highly infectious waste

Type C waste needs extra attention because of infection risks. Examples are blood and faeces from people with HIV or hepatitis (C1), or contaminated blood and microbiological cultures from laboratories (C2). Although part of RPBI waste can be considered as infectious waste (the type of waste is the same, it is more infectious because of its source, i.e. a patient with Hepatitis) this research focuses on the normal processing of this waste, and not on special occasions. These occasions need special requirements and precautions that were not taken into this research: the focus is on the regular way of managing waste.

D: Other hazardous waste

E: Radioactive waste

Types D (e.g. thermometers, blood-pressure gauges) and E waste are important for hospitals, but were not surveyed in this research because of limited time reasons.

In outline, this report focuses on recyclable domestic waste (A1) and RPBI: human anatomic waste (B1), sharps (B2) and blood and body fluids (B5).

3.3 Research strategy

This research has been set up in 2 different parts. The first part, a literature study, was done in order to gain a general overview of the Mexican health care system and to identify possible bottlenecks. These bottlenecks will be described in the next paragraph. This part was accomplished in the Netherlands. Especially reports and documents of the World Health Organization were used, since this organization stands for sustainable development, also when it comes to waste in hospitals. This matches the idea of the research and the goals of the pilot project.

The second part was the fieldwork part, accomplished in Mexico. Three different classes of hospitals were visited and studied: social hospitals (all of the IMSS organization), public hospitals and a private hospital. Because different kinds of hospitals were included in the research, a better understanding and overview was obtained about the possible solutions to bottlenecks for sustainability and problems with waste in the hospitals. The different types of hospitals have different target groups and there might be

[11] Free translation of the writer. Literally, the law says: "Son aquellos materiales generados durante los servicios de atención médica que contengan agentes biológico-infecciosos según son definidos en esta Norma, y que puedan causar efectos nocivos a la salud y al ambiente." (Art. 3.13).

opportunities to learn from each other's procedures.

The original design of the research was to investigate 3 hospitals, all of a different type, in an in-depth design. However, during the fieldwork was decided that more hospitals were to be visited. This kind of research resulted in a less in-depth investigation, but created a broader view on the situation. A broader overview was seen as more useful for the Dutch foundation to prepare their pilot project in 2007 than a focused view on only 3 hospitals.

In total 12 hospitals were visited: 5 public hospitals, 6 social hospitals and 1 private hospital. During every visit places were waste is dealt with and treated were shown to get a first impression of the hospital, like patient rooms, general halls, the waste depository etc. The observations focused on the RPBI (dangerous biologic-infectious waste) and domestic waste. Photographs were taken (with permission in every case) to illustrate and to help assess the situations found. The visits were used to see if the proposed bottlenecks matched reality in the different hospitals.

Then interviews were held with a representative of the management of the hospital, with nurses and with cleaning staff. Interviewing was seen as a good method, besides the observations, in obtaining an impression of the situation. The first round of interviews focused primarily on trying to get an overview idea of the current situation in the hospital regarding waste. Informants were asked what the bottlenecks are and how they think the situation could be improved. The second round of interviews focused on additional information that was needed.
In the beginning of the research a tape recorder and questionnaire were used for interviewing to support the researcher with the Spanish language. Later it turned out to be better not to use these kinds of resources, because stakeholders tended to be more open without.

Also some external stakeholders were questioned. These are Med-Am S.A. de C.V. (private company that collects RPBI) and COFEPRIS (*Comisión Federal para la protectión contra Riesgos Sanitarios*, an autonomous organ of the Ministry of Health which focuses on the protection of sanitary risks).

3.4 Bottlenecks

In order to draw a picture of the current situation regarding waste management, propositions were made as regards possible bottlenecks. These propositions were then tested with literature and/or with fieldwork in Mexico, to check if they were correct.
Different factors contribute to an inappropriate waste handling process in hospitals. These factors are summarized in this section, providing bottlenecks in the process. The bottlenecks were drawn from literature, common sense and interviews with involved stakeholders.

The expected bottlenecks are:
1. Lack of or inappropriate waste management plan;

2. Lack of appropriate facilities inside the hospital:

-2.1 Storage rooms;

-2.2 Incineration systems;

-2.3 Separation system and materials for this system;

3. Lack of a sufficient training program for the personnel;

4. Lack of knowledge of the personnel about legal instructions and consciousness of the risks of waste;

5. Lack of internal and/or external supervision;

6. Lack of legislation.

This section describes expected bottlenecks for sustainable waste management that may occur in the hospitals studied. These expectations are based on case studies, literature and common sense.

3.4.1 Lack of or inappropriate waste management plan

Every hospital should have a management plan in which the current legislation, procedures and guidelines are described (Prüss et al, 1999:34). It is important to know if such a plan exists and how it is communicated to the personnel. An interview with a team leader of advisors of the Medical Hospital in Utrecht made clear that such a plan is important, both for getting projects started and for motivating people[12].

3.4.2 Lack of appropriate facilities inside the hospital

Different facilities are needed in order to deal with medical waste in an appropriate way. The World Health Organization describes appropriate storage rooms, incinerator or other facility for disposal of waste, appropriate separation system and materials for this system, a training program for the personnel and an appropriate waste management plan with rules and procedures (Prüss et al, 1999). These particular facilities were chosen to be bottlenecks, for reasons of relevance, and these facilities could be observed.

3.4.3 Storage rooms

The WHO makes several recommendations for storage rooms (Prüss et al, 1999: 64). Examples are the ability to prevent unauthorized persons to enter, inaccessibility to animals, insects and birds, at least passive ventilation, no fresh food stores or food preparation areas should be nearby etc. (idem, 65). The Mexican law about RPBI describes the exact prescriptions, of which many correspond with the recommendations of the WHO. More information about the Mexican law about RPBI can be read in the chapter 4.

[12] Interview with H. D. de Labije MA, UMC Utrecht (22 April, 2006, Utrecht, the Netherlands)

3.4.4 Incineration

The WHO claims that, from the sustainability view, low and high tech incineration has advantages as well as disadvantages, and should be well considered. Advantages are that it has good disinfection efficiency, a drastic reduction of weight and volume, residues can be disposed in landfills and there is no need for highly trained personnel. The last advantage is that this method is affordable (Prüss et al, 1999: 110). The disadvantages are that there are significant emissions of pollutants, slag and soot need to be removed periodically and it is not always efficient in destroying thermally resistant chemicals and drugs (idem). It is interesting to see how Mexico deals with this claim of the WHO, explained in the chapter 4.

3.4.5 Separation system and materials for this system

Another facility that is very important for adequate handling of waste is an appropriate separation system like colored containers and bags for a proper separation, storage and transport of different types of waste. The annual report from the Mexican Ministry of Health claims that 90-100% of the hospitals use containers for dangerous biological-infectious waste (Gómez Dantés et al., 2005). Therefore a field study check will be useful.

Personnel will not be able to dispose waste separately if they to not have sufficient tools like containers to store and separate the waste. They also need protective clothing when collecting waste. The WHO claims that personnel collecting or handling waste should at least be equipped with overalls, industrial aprons, leg protectors and/or industrial boots and disposable gloves or heavy-duty gloves. (Prüss et al, 1999: 141).

3.4.6 Training for personnel

Prüss et al. describe the aim of training of health-care personnel as "to develop awareness of the health, safety and environmental issues relating to health-care waste, and how these can affect employees in their daily work" (1999, 160). The contents of the training should include information on roles and responsibilities, technical instructions on application of waste and aspects of the waste management policy (further discussed in the next subsection). Structural repetition will refresh the knowledge of current staff and will inform new personnel.

3.4.7 Lack of knowledge of the personnel about legal instructions and risks of waste

Da Silva et al. (2004) investigated the medical waste management in the State of Rio Grande do Sul, Brazil. They investigated health facilities in the Vacacaí river basin, including public, private and philanthropic hospitals (21), health centers (48) and clinical laboratories (22), using forms to question authorities and personnel of the facilities. One of their conclusions was that a lot of the Brazilian health institutions did not have a Training Program. This is linked to the fact that the researchers found a lack of awareness concerning risks and environment. Cleaners and nurses are responsible for collection, internal storage and transportation to external storage. The research showed that waste is not segregated as directed by the Resolutions: only 56% of the hospitals, 42% of the

health centers and 14% of the clinical laboratories separate hazardous waste in the correct way. In all health facilities the personnel responsible for collection did often not wear appropriate protective clothing.

Previous research about waste management in hospitals in 4 countries (Colombia, Vietnam, Pakistan and Philippines) showed that doctors, nurses, waste handlers, administrators etc. have a "[…] lack of knowledge about and concern for the handling, fate and effects of infectious and hazardous health care wastes […]" (Pescod 1998). Pescod also found that there is, what he calls, a "common perception" (1998), which is that "every body else is doing the same so there lies no […] danger in doing it myself".

Van Gemert (2003) did research in five Dutch hospitals about the protocol for exposure to blood. This protocol informs the personnel how they can prevent accidental exposure to blood and, if so, how they can prevent infection with hepatitis B or C or HIV. This research also investigated the MRSA[13] protocol that describes how to prevent an outbreak of MRSA and what to do if this situation does occur. One of the conclusions is that the protocols do not work properly, because the personnel over-estimate their own knowledge about precautions and risks. The need for practical support is high and varies for different target groups, according to van Gemert. The report makes clear that personnel should become aware of the risks, have knowledge about the risks and should be willing to apply the rules, in order to have a policy working properly. This corresponds to the data of Pescod.

The 3 described research studies indicate that a lack of knowledge and consciousness of the personnel might be one of the bottlenecks in the management of waste in hospitals.

3.4.8 Lack of internal and external supervision

Although social aspects like enthusiasm, consciousness and social acceptance are important for improving the current situation in hospitals, supervision and rules are too, according to an interview[14]. A bottom-up as well as a top-down system is needed for improvement. This statement was checked in the fieldwork in Mexico and can be seen on a micro-level (inside the hospital: internal supervision) and on a macro-level (from government tot hospital: external supervision).

3.4.9 Lack of legislation

In the previous mentioned research by Da Silva et al. (2004) the researchers describe Resolution No 5 (1993), written by the National Environmental Counsel of Brazil, which specifies responsibilities to various sectors concerning medical waste. This resolution classifies medical waste into 4 categories, which are infectious-biological, infectious-hazardous, radioactive and the rest. In 2001 Resolution 283 was written, which states that infectious-biological waste must be treated adequately, to 'eliminate their pathological characteristics' (Da Silva et al, 2004). Health facilities should also establish a Medical Waste

[13] *Methicillin-Resistant Staphylococcus Aureus*: a bacterium that spreads via hands and air and usually affects people with low resistance, therefore often occurring in hospitals.
[14] Interview with MAs. H. D. de Labije, UMC Utrecht (22 April, 2006, Utrecht, the Netherlands)

Commission (MWC), a Medical Waste Management Plan (MWMP) and a Training Program (TP) for personnel.

The research of Da Silva et al. makes clear that the situation concerning the health facilities is very poor. In this study, only approximately 1/3 of the hospitals have a MWC, a MWMP and a TP for their personnel. The situation in the health centers and clinical laboratories is even worse. None of the studies health centers had a MWC, only 4,2% had a MWMP and only 10,4% a TP. For the clinical laboratories the percentages are resp. 13,6; 9 and 13,6. This shows that, although legal instructions are very clear, a lot of the healthcare facilities do not have the institutions prescribed. Economic problems mean that the government lacks to support health institutions in establishing health facilities concerning waste and to supervise these (daSilva et al, 2004).

This case study shows that in Brazil appropriate legal instructions do exist. However, in other cases it may be that a lack of legal instructions can be one of the bottlenecks in waste management.

3.5 Expected differences between three types of hospitals

As described paragraph 2.1 three different types of hospitals exist in Mexico. Differences in waste management between these three types were expected.

According to the literature, public hospitals in Mexico often have a lack of equipment and personnel (Barraz-Lloréns et al, 2002; Ewen, 2004). Public hospitals rely almost totally on general taxes with just a small share for the patient himself, while most private hospitals are for-profit organizations (for more information about this, see paragraph 2.1). The middle and high-income part of society use private hospitals, making it plausible to think that they require higher standards, since most payments are out of pocket (Barraz-Lloréns et al, 2002). This might lead to a good waste management, since the customers have high expectations. Social hospitals might be expected to be in the middle, for people who are insured, but who do not belong to the highest income class of society.

However, literature indicates that the quality of the private hospitals in Mexico is very heterogeneous (Fleury et al, 2000; Barraza-Llorórens et al, 2002). An alternative hypothesis is that because these hospitals are for-profit organizations, they could save costs by not investing in expensive contracts with private companies, expensive separation systems, training programs for the personnel etc., and might thus have a poor standard of waste management[15].

Concluding it can be said that the opinions about the quality of the three types op hospitals differ. Literature does not agree nor is totally clear about the differences. Therefore a field study was useful to see which hypothesis was correct. The results of this field study, as well as the results of that part of the literature study that was to see if the proposed bottlenecks were correct are explained in the next chapter.

[15] Interview with Dr. Nelly Cisneros González, head of the Scientific Evaluation Area and Technological Support, Direction of Medical Achievements, IMSS. (19 April 2006, Enschede, the Netherlands)

4 Results

This chapter explains the results that were found in literature in March and April 2006 and in the fieldwork that was done in 12 Mexican hospitals in May – July 2006. These results will create a clear picture of the waste management in the 12 hospitals and will make clear which of the possible bottlenecks were correct and which were not. The structure of this chapter follows the sub questions listed in paragraph 3.1. Some of these sub questions have a corresponding proposed bottleneck, which in that case will be outlined as well.

Important to mention on beforehand is that in general none of the hospitals scored perfectly on all the criteria. The private hospital generally scored pretty well, as did 2 social and 2 public hospitals. However, 'pretty well' means that these hospitals had some criteria they did not fulfil perfectly, while the others scored badly on many criteria, as will be further explained in the next paragraphs.

4.1 Waste management procedures

The first sub question is: "What are the waste management procedures at the different hospitals?" This is a describing question. No bottleneck was assigned to this question. This question was answered by asking nurses, cleaning staff and the management of the 12 hospitals about the procedures and by having a tour in every hospital.

The procedures are the same in every hospital; no matter whether it is a public, social or private hospital. The waste that is produced is being deposited in waste bins that contain different coloured bags, or in special containers for e.g. needles (for details, see paragraph 4.3). Nurses, doctors etc. produce this waste. Once or twice a day the cleaning staff is collecting this waste, depending on the hospital. No clear differences were seen between the 3 types of hospitals in number of collections. During this collection they often use a trolley to transport the waste. The cleaning staff is also assigned with the task to replace the bags and containers. The staff needs to follow a prescribed route through the hospital when transporting RPBI, ending at the storage room.

Figure 3 A sign that indicates the route of RPBI

Source: own archive

This room is often situated outside the hospital (for details, see paragraph 4.3). In this room the waste is temporarily being stored and collected by external companies. RPBI waste is usually collected 3 times a week; domestic waste from hospitals once a day.

4.2 Waste management plan

The sub question answered in this paragraph is: "Do the hospitals have a policy for waste management, what are its contents and how is this being implemented and communicated?" The management of the 12 hospitals were questioned about this. Also the cleaning staff and nurses were asked if they were aware of the existence of such a plan and what it contained.

None of the investigated hospitals had a waste management plan at the time of research. When asked for such a document, 10 out of 12 hospitals showed a copy of the law about RPBI: *NORMA Oficial Mexicana NOM-087-ECOL-SSA1-2002,* from the year 2002. This law describes how hospitals should manage this kind of waste, described in more detail in paragraph 4.6. However, the law describes this in a general way, not specified for a particular hospital. A waste management plan should e.g. contain information about the way the personnel is trained and informed, at what precise location certain waste should be stored (rather than the general term 'storage room', that is being used in the general law NOM-087), what to do in emergency cases concerning waste etc. Such a plan describes in more detail the particular situation in a particular hospital. 10 of the 12 hospitals implemented the law in their own hospital. The other 2 hospitals did use the law for their own situation, but did not have a copy to be shown.

The conclusion is that in general the hospitals were aware of the existence of the law, but did not have a waste management plan that was specified for their hospital. The bottleneck 'lack of or inappropriate waste management plan' proved to be correct. However, some hospitals did perform pretty well on waste management, even though they did not have a waste management plan. So, although the described situation of the bottleneck did occur in reality, it did not have the negative effect like the bottleneck predicts (i.e. bad waste management).

4.3 Lack of appropriate facilities inside the hospital

Three different facilities were investigated in every hospital to answer the sub question: " Do the hospitals have sufficient and appropriate facilities to implement sustainable waste management?" These facilities are a storage room, an incineration facility and a separation system. A lack of these 3 facilities was also a proposed bottleneck.

4.3.1 Storage rooms

Different rules for storage rooms of RPBI waste exist, coming from the NOM-087-SSSA1-SEMARNAT-2002. The following aspects have been taken into account in order to judge the storage rooms.

The storage room should not be near any patient rooms, storage rooms for medicines and materials, kitchens, meetings rooms, sanitary facilities, offices, launderettes etc., according to the law. All of the hospitals met this requirement. All the investigated hospitals had a storage room that was situated outside of the hospital. Because of this, nearly all the storage rooms were easily accessible for the companies that collect the waste, another factor of the law. In only 1 hospital (an IMSS hospital) this was not the case because of reconstruction of the hospital.

Waste in the storage rooms should be stored in containers and the yellow bags should be stored at 4 degrees Celsius at most. Nearly all the hospitals used this kind of storage. In only 1 public hospital no large containers were used. All the hospitals used refrigerators to cool the pathological waste (B1 category, the yellow bags).

The room should not be accessible for those who are not authorized. This means that the room should be locked and a sign should say that unauthorized persons are not allowed to enter. Only 1 IMSS hospital had locked the room, in contrast to the public hospitals, in which only 1 had not locked the room. No hospitals had a clear sign that stated 'only authorized personnel'. All the hospitals did use a sign that indicated that RPBI waste was stored, with the symbol of RPBI.
Remarkable is the fact that the storage room of the private company met all the requirements of the law.

Summarized in table 1:

Table 1: Storage room

		IMSS	Public	Private	TOTAL
Away from areas	OK	6	5	1	12
	X	-	-	-	-
Separation	OK	6	4	1	11
	X	-	1	-	1
Locked	OK	1	4	1	6
	X	5	1	-	6
Sign	OK	6	5	1	12
	X	-	-	-	-
Access companies	OK	5	5	1	11
	X	1	-	-	1

4.3.2 Incineration

Since a few years it is forbidden in Mexico to use a own incinerator at a hospital[16] and hospitals need to have a contract with a private company that collects and disposes the medical waste.

According to the report 'Salud: México 2004', an annual report about the health care of Mexico published by the Ministry of Health, 95% of the IMSS hospitals have a contract with a private company for disposing RPBI. This waste is described as biologic waste, like remains of blood and other body

[16] Interview with Roxana Muñoz Hérnandez, researcher at the Universidad Autónoma Metropolitana D.F., Mexico (16 May 2006, Mexico City)

parts, which are often a source of infection[17] (Gómez Dantés et al., 2005: 164). About 85% of the ISSSTE hospitals have such a contract (Gómez Dantés et al., 2005). All the investigated hospitals had such a contract and were able to show administration of the collection by that company.

4.3.3 Separation system and materials for this system

In all the hospitals studied some kind of separation system for RPBI and normal waste existed. All the hospitals used red and other colored (mostly green or black) bags, and red containers for the sharp objects (see figure 4). However, the differences can be seen in the amount of materials and in the separation system of glass, paper and plastic.

4 of the 12 hospitals had sufficient colored bags for RPBI and red containers for sharp objects. 8 of them had a (temporary or structural) lack of materials. 4 of them were IMSS hospitals and 4 of them social hospitals. In the private hospital never lack of materials existed. A summary can be found in table 2.

Table 2: Separation materials

		IMSS	Public	Private	TOTAL
Sufficient materials	YES	2	1	1	4
	NO	4	4	-	8

Figure 4 Separation materials

Source: own archive

Two hospitals did separate domestic waste (glass, paper and plastics). Both were IMSS hospitals. Two hospitals separated paper only and the rest did not, or not yet (2 hospitals, a private and a public hospital, had plans for separation this kind of waste). None of the public hospitals separated, while 4 IMSS hospitals separated this kind of waste (or a part of it). A difference between IMSS hospitals and public hospitals can be found here. The private hospital did not separate yet, but was working on a plan

[17] Literally, the reports says: "Los RPBI están constituidos por desechos biológicos, como restos de sangre y otros componentes corporales, los cuales frecuentemente son vehículo de agentes infecciosos." (Gómez Dantés et al., 2005: 164), in which RPBI stands for Residuos Peligrosos Biológico-Infecciosos

for this. Table 3 shows a summary.

Table 3 Separation of domestic waste (glass, paper and plastics) in the hospitals

	IMSS	Public	Private	TOTAL
Separation domestics YES	2	-	-	2
Partly*	2	-	-	2
NO	2	5	1	8

*Partly means: only separation of paper.

4.3.4 Concluding

The sub question of this paragraph is "Do the hospitals have sufficient and appropriate facilities to implement sustainable waste management?" The answer is that hospitals partially have sufficient and appropriate facilities. All the investigated hospitals had a storage room that more or less met the requirements of the law. The quality of the rooms varied among the different hospitals. Since law forbids incinerating waste at the hospital plant, all the hospitals had a contract with a private company for collecting the waste. However, 8 of the 12 investigated hospitals occasionally or structurally had a lack of separation materials like coloured bags and containers. Only 2 hospitals separated domestic waste as well.

4.4 Training for the personnel

An appropriate training program for the personnel makes the personnel aware of the risks of waste, the precautions they have to take and the way waste should be separated. This paragraph answers the sub question: "Is the personnel well trained in waste handling? Are they conscious of the possible risks of waste?"

When we look at the results about the training programs in the investigated hospitals, the conclusion can be drawn that no great differences between private, social en public hospitals exist.

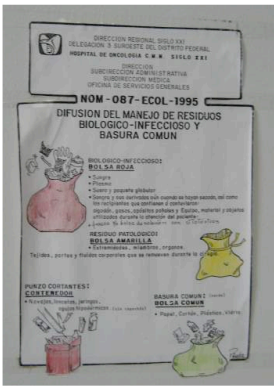
One of the aspects that have been investigated is if a training program is given at a structural basis. This can vary from once a month to once a year. The management as well as the personnel itself must say a training program is structural, to let it be classified as 'structural'. Only 4 investigated hospitals had such a structural education system, 2 IMSS hospitals and 2 public hospitals. Of the hospitals that did not have such a system, 4 of them were IMSS hospitals, 3 of the public and 1 private. In these hospitals a course was given once in a while (from a quick chat to a meeting of 1 or 2 hours); normally only when the law changes. No hospitals were found that did not give any kind of information at all. The hospitals that gave courses at a structural basis, all used special kind of presentation materials for these courses like PowerPoint-presentations or audiovisual materials. The rest sometimes provided the personnel with a handout, but most of the times it was just chatting. In only 1 hospital such a course was obligatory.

Another factor that is related to education is if information is being provided in the hospital at the different departments, like posters about hospital waste (see figure 5 for an example). Posters can

show the separation system and can warn the personnel to wear gloves and protection gear for their mouth and makes the personnel conscious during all the working day. Even if there is no structural training program for the personnel, posters can inform them on a daily basis about at least some aspects of the waste management.

Of the 12 hospitals investigated, 6 of them used posters in every room or at every personnel desk[18], of which 3 of them were IMSS hospitals and 3 of them public hospitals. 3 hospitals had posters at some places (a few rooms, some departments of the hospital) and 2 hospitals did not use any posters at all. It is surprising that again no great difference can be found between the public and IMSS hospitals. The only thing that can be said is that no public hospital without posters was found. The private hospital did not use any posters.

Figure 5 An example of a poster with the separation system of waste



This poster tells what kind of waste should be deposited in a certain bag or container. A reference has been made to the law about RPBI (in this case the one from 1995).

Source: own archive

When these 2 factors are considered (structural education system and posters), no differences can be found between the types of hospitals. Only 1/3 of the investigated hospital gives their personnel education at a structural basis and only half of the hospitals use posters in every room or at every personnel desk. We can conclude that indeed a lack of an appropriate education and training system exists. Besides, there is great variety in the kind of education. Some hospitals inform their personnel in just a quick chat, while others use an 8-hour program, in which the personnel get a certificate. No great differences can be found between social, public or private hospitals. Table 4 shows a summary.

Table 4: Training program

		IMSS	Public	Private	TOTAL
Structural basis	YES	2	2	-	4
	NO	4	3	1	8
Special materials	YES	3	3	-	6
	NO	3	2	1	7
Posters	YES, everywhere	3	3	-	6
	Yes, a few	1	2	-	3
	NO	2	-	1	3

[18] Although posters at the personnel desk inform the personnel about waste, these posters do not inform the patient and family of the patient about waste. They also are producers of waste in hospitals. However, this research focused on the personnel.

4.4.1 Lack of knowledge of the personnel about legal instructions and risks of waste

Connected to the training program is the knowledge of the personnel of the legal instructions. In the 12 hospitals that were investigated, generally people were aware of the rules that existed and no differences between the 3 types of hospitals were seen. Nurses knew the separation system and waste collectors did know that they should wear protective gear when managing waste and that a route through the hospital exists which they have to follow when collecting the waste. This was made clear during several interviews.

No great differences were seen between the 3 types of hospitals. But despite that no lack of knowledge existed, waste that was disposed in a wrong bag was seen. When asking nurses about this, they claimed that often under pressure of work they just threw the waste away without realizing in what kind of bin. Another often-heard argument was that the family of the patients did not know the separation rules and threw the waste away in the wrong bins.
Connected to this, is the knowledge of the risks of waste. As with the knowledge of rules, personnel interviewed were aware of the risks of waste. They knew for example that blood can be a source of infections and should be considered as high dangerous. No great differences were seen between the 3 types of hospitals.

4.5 Supervision

The fifth sub question is "Who is directly concerned with internal and external supervision of waste management of the hospitals? How is this supervision being executed?" First the internal supervision will be discussed, then the external supervision.

Different interviews proved that there is a lack of internal control and supervision in most of the investigated hospitals. None of the superior of the nurses did control or supervise their nurses on a structural basis by examine the waste that had been disposed. If these kinds of controls did happen, it was only occasionally. Sometimes nurses are addressed when they do something wrong, but no consequences exist. All of the interviewed supervisors mentioned that a lack of time was the main reason for not having a supervision system on a structural basis. No differences were noticed between the 3 types of hospitals.

As explained in paragraph 2.2, COFEPRIS (SSA) and PROFEPA (SEMARNAT) should execute the external control. However, in reality these ministries do not exam the hospitals on a structural basis[19]. Only in 2 hospitals, 1 public and 1 social, structural external supervision did exist. COFERPRIS does not have sufficient materials or personnel to make these visits on a regular basis. Therefore hospitals are being visited irregularly or not at all. Due to a lack of time, the focus of the visits is only on the fact if the hospital uses red bags, although law requires more points of attention like appropriate storage rooms (see next paragraph). If the situation is unsatisfactory, COFERPRIS should visit the hospital again after

[19] Interview with dr. J.J. Valentin Hérnandez, COFERPRIS (17 July 2006, Destrito Federal, Mexico)

a while. In the mean while the hospital can improve the situation. However, in reality COFERPRIS cannot visit the hospital regulatory for monitoring and so the function of supervision diminishes.

Concluding can be said that there is a lack of internal and external supervision.

4.6 Legislation

This last paragraph will answer the question "What is the current legislation about hospital waste?" and will explain whether sufficient legislation is a bottleneck or not.

There are several laws that describe in detail the rules for handling hospital waste. The 'Ley General para la prevención y gestión integral de los residios'[20] describes that there should be a management plan about managing dangerous and other waste (Art. 31), according to the rules described in this and other laws. In this plan the following aspects should be described (Art. 29):
-the procedures of collection, storage, transport and trip to recycling, treatment or final disposal that are expected;
-the strategies and medias that will be used to inform the users about the actions they have to take to manage the waste;
-the procedures about how users are informed about the precautions they have to take and the way they have to manage the waste, in order to reduce risks;
-A description about who are responsible for the formulation and execution of the plan.

When management plans about waste contains aspects that are not according to the rules described in the laws, this plan should not be applied.

The Mexican law describes very clearly the rules for using separation materials such as bags and containers. These laws are described in NORMA Oficial Mexicana NOM-087-ECOL-SSA1-2002[21], which is about dangerous biological-infectious waste (RPBI). This waste is defined "as those materials that are generated during medical service which contain biologic-infectious agents defined in this law, and that can cause harm to health and environment"[22]. Separation is defined as "separation of matter, materials of dangerous waste of the same character that present a risk"[23].

The law divides this waste into 5 categories: blood, cultivation and stocking of biologic-infectious agents, pathologic waste (like tissues and organs, cadavers and biologic samples), non-anatomic waste

[20] Cámara de Diputados del H. Congreso de la Unión, Secretaría General, Secretaría de Servicios Parlamentarios, Dirección General de Bibliotecas, *Nueva Ley DOF 08-10-2003*
[21] NORMA Oficial Mexicana NOM-087-ECOL-SSA1-2002, Protección ambiental - Salud ambiental - Residuos peligrosos biológico-infecciosos - Clasificación y especificaciones de manejo. (article 5.1)
[22] Free translation of the writer. Literally, the law says: "Son aquellos materiales generados durante los servicios de atención médica que contengan agentes biológico-infecciosos según son definidos en esta Norma, y que puedan causar efectos nocivos a la salud y al ambiente." (Art. 3.13).
[23] Literally: "Segregación de las sustancias, materiales y residuos peligrosos de iguales características cuando presentan un riesgo". (Art. 3.17)

(like containers that contain blood, materials of healing like bandages etc) and sharp objects.
The way these different type of waste need to be separated and what kind of separation system needs to be used, is described in the table below. This table comes directly from the law (art. 6.2.1).

Table 5 Different types of RPBI

Type of waste	Physical state	Way of collection	Color
1. blood	liquid	Hermetic containers	red
2. biologic-infectious agents	solid	Polypropylene bags	red
3. pathologic	solid	Polypropylene bags	yellow
	liquid	Hermetic containers	yellow
4. non-anatomic	solid	Polypropylene bags	red
	liquid	Hermetic containers	red
5. sharp objects	solid	Rigid polypropylene Containers	red

The different types of waste are not to be mixed with each other. The containers and bags should have the universal symbol biological risk attached and the text: "RESIDUOS PELIGROSOS PUNZOCORTANTES BIOLOGICO-INFECCIOSOS" (see figure 6).

Figure 6 Symbol of RPBI

Source: NORMA Oficial Mexicana NOM-087-ECOL-SSA1-2002.

The bags as well as the containers for sharp objects may contain a maximum of 80% of their capacity. For medical units that are in rural areas and hard to reach, special requirements exist. These will not be further discussed here.

Section 6.3 describes the rules for storage. The law prescribes that there should be a storage room for storing dangerous biological-infectious waste. The waste should be stored in metal or plastic containers, again with the symbol and text. The law divides hospitals and medical units into 3 different levels:

Level 1: hospitals with 1-5 beds; clinic laboratories and blood banks with 1-50 analyses per day; psychiatric hospitals, clinical analytic centers.
Level 2: hospitals with 6-60 beds; clinic laboratories and blood banks with 51-200 analyses per day; clinics which investigate biological-infectious agents; centers which generate 25-100 kilograms of dangerous biological-infec-

tious waste per month.

Level 3: hospitals with more than 60 beds; centers which produce and experimental investigate infectious diseases; clinic laboratories and blood banks with more than 200 analysis per day; centers which generate more than 100 kilograms of dangerous biological-infectious waste per month.

Depending on the level, hospitals are allowed to store the waste for 30, 15 of 7 days (resp. level 1, 2 of 3). (art. 6.3.3). The waste should be stored at most 4 degrees Celsius, in a storage room with cooling or a refrigerator.
There are several specific rules for storage rooms (art. 6.3.5). They should be:

-separated from rooms for patients, store of medicines or other materials, kitchens, sanitation facilities, offices etc.;
-easily accessible for transportation, but without risk of leaking or animals coming in;
-signs which indicate danger should be placed and only authorized personnel should have access;
-the design, construction and location should obey the rules of SEMARNAT;
-special exception for medical units who cannot require the last rule (not specified here).

Concluding can be said that no lack of legislation exists. The law describes clearly the demands.
However, the law is not totally clear about the courses of the personnel and the external supervision.

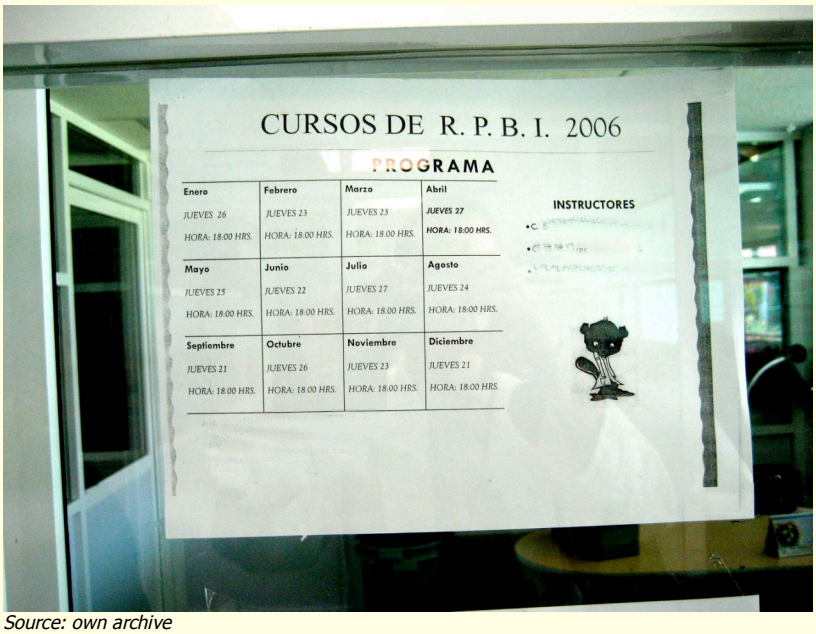
4.7 Idea champion

When the previous mentioned findings are analyzed, it is noticeable that in some hospitals the situation was reasonable, although they too did have the problems that were proposed. How can this be explained? In the hospitals in which the situation regarding waste management was reasonable, something was found that lacked in the other hospitals: an "idea champion". An idea champion is "a highly respected individual who maintains momentum and commitment of change, often taking personal risks in the process" (Kanter, 1983; Fernandez & Rainey, 2006). These idea champions were convinced of the importance of adequate waste separation, education for the personnel about this and consciousness about the risks. They used some of their working time (with permission of the management) to make a structural education program, sheets for a PowerPoint presentation to make the course more attractive etc. Two examples of an idea champion that was found during the fieldwork are illustrated in textbox 1.

Textbox 1: Examples of an idea champion

In a hospital in Villahermosa[1] (Tabasco State, Mexico) an idea champion was found. This man, who was working at the purchase department, used some of his working time for activities related to adequate waste management. He believed that separation of waste is very important, and that all the personnel should be informed about this. He introduced a structural education system (see figure 7) in which he used media like PowerPoint, sheets and videotapes to make the course more attractive to the personnel. This man was highly respected by his colleagues, and supported by the management.

Figure 7: Structural education program



Source: own archive

Another example of an idea champion was found in a hospital in Cancún[1] (Quintana Roo State, Mexico). This woman investigated the situation in her own hospital regarding waste, writing a report with recommendations for the management. With this report she wanted to improve the situation by making the personnel and management aware of the importance of correct waste management.

[1] Due to reasons of privacy, the names of the hospitals are not mentioned. Figure 7 has been edited in order to guarantee this privacy.

5 Conclusions and recommendations

These conclusions are based on a literature study in March and April 2006 and a fieldwork study in May – July 2006 in Mexico. Different proposed bottlenecks were checked to see if they were correct or not.

The main question of this research is: "*Does hospital waste management regarding RPBI and domestic waste produced by Mexican hospitals differ at three different types of hospitals and how can waste management be improved?"* The answer is that on many criteria the three different types of hospitals scored quite the same. This leads to the first conclusion that in general the quality of waste management regarding RPBI and domestic waste differs not much at the three types of hospitals. The most remarkable similarities are that none of the hospitals had a clear management plan for waste, specific for their hospital, that generally the personnel had knowledge about the rules and risks but in all the hospitals wrongly separated waste was found, and that in none of the 3 types the internal as well as the external supervision was on a structural basis.

The second conclusion specifies the first conclusion, and indicates that private hospitals are not per se better than public or social hospitals when it comes to waste management. It is true that the private hospital never had a lack of materials for the separation system, as opposed to the public and social hospitals. Also the requirements for the storage room were perfectly met in the private hospital, while in the public and social hospitals these requirements sometimes were not met. But the education system in the private hospital was not on a structural basis, no posters were seen in the hospital, and the hospital had the intention to separate domestic waste, but did not yet at the moment of investigation. Some of the public and social hospitals scored better on these criteria than the private hospital. The hypothesis that the private hospital is better than social and public hospitals when it comes to management of RPBI and domestic waste proved to be false, at least on the above-mentioned criteria.

The third conclusion is that especially differences between the social and public hospitals are small. The first difference is the public hospitals scored better on the criterion to lock their storage rooms to prevent unauthorized people to enter (the storage rooms of all the public hospitals were locked, while those of the social hospitals sometimes were not). However, in the second difference the social hospitals score better than the public hospitals: none of the public hospitals separated domestic waste, while some of the social hospitals did have such a separation system. These two differences are the only great differences that were found; on all the other criteria (like education program, waste management plan and awareness and consciousness of the personnel) the social and public hospitals scored the same.

The main problem in all 3 types of hospitals is the lack of awareness of the personnel about the importance of an adequate waste management. Site observations made clear that personnel throw away waste in the wrong bins. A common excuse is that work could be very busy and stressful, leaving

little time for an appropriate separation. Another problem, related to the previous problem, is the training of the personnel. In many hospitals this is not on a structural basis, and the courses are not obligatory. By introducing a qualitative, structured education program the personnel becomes more aware of the importance of separation, which has a positive effect on all the stakeholders who deal with the waste, as for their own families and the environment. This might lead to a better consciousness and awareness of the importance of adequate waste separation.

With a structural training program and supervision, but most of all with an idea champion who believes it is important to manage hospital waste adequately, the situation regarding waste management in the three types of Mexican hospitals could be improved. Such an idea champion should get the freedom and resources (e.g. time during his working hours) to implement his ideas. When personnel get motivated, enthusiastic and convinced of the importance of adequate separation, supervision can play a minor role. An idea champion cannot solve problems like a lack of materials and inappropriate storage rooms when e.g. financial resources are poor. However, observations made clear that despite such lacks, the situation of such a hospital could be relatively good when an idea champion was found.

It should be clear that the conclusions drawn here are applicable to the investigated hospitals and that, although it creates an impression of the situation in Mexican hospitals, the 12 investigated hospitals are only a small part of all the hospitals in Mexico. Therefore generalization is possible, however on a small scale.

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