Health Care Waste Management

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Abstract

Health services have an exceptional role in the spheres of preventive medicine and public health promotion, in the sense of keeping a favorable balance between costs and benefits. Health care waste management (HCWM) is a process to help ensure proper hospital hygiene and safety of health care workers and communities. Collecting, transporting, processing and disposing waste material is known as waste management. Poor management of HCW exposes healthcare workers, waste handlers and the community to infections, toxic effects and injuries.

Key words: health care, environment, management, waste treatment, quality

1 Introduction

Collecting, transporting, processing and disposing waste material is known as waste management. The aim is to clean up the surrounding environment and see that the waste does not have a detrimental effect on our health. Nowadays waste management has gone a step further and not only plans proper disposal but also attempts to see whether we can reuse and recycle certain materials from waste matter. Waste management differs from country to country and in urban and rural areas. How waste is managed in a commercial industrial area will be very different from how it is handled in a residential area. In residential areas it is usually the responsibility of local government bodies while in industrial areas it is the industry responsible for creating the waste. The most commonly followed waste management systems involve collection and disposal of waste, the commonest way of disposal being landfills and incinerators.Landfills are the most common practice in many countries as it is a relatively inexpensive method of disposing of waste materials. These were often created in disused quarries or mining voids. The disposed waste is usually compacted and covered to prevent vermin and wind-blown litter. Landfills usually have a system to extract the gas that the decomposing waste matter generates. Opposition from adjacent landowners especially in urban areas have made it difficult to establish new landfills and the authorities have to transport it further away for disposal making disposal more expensive. Incineration destroys waste material by burning it. Regarded as a practical method of disposing of hazardous waste materials, it has of late, become controversial for many reasons such as the fact that it creates toxic gas and ash, which can harm local populations and pollute groundwater [1]

2 Problem Formulation

2.1 Quality and Environmental Management

Health services have an exceptional role in the spheres of preventive medicine and public health promotion, in the sense of keeping a favorable balance between costs and benefits. Because of this try to improve delivered health service quality and safety through process improvements to increase the value added to the organization and customer, improve the image of the organization, increase customer confidence and have a tool to reward quality. Also are important: maintain consistency in the global approach with TS-16949 and other ISO 9000/14000 sector-specific documents, e.g. medical devices (ISO13485), medical laboratories (ISO/DIS 15189), develop/incorporate a process that is actionable, minimize/reduce burden on health service organizations [12].

Process modeling uses guidelines of the ISO 9001:2000 standard. Arnica Montana, a private

pharmacy, decided to apply a process method in the spheres of operating quality management, environment treatment, safety and health at work precautions – for the entire scope of pharmacy activity. ISO 9001:2000 is one of International Standards dealing with quality system requirements that can be used for external quality assurance purposes. ISO 14001:2004 dealing with environment system requirements [7]. A process method means systematic recognition and management of processes used within the pharmacy and their mutual impact. The model takes into account an important role a customer has in defining input requirements [13]. Because of these, communication has an important role. Customers' satisfaction supervision is essential for evaluating and confirming the fulfillment of customers' requirements. It is equally important for the performers of the process to carry out their work tasks with little or no work risk [4]. Figure 1 shows a schematic presentation of the environmental process method sample model.

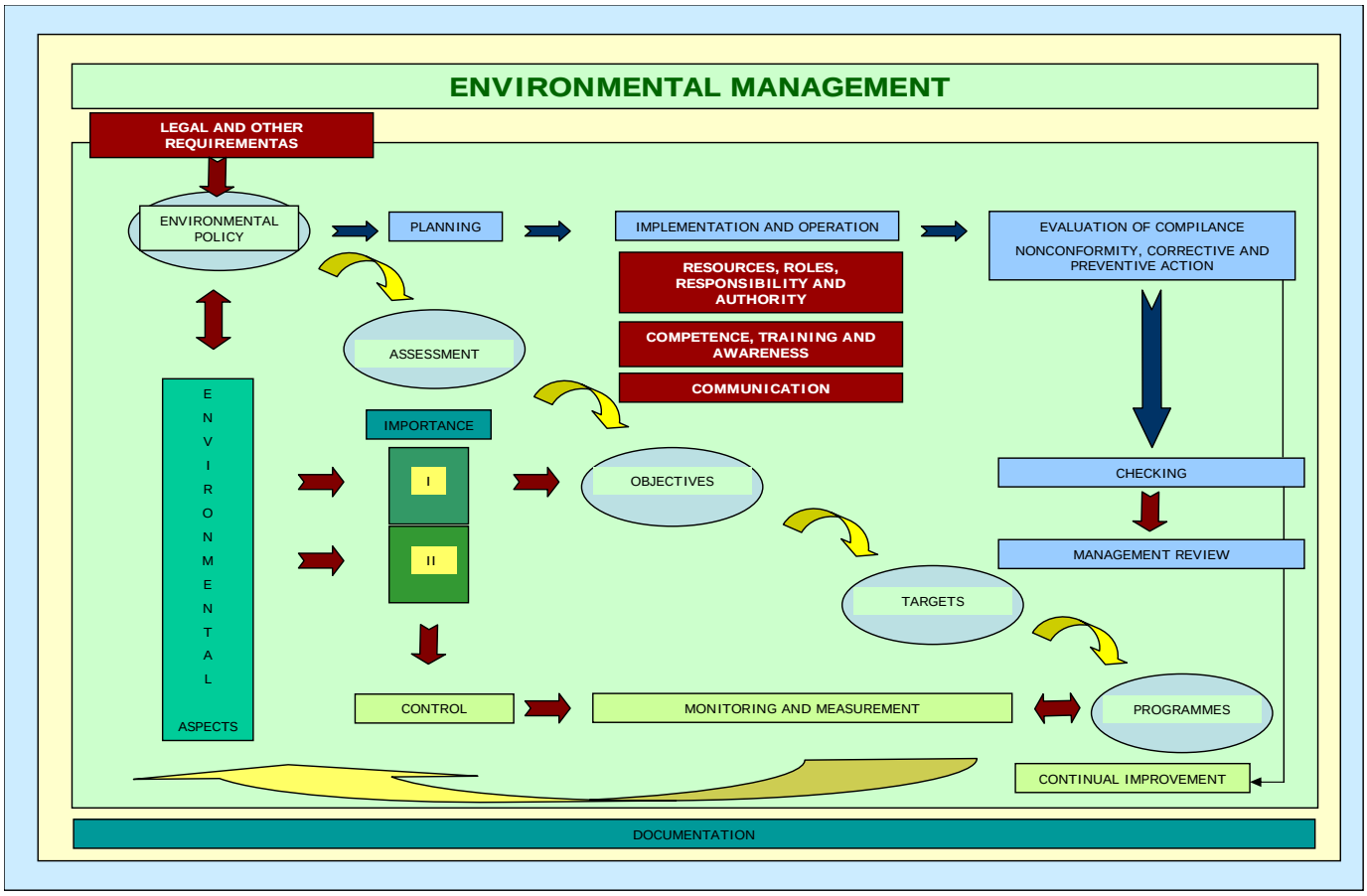

Figure 1: Environmental management system model ISO 14001:2004

An efficient and successful system of providing quality and environmental service pertaining to medicinal products/services supply - a system satisfying the needs, wishes and expectations of everybody concerned through an overall activity control, is one of the most suitable mechanisms enabling us to have global supervision and to act globally on the local market – with global characteristics. Simultaneously, such a system offers a possibility of constant growth in business operation [5].

Total quality management (TQM) promises much for service industries yet it has been little used in European healthcare. Of those hospitals and services which have implemented TQM, few have had great success and many have found difficulties sustaining their programmes. This paper defines TQM in healthcare and considers examples and results of TQM in European healthcare. It distinguishes between team projects using TQM methods and organization-wide TQM programmes, and finds more evidence for the success of projects than for programmes. The paper discusses whether the differences between healthcare and many other industries explain the mixed results,

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and considers the prospects for future TQM programmes in European healthcare [14].

2.2 Health Care Waste Management

Health care waste management (HCWM) is a process to help ensure proper hospital hygiene and safety of health care workers and communities. It includes planning and procurement, construction, staff training and behavior, proper use of tools, machines and pharmaceuticals, proper disposal methods inside and outside the hospital, and evaluation. Its many dimensions require a broader focus than the traditional health specialist or engineering point of view [2]. The need for proper HCWM has been gaining recognition slowly. It can:

- help control nosocomial diseases (hospital acquired infections), complementing the protective effect of proper hand washing;
- reduce community exposure to multi-drug resistant bacteria;
- dramatically reduce HIV/AIDS, sepsis, and Hepatitis transmission from dirty needles and other improperly cleaned/disposed medical items;
- control zoonoses (diseases passed to humans through insects, birds, rats and other animals);
- cut cycles of infection;
- easily and cost-effectively address health care worker safety issues, including reducing risk of needle sticks;
- prevent illegal repackaging and resale of contaminated needles;
- avoid negative long-term health effects; eg, cancer, from the environmental release of toxic substances such as dioxin, mercury and others [2].

HCW can be subdivided into various categories (Table 1). Segregation of different waste categories is critically important to enable proper disposal. Approximately 80% of all HCW can be disposed of through regular municipal waste methods. The other 20% can create serious health threats to health workers and communities if not disposed of properly [2].

Waste category	Description & examples
infectious waste	waste suspected to contain pathogens, eg laboratory cultures, waste from isolation wards, tissues (swabs), materials or equipment that have been in contact with infected patients, excreta
pathological waste	human tissues or fluids, eg body parts, blood and other body fluids, fetuses
sharps	sharp waste, eg needles, infusion sets, scalpels, knives, blades, broken glass
pharmaceutical waste	waste containing pharmaceuticals, eg pharmaceutiicals that are expired or no longer needed, items contaminated by or containing pharmaceuticals (bottles, boxes)
genotoxic waste	waste containing substances that are capable of causing damage to DNA, eg waste containing cytostatic drugs (often used in cncer therapy), genotoxic chemicals
chemical waste	waste containing chemical substances, eg laboratory reagents, film developer, disinfectants that are expired or no longer needed, solvents
wastes with high content of heavy metals	Batteries, broken thermometers, blood-pressure gauges, etc.
pressurized containers	gas cylinders, gas cartidges, aerosol cans
radioactive waste	waste containing radioactive substances, eg unused liquids from radiotherapy or laboratory research, contaiminated glassware, packages or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclides, sealed sources

Table 1: WHO categories of health care waste

Disposal methods vary according to type of waste, local environment, available technology, costs and financing, and social acceptance (due to religion, customs, etc). Each facility or health authority must assess local conditions and decide on appropriate HCW solutions; there is no single best method or method mix [2].

2.3 Waste Treatment in Slovenia

In 2005 Slovenia recovered 58% of waste generated by production and service activities. The rest of waste was disposed (30%), delivered to abroad (9%) or temporary stored. In 2005, 5,585,080 tons of waste was generated by production and service activities.

Compared to 2004, the amount of waste decreased by 5.2%. The greatest share in the total amount of waste was generated by manufacturing (38%), followed by electricity, gas and water supply (27%) and construction (18%). The rest of waste was generated by other activities (17%). In 2005, 54% of waste was internally recovered or internally disposed; the remaining 46% of waste was delivered to the others for recovery or disposal.

In 2005 the amount of hazardous waste increased by 16%. So, 122,161 tons of hazardous waste were generated. A slightly higher share of hazardous waste (54%) was delivered to the others for recovery or disposal, while the rest of hazardous waste (46%) was recovered or disposed individually by the business entities.
In 2005 total recovery of waste decreased by 9.6% compared to 2004, but it was still 18% higher than in 2003. In 2005 the disposal of waste increased by 2.8%. At the same time the waste export increased by as much as 51.3% over the previous year [3]. Table 2 presents amount of waste from manufacturing and services and waste handling, Slovenia, 2002-2005.

	Amount of waste generated	Amount of waste generated and waste store	Internal treatment of waste	Amount of waste delivered to the other
	T			
2002	4.067.315	4.089.604	2.786.969	1.302.635
2003	4.570.267	4.686.134	3.163.418	1.522.715
2004	5.893.306	5.981.378	3.658.143	2.323.235
2005	5.585.080	5.669.138	3.034.056	2.635.082

Table 2: amount of waste from manufacturing and services and waste handling, Slovenia, 2002-2005 [3].

Table 3 presents hazardous waste and waste handling, Slovenia, 2001-2005

	Amount of hazardous waste generated	Amount of hazardous waste generated and waste store	Internal treatment of hazardous waste	Amount of hazardous waste delivered to the other
	t			
2001	67.517	67.520	33.826	33.694
2002	63.206	66.780	33.364	33.416
2003	64.180	67.137	28.933	38.203
2004	104.073	108.882	53.062	55.820
2005	122.161	126.848	57.997	68.851

Table 3: hazardous waste and waste handling, Slovenia, 2001-2005 [3].

Figure 2 presents waste recovery and waste disposal in Slovenia, 2002-2005.

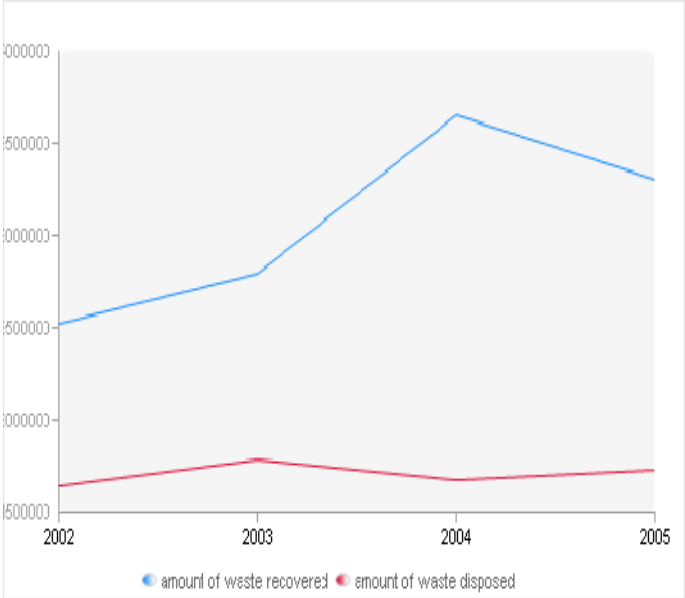

Figure 2: Waste recovery and waste disposal in Slovenia, 2002-2005 [3].

Health services have an exceptional role in the spheres of preventive medicine and public health promotion, in the sense of keeping a favorable balance between costs and benefits. Health service organizations should define all their processes. These processes, which are typically multidisciplinary, include administrative and other support services, include such examples as:

a) the organizational development, including quality, environmental, safety and health management system,
b) the development and delivery of training to educate,
c) the process,
d) the preventive and corrective maintenance program for equipment and facilities,
e) the continued care of patient/client in any setting,
f) the counseling of a patient/client and family [4].

One point of view of all their process is waste treatment. The stages in HCWM are: production of waste within a hospital ward, segregation of waste, ward storage, onsite transportation and treatment (if

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any), onsite central storage, offsite transportation, treatment, and final disposal. Dealing with such a comprehensive subject which impacts the construction and functionality of health facilities, can be daunting. Several agencies (WHO, the World Bank) and NGOs (Health Care Without Harm) have developed useful guidelines [2].

3 Problem Solution

3.1 Operating quality management in private pharmacies

Private pharmacies are a new constituent element of pharmacies activity and can significantly affect the development and growth of the latter. Simultaneously, they exert influence on resources usage and consequently on costs optimization. Controlling costs is a very important aspect of differentiation and competitiveness between the two sectors, private and public. Expert work along with permanent education enables us to form a competitive advantage in both spheres of the public audience, expert and non-expert, and to achieve considerably better results than in the past. Creating, maintaining and improving the system of operating quality management, following the guidelines and requirements of the SIST ISO 9001:2000 standards, serves as a rational operation tool giving grounds to systematization and to a comparison between both sectors, private and public. Information support allows a direct comparison. This is the reason for the decision of private pharmacies sector to optimize business processes and introduce information support of business operation. With the quality management system and information support of the business operation we can achieve the following basic goals:

- Assure and permanently improve the level of pharmacy service quality,
- assure constant growth of general population's satisfaction with medicinal products supply,
- optimize the economic aspect of business operation.

Reaching the three basic goals leads to the one set nationwide – quality service and rational medicinal products supply, a project which comprises five stages:

1. Current situation analysis.

2. Modeling and optimizing business processes.

3. Information support plans.

4. Evaluating the quality of the sample model results.
5. Application into business reality.

Three basic aims of the project:

1. Find reasons of ineffectiveness on the level of global pharmacy operation and give suggestions for improvement.

2. Find reasons of ineffectiveness on the level of pharmacy individual business processes and give suggestions for improvement.

3. Find deficiencies in information support structures of the pharmacy and give suggestions for improvement.

Definition of the term 'quality of health service' is a complex procedure. Health service is a public service which differs greatly from other public services due to the following characteristics:

- unlimited demands for health services and limited financial resources,
- sensitive users of health services (clients) with a limited influence on the quality,
- presence of highly trained professionals,
- enormous influence on quality of life, and
- satisfaction of complex needs: expectations and demands of users (patients), demands of payers (health insurance companies, public financial resources), professional standards, and moral (ethical) standards [15].

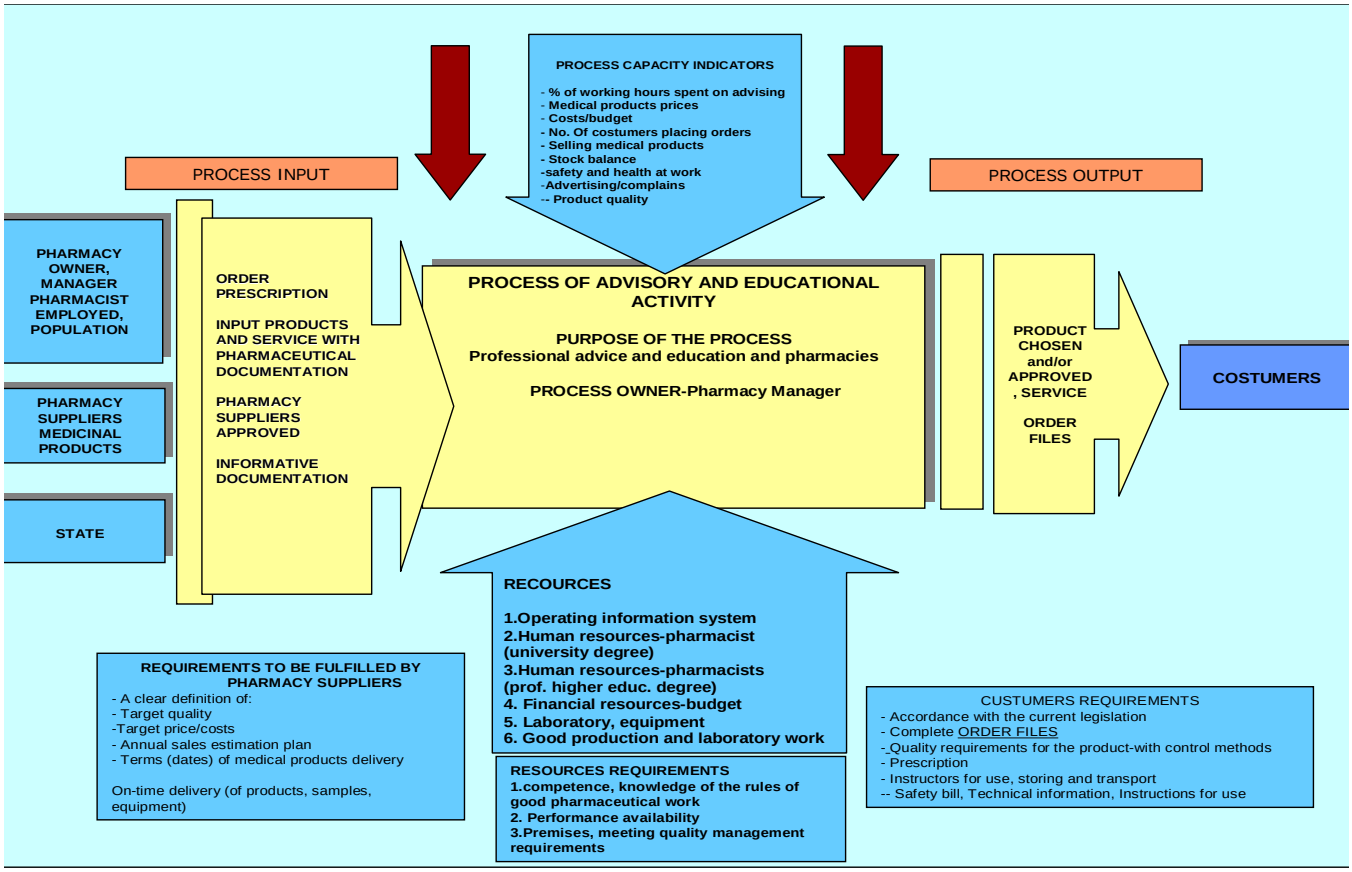
This definition emphasises three basic dimensions of quality:

- Client Quality,
- Professional Quality, and
- Management Quality.

These dimensions of quality are demanded from three interest groups, involved in the health care system: users, professionals (providers of services) and management. A full cooperation between these groups is a fundamental issue for a successful quality improvement of health services [16].
Different definitions of the term 'quality' create a slight problem in the implementation of quality in public and private health care.

3.2. Modeling and optimizing processes

There is an analysis based necessity for modeling basic, support and external processes. Process modeling uses guidelines of the ISO 9001:2000 standard. Arnica Montana, a private pharmacy, decided to apply a process method in the spheres of operating quality management, environment treatment, safety and health at work precautions – for the entire scope of pharmacy activity. Every activity that receives input items and transforms them into output items is considered a process. A process method means systematic recognition and management of processes used within the pharmacy and their mutual impact. Figure 3 shows a schematic presentation of the process method sample model. The model takes into account an important role a customer has in defining input requirements. Customers' satisfaction supervision is essential for evaluating and confirming the fulfillment of customers' requirements. It is equally important for the performers of the process to carry out their work tasks with little or no work risk. The role of management is shown in creativeness for the support of collaborators' creativeness. The processes innovation is so a segment in the innovative business system. In the example of environment protection it is necessary that we are as much collaborative, creative and target directed as possible [19].



Picture 3: Modelling the process method in the private pharmacy

3.3 Handling and Disposal

Management should consider actions such as:

- Identifying the product realization processes that provide added value to the organization,
- Identifying the support processes that influence the effectiveness and efficiency of the realization processes,
- Creating an environment that encourages the involvement and development of people, and
- Provision of the structure and resources that are necessary to support the organization's strategic plans [12].

Optimizing processes in private and public Health services is essential for process costs control and in for contributing to a rational medicinal products/services

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supply of the population. Privatisation of a public health service may be one possible step in combination with a thorough consideration of all benefits and deficiencies [6].An organization should allow adequate time for the environmental management to be effective. Constant growth in business operation means also care of environmental and environmental management system.. handling and disposal. The success of the organization depends on the understanding and satisfying the current and future needs and expectations of present and potential customers and end-users, as well as understanding and considering those of other interested parties. Because of these, management shall ensure that appropriate communication channels are established within the organization and that communication takes place regarding the effectiveness of the management system. An efficient and successful system of providing quality and environmental service pertaining to medicinal products/services supply - a system satisfying the needs, wishes and expectations of everybody concerned through an overall activity control, is one of the most suitable mechanisms enabling us to have global supervision and to act globally on the local market – with global characteristics. Simultaneously, such a system offers a possibility of constant growth in business operation [5]. ISO 14001:2004 dealing with environment system requirements [7].Important part of EMS is handling care waste management. HCWM is most effective when proper methods are employed at each step, from planning and procurement through disposal. The first step should be determining realistic options for HCWM given the budget, technology, and local community preferences. Different aspects of health care waste must be considered when choosing the appropriate treatment technology (such as volume, temperature, whether the waste is liquid or solid, hazardous or infectious) [2]. To ensure worker safety, it is normally necessary to procure plastic bags, trash bins, 'sharps' containers, and sometimes even special trucks. It is sometimes advisable to ensure access to disposable gloves and other protective equipment for staff (eg boots, aprons, thick rubber gloves), needles and syringes, laboratory equipment, cleansing agents, and tubes/hoses/other items associated with diagnostic and intensive care machines. Disposable items increase the amount of HCW each hospital or health care facility produces, and have cost implications [2]. For this purpose there are various tools and regulations in the organisational and technical-technological field and in the field of controlling human resources and the treatment in line with employee's abilities. The consequences of this (tools and regulations) are economy effects which develop into Sustainable Development effects [20].

3.4. Business information system

Optimizing information technology is a further vital factor following the setting of organizational processes and it means the setting of an effective business information and decision making system – quality information can be selected from a data pile, which makes tactical decision making possible.

The system should involve the following elements:

- Data warehouse
- Reporting
- Creating and analyzing information

A data warehouse is a static base of data depending on time. The effectiveness of data warehouses is gained by their separation from the transactional data system (with terminated transfer unit) which prevents losing their sense and effectiveness. Furthermore, the data in data warehouses is consistent and permanent, which is not always the case in transactional data systems. Consequently, the data warehouse will be filled solely with verified summary data for a chosen period, depending on the desired evaluation accuracy. The data in data warehouses is related to history – data warehouses comprise a number of time cross-sections that are no longer changing. Thus, specified time cross-section data is transported into a data warehouse and can afterwards be only read. The table features data categories, saved in the data warehouse, their sources,

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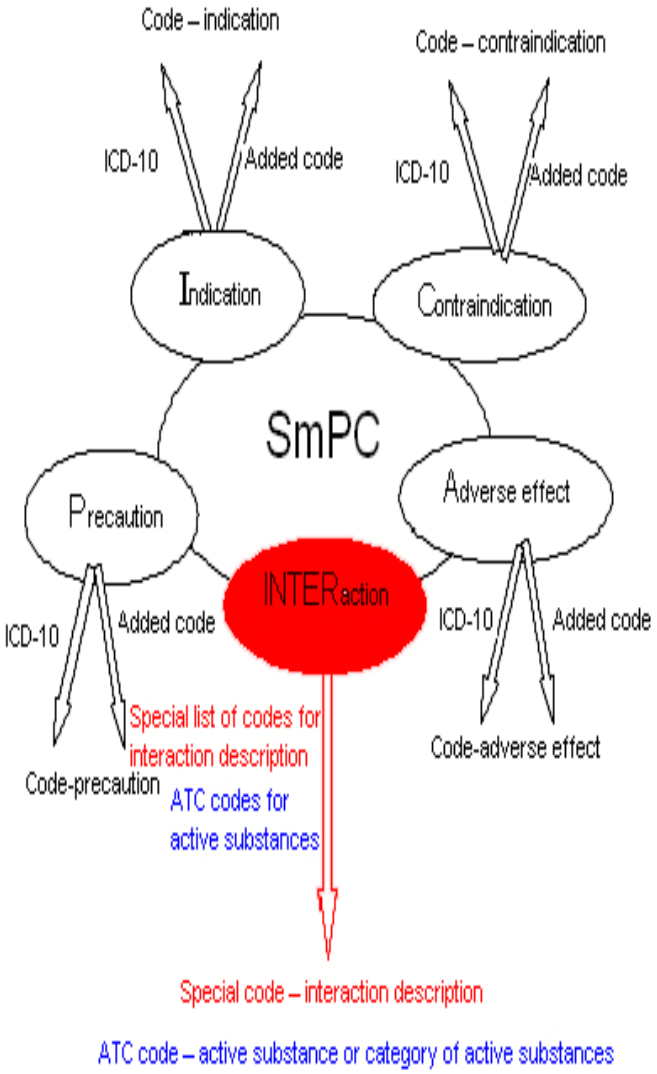

Figure 4: Data input process algorithm [18]

3.5 HCWM technologies at national level

WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends[17]. WHO recommended:

Technical issues pertaining to the management of HCW are rarely dealt with at national level. The rare occasions where centralized decisions are taken in this respect usually occur before national immunisation campaigns. Decisions that can and should be taken at national level and that relate to HCWM technologies typically focus on the elaboration of guidelines and standards (colour coding of containers; legal requirements for the transport of HCW; emission norms, etc…). These documents must take into account both national legislation as well as international legally binding Conventions. For cost-effectiveness and efficiency, it could be advisable to envisage bulk purchasing of certain items necessary in the HCWM process at national level such as safety boxes and other waste containers, protective equipment, etc. At the level of HCW treatment options, hazardous HCW can be dealt with in a decentralized manner with each HCF having it's own on-site system or in a centralized way, HCW being transported off-site to a HCW treatment unit that can be located either in a regional referral HCF or in a public / private waste treatment plant. Recycling options should be investigated whenever possible [17].

- **Decentralised HCW treatment**

The advantages of on-site HCW treatment are situated at the level of convenience and minimization of risks to public health and the environment by confinement of hazardous HCW to the healthcare premises. Decentralized, on-site treatment is often the only feasible solution for rural / remote HCFs and is also advisable when HCFs are situated far from each other and the road system is poor.

Disadvantages are that extra technical staff may be required to operate and maintain the systems. It may also be difficult for authorities to monitor the performance of many small facilities: this may result in poor compliance with operating standards, depending on the type of systems, and subsequent increased environmental pollution.

- **Centralised HCW treatment**

The advantages in choosing off-site centralized HCW treatment solutions are:

- financial: greater cost-effectiveness can be achieved in larger units unless the running costs for waste collection and transportation remain too expensive;
- technical: efficient operation and maintenance of units is easier to ensure in a centralized facility than in several plants where financial and human resources may not be readily available;
- legal compliance: conformance to environmental norms are easier to achieve thanks to the use of more sophisticated/ expensive technology and by the reduced number of facilities that need to be monitored by environmental surveillance authorities.

- **Public - private partnerships**

The initial investments required to set up a central treatment unit can be quite high and public-private partnerships can be potential solutions to this limitation. Another option consists in purchasing

several units at national level; apart from being financially interesting it could help solve a frequent weak point at the level of technical support by having the training of a group of technical specialists in the operation and maintenance of these systems included in the contract.
The prerequisites for these options are:
- to have the necessary technical competencies at the level of the Ministry of Health to ensure the tendering and subsequent selection of the technical option be properly carried out;
- to carry out a comprehensive survey of the needs within the country so as to be able to determine both the number of units required and their optimal distribution.
This last point should be carried out during the national assessment on HCWM taking into account the quantities of waste being produced within the different HCFs, storage and transport issues[17].

3.6 Costs of construction and operation of a health-care waste incineration plant

All organizations need to establish accounting procedures to document the costs they incur in managing health-care waste. Accurate record-keeping and cost analysis must be undertaken by a designated individual. Health-care waste costs should be the subject of a separate budget line; this allows costs for different periods to be compared and helps to reduce management costs [18].Lists the elements that should be included in the cost assessment
- **Site:** Cost of land , Rights of way, Site preparation and infrastructure, Provision of utilities to site
- **Consultancy fees:** Environmental/waste management consultant, Engineering, Architectural, Legal fees
- **Construction costs:** Incinerator building, Waste storage room, Offices
- **Incinerator:** Cost of incinerator, Freight and storage charges
- **Waste transport costs:** Waste collection trucks, Bins/containers for transporting waste from hospitals to incinerator site
- **Equipment costs:** Trolleys for collecting waste bags from wards, Bag holders to be located at all sources of waste in hospitals, Weighing machines for weighing waste bags, Refrigerators for storage of waste if necessary
- **Financing charges:** Interest, Taxes, Accounting and audit fees
- **Direct operating costs:** Manpower requirements (manager,operators, drivers, . . .), Yellow bags with tags for infectious wastes, Black bags for non-risk waste, Sharps containers, Transportation costs Utilities (fuel, water, electricity) , Chemicals (for flue-gas cleaning)
- **Indirect operating costs:** Training Incinerator maintenance and parts replacement, Vehicle maintenance, Uniforms and safety equipment, Ash disposal cost, Compliance monitoring of flue-gas Emissions, Project management and ,administrative costs for the organization responsible for the project execution and long-term operation of the project

4 Conclusion

Health service design, delivery, management and/or administration should focus ultimately on the patient/client [9]. The interest of customers, users, developers and others in the environmental aspects and impacts of products is increasing [10].With the environmental management system and information support of the business operation we can achieve the following basic goals:

- Assure and permanently improve the level of health service quality,
- assure constant growth of general population's satisfaction with health service supply,
- optimize the economic aspect of business operation [5].

Poor management of HCW exposes healthcare workers, waste handlers and the community to infections, toxic effects and injuries. This has to be taken into consideration when choosing a treatment or a disposal method by carrying out a rapid environmental impact assessment .

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