Results of a hospital waste survey in private hospitals in Fars province, Iran

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Abstract

Hospital waste is considered dangerous because it may possess pathogenic agents and can cause undesirable effects on human health and the environment. In Iran, neither rules have been compiled nor does exact information exist regarding hospital waste management. The survey presented in this article was carried out in all 15 private hospitals of Fars province (Iran) from the total numbers of 50 governmental and private hospitals located in this province, in order to determine the amount of different kinds of waste produced and the present situation of waste management. The results indicated that the waste generation rate is 4.45 kg/bed/day, which includes 1830 kg (71.44%) of domestic waste, 712 kg (27.8%) of infectious waste, and 19.6 kg (0.76%) of sharps. Segregation of the different types of waste is not carried out perfectly. Two (13.3%) of the hospitals use containers without lids for on-site transport of wastes. Nine (60%) of the hospitals are equipped with an incinerator and six of them (40%) have operational problems with the incinerators. In all hospitals municipal workers transport waste outside the hospital premises daily or at the most on alternative days. In the hospitals under study, there aren’t any training courses about hospital waste management and the hazards associated with them. The training courses that are provided are either ineffective or unsuitable. Performing extensive studies all over the country, compiling and enacting rules, establishing standards and providing effective personnel training are the main challenges for the concerned authorities and specialists in this field.

1. Introduction

Industrial and economic advancements and urban growth together with increases in population and population density have resulted in an increase of per capita waste production. Hospital waste is potentially dangerous, since it may possess pathogenic agents. Some of the pathogenic organisms are dangerous, because they may be resistant to treatment and possess high pathogenicity. Inadequate waste management will cause environmental pollution, unpleasant smell, growth and multiplication of insects, rodents and worms and may lead to the transmission of diseases like typhoid, cholera, hepatitis and AIDS through injuries from syringes and needles contaminated with human blood (Henry and Heinke, 1996). Hence, collection and disposal of waste in the proper manner is of great importance as it can decrease directly and indirectly health risks to people, and damage to flora, fauna, and the environment (Centers for Disease Control and Prevention, 2001). Inability to follow minimum standards of hospital waste management not only decreases the quality of life and health in a society but also increases the workload of health services. Today, collection, transport and disposal of waste have turned into a complicated and important problem that needs to be regulated by definitive rules.

This issue is so important that in many industrialized countries, specific rules and regulations have been implemented for medical institutions, regardless if they belong to the public or to the private sector (New York State, Department of Environmental Conservation, 1996). In Iran, as in many other developing countries, regrettably no rules have been compiled as yet. Furthermore, frequently accurate information about the
amount of waste produced and the method of treatment and disposal in the hospitals is not readily available.

In this article, we present and discuss the results of a survey on hospital waste in all private hospitals of the Fars province in Iran. Iran is located in Middle East Asia and has a total population of about 60 million inhabitants. It is the second most populated and second largest country in this region. Shiraz, the largest city in the southern part of Iran and capital of the Fars province, serves as referral center for about one quarter of Iran’s medical cases. This study was conducted to determine the amount of hospital waste produced, the condition of segregation of wastes, type of storage containers used, temporary storage area, collection procedures, on-site transport and treatment of wastes, off-site transport, disposal of hospital wastes and finally to assess the type of training provided to hospital personnel, existing rules and regulations in this field and the type of sewerage system used at hospitals. At the end, measures for improvement of present condition and solving the problems identified were suggested.

2. Materials and methods

Fars province has a total of 50 hospitals. In this cross sectional study, all 15 private hospitals of Fars province, all located in Shiraz, were assessed in a period of 4 months (March–June 2002). Private hospitals were selected because they are less influenced by financial problems than governmental hospitals. Private hospitals charge patients special fees. The fees charged by private hospitals are more than public hospitals charge. On the other hand patients in poor condition are not admitted in these private hospitals because of the limited number of wards and services to cover patients, so these hospitals have a special status. Private hospitals are more concerned on their quality than government hospitals and make capital investments to let the status of waste management in their facilities be assessed by specialists.

Personnel in charge of environmental health departments, waste management departments and members of the Central Committee of Nosocomial Infection Control were interviewed. Based on the recommendations of the World Health Organization (WHO) for evaluation of hospital waste management in developing countries, (Prüss et al., 1999, World Health Organization, 2001) a data form and questionnaire were developed. After taking into consideration specific Iranian differences and the views of the environmental health specialists as well as those of the members of the Central Committee of Nosocomial Infection Control Committee of Fars province regarding the present problems in the management of hospital waste and the expected results from the questionnaire, some modifications were made to the questionnaire suggested by the WHO. In each hospital, after interviewing hospital directors, waste management employees and other personnel as well as observing the process of collection and disposal of wastes, the wastes were weighed over a period of 1 month. The data were recorded in specific data forms. The data forms and questionnaires were completed and stored for further analyses. Data was coded and analyzed using SPSS 10 software.

3. Results and discussion

3.1. Location and capacity of hospitals

All private hospitals of the province of Fars are situated in Shiraz. Shiraz, the capital of the province, has a hot and dry climate and serves as the referral center for the health service, not only for its own habitants, but also for other Southern provinces of Iran. The total number of beds in these hospitals is 1327. The mean, minimum, and maximum bed occupancy during the study period was 53.73±19.9, 15, and 90%, respectively. The average number of services provided in these hospitals was 7.6±1.8 (minimum 4, maximum 11).

3.2. Waste production

Waste is produced from the various activities performed in the hospitals. General waste produced at the hospital is related to food preparation, administrative departments, and landscaping. This type of waste is similar to household waste and city waste. In the hospitals, different kinds of therapeutic procedures such as cobalt therapy, chemotherapy, dialysis, surgery, delivery, resection of gangrenous organs, autopsy, biopsy, para-clinical exams, injections, etc., are carried out and result in the production of infectious wastes, sharp objects contaminated with patients’ blood and secretions, radioactive wastes and chemical materials which are considered to be the hazardous wastes (Prüss et al., 1999). The amount of waste generated in the hospitals depends upon various factors such as the number of beds, types of health services provided, economic, social and cultural status of the patients and the general condition of the area where the hospital is situated. For example, in hospitals located in low socioeconomic areas of the cities, most of the waste consists of residues from fruits which are voluminous and abundant, whereas in those located in high socioeconomic areas of the city; most of wastes contain flowers, cans and single use containers for food. However, we did not find any statistically significant correlation between types of services in hospitals and amount of waste production ($r = 0.08, P = 0.59$), which, in part, is due to the homogeneity of the services in the hospitals under study with small differences in services they provide (Table 1).
Waste generation rate in the hospital varies from 1.25 to 14.8 kg/bed/day. The data in Table 1 indicate the waste generation rate by considering the occupancy rate in the hospitals.

In a study performed in 1991 in hospitals of Tehran (the capital city of Iran), the waste generation rate was reported to be 2.71 kg/bed/day. (Mohammadi Baghaee, 2000). The waste generation rate in Dar es Salaam (Tanzania) hospitals in 1993 was reported to be between 0.84 and 5.8 kg/bed/day (Mato and Kassenga, 1997). The results of our study corresponded with the report by the WHO regarding the waste generation rate in general and university hospitals, which are 4.2–21.1 and 4.1–8.7 kg/bed/day, respectively (Prüss et al., 1999).

The total amount of waste produced in the hospitals was 2561.6 kg daily (935 t/year), 71.44% consisted of “general” waste, 27.8% infectious waste, and 0.76% comprised of sharps. In comparison to the study performed in Dar es Salaam, infectious waste amounted for 60.2% of the total waste (Mato and Kaseva, 1999). The WHO has estimated the amount of infectious waste and sharp objects in developing countries to be about 15 and 1%, respectively (Prüss et al., 1999). However, in our study the amount of infectious waste was higher and the sharp objects were lower in most of the studied hospitals than the amounts reported by the WHO. In 1993, the amount of sharp wastes was reported to be between 0.5% and 9% in China and Taiwan (Chih-Shan and Fu-Tien, 1993).

Waste generation rate in the hospital varies from 1.25 to 14.8 kg/bed/day. The data in Table 1 indicate the waste generation rate by considering the occupancy rate in the hospitals.

3.3. Waste segregation and waste containers

In a few hospitals, radioactive, infectious, and sharp wastes are separated from the general waste stream at the site of production so they are not stored in similar containers and are disposed together. Anatomical parts that are attached to the bones are given to the patient’s guardians and are buried according to religious rites. In the case where bone is not attached to the anatomical part, the part that has been removed is considered to be infectious waste. In all hospitals, pharmaceutical waste and pressurized containers are disposed along with the general waste. Liquid pharmaceutical waste is poured into the drains along with liquid chemical waste. This study revealed that segregation of all wastes is not conducted according to definite rules and standards, some amount of hazardous waste is stored in the same containers as the domestic wastes, and no control measures exist for the management of these wastes. All the hospitals have provided plastic bags and strong plastic containers for infectious waste such as empty containers of antiseptics used in the hospital. This is in accordance with the proposal by the WHO (Prüss et al., 1999).

3.4. On-site transport

At the end of each shift, hospital waste is collected and transported to a temporary storage area by hospital staff. In 13 (87%) hospitals, closed containers with a capacity of about 500 l are used for on-site transport of waste from the sites of production (different wards) to

Table 1

<table>
<thead>
<tr>
<th>Capacity (beds)</th>
<th>Types of Services</th>
<th>Waste generation rates (kg/bed/day)</th>
<th>Waste generation rates (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 50</td>
<td>SUR, ER, LAB, GYN, RAD, OBS</td>
<td>1.00 0.23 0.01 1.24</td>
<td>30.0 7.0 0.4 37.4</td>
</tr>
<tr>
<td>B 100</td>
<td>INM,SUR, ER, LAB, GYN, RAD, CCU</td>
<td>1.67 0.5 0.02 2.19</td>
<td>100 30 1 131</td>
</tr>
<tr>
<td>C 200</td>
<td>INF,SUR, ER, LAB, GYN, RAD, CCU</td>
<td>1 1 0.02 2.02</td>
<td>100 100 2 202</td>
</tr>
<tr>
<td>D 60</td>
<td>INF,SUR, ER, LAB, GYN, RAD, OBS</td>
<td>9.52 0.24 0.02 9.78</td>
<td>200 5 0.5 205.5</td>
</tr>
<tr>
<td>E 30</td>
<td>INF,SUR, ER, LAB, GYN, RAD, ORTH</td>
<td>5.56 1.11 0.07 6.74</td>
<td>150 30 2 182</td>
</tr>
<tr>
<td>F 26</td>
<td>SUR, ER, LAB, GYN, RAD, OBS</td>
<td>1.15 0.31 0.02 1.48</td>
<td>15 4 0.25 19.25</td>
</tr>
<tr>
<td>G 70</td>
<td>INF,SUR, ER, LAB, GYN, RAD, CHE, ICU, CCU, OBS</td>
<td>6.12 0.61 0.04 6.77</td>
<td>300 30 2 332</td>
</tr>
<tr>
<td>H 50</td>
<td>INF,SUR, ER, LAB, GYN, RAD, OBS</td>
<td>10.67 4 0.13 14.8</td>
<td>80 30 1 111</td>
</tr>
<tr>
<td>I 77</td>
<td>INF,SUR, ER, LAB, GYN, RAD, ICU, CCU, OBS</td>
<td>2.34 0.26 0.02 2.62</td>
<td>90 10 0.8 100.8</td>
</tr>
<tr>
<td>J 25</td>
<td>SUR, ER, LAB, RAD</td>
<td>1.25 0.25 0.04 1.54</td>
<td>5 1 0.15 6.15</td>
</tr>
<tr>
<td>K 150</td>
<td>INF,SUR, ER, LAB, GYN, RAD, OBS</td>
<td>1.9 0.76 0.02 2.68</td>
<td>200 80 2 282</td>
</tr>
<tr>
<td>L 60</td>
<td>SUR, ER, LAB, GYN, RAD, OBS</td>
<td>3.33 0.33 0.02 3.68</td>
<td>100 10 0.5 110.5</td>
</tr>
<tr>
<td>M 65</td>
<td>INF,SUR, ER, LAB, GYN, RAD, CCU, OBS</td>
<td>3.85 0.38 0.03 4.26</td>
<td>150 15 1 166</td>
</tr>
<tr>
<td>N 300</td>
<td>INF,SUR, ER, LAB, GYN, PED, RAD, ICU, CCU, NICU, OBS</td>
<td>0.76 1.67 0.02 2.45</td>
<td>160 350 5 515</td>
</tr>
<tr>
<td>O 60</td>
<td>SUR, ER, LAB, GYN, RAD, OBS</td>
<td>4.17 0.28 0.03 4.48</td>
<td>150 10 1 161</td>
</tr>
</tbody>
</table>

INM, Internal Medicine ward; SUR, General Surgery ward; ER, Emergency Room; LAB, Laboratory; GYN, Gynecology ward; PED, Pediatrics ward; RAD, Radiology ward; CHE, Chemotherapy ward; ICU, Intensive Care Unit; CCU, Coronary Care Unit; NICU, Neonatal Intensive Care Unit; ORTH, Orthopedic surgery ward; OBS, Obstetric ward.
the temporary storage area. The staff employed for handling waste in 10 hospitals (66.7%) used almost complete personal protective equipment (the protective equipment included special dress-shirt and trousers along with at least two of the following: gloves, mask, boots, apron), in two hospitals (13.3%), only masks and gloves were used and in three hospitals (20%), only aprons were used. The lack of suitable and sufficient protective equipment, the lack of knowledge regarding the correct usage of equipment and the lack of pertinent understanding of the personnel regarding the benefits of using protective equipment exposes them to serious dangers.

In more than half of the hospitals (60%), needle stick injuries are not reported and registered and no regulations for adequate management like post exposure prophylaxis are provided. In six hospitals (40%), health care workers are referred to a physician for performing whatever is needed after the physician’s consent. None of the hospitals have any special procedures to follow up on the persons that have received needle sticks. Furthermore, accidents related to the overturning or tearing of the storage containers during on-site transport are not registered or reported in any of the hospitals that were studied.

3.5. Temporary waste storage area

The place where the hospital waste is kept before transporting to the final disposal site is termed as a temporary waste storage area. This area must be well sanitized and secured in such a way that it should be accessible only to authorized persons (Prüss et al., 1999). Only four hospitals (26.7%) have a well sanitized and secured temporary storage area and eight hospitals (53.3%) have well secured but poorly sanitized temporary storage areas. Three hospitals (20%) do not have any temporary storage area and the waste simply is dumped in the corner of the hospital yard until it is time for off-site transport. The infectious and non-infectious waste are kept in separate containers and are not mixed together in the hospital’s own temporary storage area.

3.6. Hospital waste treatment

Waste treatment leads to a decrease in volume, weight, and risk of infectivity and organic compounds of the waste (Prüss et al., 1999). The only treatment system used for infectious and sharp wastes in the hospitals included in our study was incineration; nine private hospitals (60%) were equipped with an incinerator. Among these, six hospitals had operational problems while using the combustion units related to the lack of skilled workers, spare parts and repair of the incinerators. The conditions of incinerator design and operation regarding temperature control, height of smokestack and the rate of smoke production were not suitable. The total amount of waste treated in the incinerators in the hospitals under study was 134.35 kg/day (18.4%) which contained 128 kg of infectious and 6.35 kg of sharp waste. In 1993, the condition of incinerators in Dar es Salaam hospitals was also reported as undesirable (Mato and Kassenga, 1997).

3.7. Off-site transport of hospital waste

In 14 (93.3%) hospitals, the municipality has the responsibility for off-site transport of the waste and in one (6.7%) hospital, off-site transport to the final disposal site was undertaken by the hospital itself, whereby waste included residue from the incinerators together with infectious, sharps and other domestic wastes. In 14 (93.3%) hospitals, waste is transported daily and in one (6.7%) hospital, transportation is performed on alternate days. In 13 (86.7%) hospitals, special trucks and in two (13.3%) hospitals, general trucks are used for off-site transportation of waste. According to scientific standards, the infectious wastes in the tropical area can be kept in a temporary storage area for 24 h during the hot season and up to 48 h in cooler seasons (Prüss et al., 1999). Hence the time of storage of waste in the temporary storage area exceeds the recommended standard in only one hospital during the hot season.

3.8. Final disposal of hospital waste

All hospitals dispose of their domestic waste at the same site as the civic waste. As the separation of hazardous waste from the domestic is not carried out properly, the domestic waste of the hospitals cannot be compared with the common city waste. Therefore, due to the intermingling of hazardous waste, these wastes should be considered infectious (New York State Department of Health, 1995).

With respect to the disposal of infectious waste, seven hospitals (46.7%) use incineration and eight hospitals (53.3%) did not (except for one hospital which uses an incinerator for sharp wastes) and buried the infectious and sharp wastes separately (apart from the general wastes). Waste from all hospitals is transported to an off-site area, which has been dedicated for this purpose located about 30 km away from the city. In eight hospitals (53.3%), an incinerator is used for treating sharps, in four hospitals, the waste is buried separately, and in three hospitals (20%), special instruments are used to destroy them and then are buried apart from the domestic waste. Radioactive wastes from all hospitals are collected and disposed of by the Atomic Energy Organization. Liquid pharmaceutical and chemical waste is poured into the sewage system in all hospitals. The final disposal site for hospital wastes in all of the private hospitals in Fars province has enough security.
and is accessible only by authorized persons. Recycling is not practiced in any of the hospitals except for the use of empty containers of antiseptics for the collection and temporary storage of sharps.

3.9. Medical staff

The responsibility for waste management in seven (46.7%) hospitals is assigned to the person in charge (supervisor) of the hospital waste management staff and in eight (53.3%) hospitals, the person in charge of the private company providing cleansing staff for the hospital has this responsibility. No academic papers have been considered for providing such responsibilities to concerned authorities. None of the supervisors have been trained on hospital waste management. Twelve of the supervisors (80%) have attended the classes sponsored by the environmental health unit or central committee of nosocomial infection prevention of Fars province. These classes are the same for all personnel (supervisors, nurses, workers) and each class lasts for a few hours. Only a part of these classes is allocated to the general concepts of waste assembly, disposal and hazards of hospital wastes.

This survey indicated that training was not provided to doctors and other personnel about hospital waste management and their potential hazards. Some hospitals (60%) provide some training for the cleansing staff and in some (13.3%) nurses are also included in these classes. Newly hired waste management staff is not trained properly; however some attend the classes described in the previous paragraph. In 40% of hospitals, no training is given to these personnel. Municipal workers who are responsible for the transportation of hospital waste to the final disposal site are not cautioned about the hazards associated with hospital waste. Hospital waste management is not mentioned in the duties of hospital members (manager, matron, environmental hygiene engineer, nosocomial infection control committee and other personnel). In none of the hospitals the cleansing staff has a detailed description regarding their duties.

Lack of proper training in the hospitals poses serious risks to the personnel as far as the hazards of hospital waste is concerned. The process of collection, segregation and disposal of hospital waste is not performed according to recommended standards, and hence patients, visitors, society and the environment are exposed to the dangers of such waste. In developed countries, training programs and educational classes are instituted repeatedly for all personnel and the content of these programs is specifically designed to different personnel. In the USA, part 1910, 1030 are related to Occupational Health and Welfare (29 CFR part 1910, 1030 OSHA) and regulates the training needs for different personnel who are employed in centers where hospital waste production occurs (New York State, Department of Environmental Conservation, 1996). At least, in the hospitals included in our study, all the personnel are vaccinated against tetanus and hepatitis B.

3.10. Hospital waste management regulations

There is no definite policy or plan for purchasing the necessary equipment and for providing the facilities for the correct management of hospital waste in hospitals examined by us. Even at the provincial level, there is not any obvious policy in this regard and no budget is allocated at the provincial or hospital level for the disposal of hospital waste.

This study indicates that regulations about proper methods of waste disposal do not exist. In fact, there are not even clearly defined rules for collection and handling of wastes from specific departments or wards such as operating rooms, chemotherapy units, laboratories, pathology sections, hemodialysis, and others. In none of the hospitals, a regular report about hospital waste management is prepared and the process of performing respective studies is also not reported. On the contrary, in developed countries, definite rules and regulations exist at the national, regional and hospital levels. For example, in the University Hospital of Freiburg, Germany, there are almost 36 rules at the national level, five rules at the regional level and 13 rules at hospital level resulting in a total of 54 rules for the correct management of hospital waste (Daschner, 2000).

3.11. Sewage system

All of the hospitals are bereft of sewage treatment system prior to disposal. In 10 hospitals (66.7%) sewage is transported into absorbent wells and in three hospitals (20%), the sewage is transported into the regular city sewage system. Two hospitals (13.3%) transfer their sewage outside the hospital by means of tankers.

4. Conclusion

In conclusion, the following problems have been identified:

1. Lack of definite policies and budget allocation at the provincial and hospital level regarding hospital waste management.
2. Lack of necessary rules, regulations and instructions on different aspects of collection and disposal of waste.
3. Lack of proper training for different personnel of the hospitals, especially the staff responsible for hospital waste management regarding the hazards and correct management of hospital waste.
4. Intermingling of hazardous wastes with the domestic waste of the hospitals.
5. Lack of incinerators or low quality of operation and improper treatment of hazardous hospital waste.
6. Lack of control and supervision on the collection and disposal of hospital waste.
7. Lack of suitable and adequate protective equipment in hospitals.
8. Pouring of liquid chemical waste into the city sewerage system without any prior treatment.

From the results obtained by our study, it becomes obvious that there are few regulations regarding medical waste management, which is a potential public health hazard. As the segregation of hazardous and domestic waste of hospital is not performed according to recommended standards, all waste generated in these hospitals has to be regarded as bio-hazardous. By following standard rules for medical waste management the amount of medical waste inappropriately disposed could be substantially reduced.

Performing comprehensive studies throughout the country, compiling necessary rules and establishing standards in this field along with planning regular and effective training programs through lectures, posters and handouts for different personnel regarding hospital waste hazards, collection, segregation of different wastes, storage, preventive measures and control of accidents/injuries, and raising the knowledge on the importance of using protective measures should be considered an urgent matter in our Health Service Department.

Our study has created awareness regarding the magnitude of the problem of medical waste management in hospitals and has generated interest for systematic control efforts for medical waste disposal. Also, we have encouraged the Vice-Chancellor for Clinical and Drug Affairs of Shiraz University of Medical Sciences and related organizations to design an appropriate medical waste management and control system in this province with teaching programs for all personnel that are involved in this process.

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