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Management of healthcare waste in circumstances of limited resources: a case study in the hospitals of Nablus city, Palestine

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The objectives of this study were the assessment of healthcare waste management and the characterization of healthcare waste material generated in the hospitals in Nablus city, Palestine, and furthermore, to estimate the prevalence of hepatitis B among the cleaning personnel working in these hospitals. The medical waste generation rate in kg per bed per day was between 0.59 and 0.93 kg bed^{-1} day^{-1}. The waste generation rate in the healthcare facilities of Nablus city hospitals was similar to some other developing countries; however, the percentage of medical wastes in the total waste stream was comparatively high. The density of medical waste at the four hospitals studied ranged between 144.9 and 188.4 kg m^{-3} with a mean value of 166.7 kg m^{-3}. The waste segregation and handling practices were very poor. Other alternatives for waste treatment rather than incineration such as a locally made autoclave integrated with a shredder should be evaluated and implemented. The system of healthcare waste management in Nablus city is in need of immediate improvement and attention. Formulating rules and guidelines for medical waste and developing strategies for overcoming the obstacles related to waste management should be considered as an urgent matter.

Keywords: Medical waste, hepatitis B, management, generation rate, hospital, Nablus, Palestine, wmr 1362–6

Introduction

Healthcare waste generated at hospitals can be classified as follows: general waste; infectious waste, pathological waste; sharps; pharmaceutical waste; genotoxic waste; chemical waste; waste with a high content of heavy metals; pressurized containers; and radioactive waste (Pruss *et al*. 1999, Alagoz & Kocasoy 2008a).

In the literature relevant to the rate of generation of medical waste for different countries (Alvim Ferraz *et al*. 2000, Oweis *et al*. 2005, Tudor *et al*. 2005, Marinkovic *et al*. 2008), it is noticeable that each country has different amounts of medical waste production depending upon its particular medical situations. Generation rates of hospital healthcare waste differ not only from country to country but also within a country (Pruss *et al.* 1999, Mohee 2005). Healthcare waste generation depends on numerous factors such as the established waste management methods, type of healthcare establishment, hospital specialization, proportion of reusable items employed in healthcare and proportion of patients treated on a daily basis (Askarian *et al*. 2004, Da Silva *et al*. 2005, Tudor 2007, Cheng *et al*. 2008). In middle- and low-income countries healthcare waste generation is usually lower than in high-income countries (Qusus 1988, Shinee *et al*. 2008). A typical average distribution of healthcare waste materials is as follows: 80% general domestic waste, 15%

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pathological and infectious waste, 1% sharps, 3% chemical and pharmaceutical waste, and less than 1% special waste which includes radioactive, cytotoxic, pressurized containers, broken thermometers and used batteries (Pruss *et al*. 1999).

There are many technologies in existence for the treatment of medical waste (Park & Jeong 2001, Yoon 2001). According to studies that have investigated the treatment of medical waste, about 59–60% of medical waste materials are treated through incineration, 20–37% by steam sterilization and 4–5% by other treatment methods (Park & Jeong 2001). Currently, the proportion of off-site treatment and disposal has increased to 84%, due to severe regulations concerning on-site incineration (Park & Jeong 2001, Lee *et al*. 2004).

Exposure to healthcare waste can result in disease or injury. All individuals, especially the healthcare staff (e.g. doctors, nurses, laboratory technicians and waste handlers) who are exposed to healthcare waste, are potentially at risk (Patil & Pokhrel 2005, Marinkovic *et al*. 2008). Cleaning personnel who handle waste containing blood-soaked objects from patient in different units in the hospitals must be protected from the transmission of hepatitis B (HBV) and other diseases [World Health Organization (WHO) 1985, Liss *et al*. 1990]. Maintenance staff, personnel who are involved in the final disposal or incineration, pharmacy personnel, personnel working in or visiting laboratories and rooms in clinics, and members of the public who live near disposal sites should also be protected (Al-Khatib 2006, Alagoz & Kocasoy 2008b). It has been reported that hospital staff frequently have an infection rate of HBV that is three to six times higher than the normal risk level (Qusus 1988). There is strong epidemiological evidence, that the main concern regarding infectious hospital waste is the transmission of the HIV/AIDS virus and, more often, of HBV through the injuries caused by syringe needles contaminated by human blood (WHO 1995, Tooher *et al.* 2005).

Hepatitis B viral infection is one of the main epidemiological infections in hospitals that can be transmitted by healthcare activities during patient treatment, investigations, vaccination, by using any type of injection needle, by trauma from surgical blades or during blood transfusion. HBV infection is dangerous and may lead to many complications such as cirrhosis of the liver or even death (Refa'i 1996, Jadallah 1998, Olowokure *et al*. 2003).

The present study aimed to investigate the existing healthcare waste management practices in four hospitals in Nablus city, as a sample of healthcare establishments to determine the regulations concerning the handling, treatment and disposal;, the amounts and types of healthcare waste generated in these hospitals; and the possible health risks, especially HBV, that may affect workers who handle the healthcare waste at these hospitals.

Methodology

A general survey of the operating procedures practiced in the handling and treatment of solid waste was performed to assess compliance with WHO (Pruss *et al.* 1999) standards. All hospitals in Nablus city (four hospitals) were selected for the purpose of this study. These hospitals were Rafidia and Al-Watani hospitals (governmental) and Al-Ittehad and Al-Injili (non governmental), hospitals. A summary of the characteristics of these hospitals is presented in Table 1.

Data were gathered through an observational checklist, a questionnaire and in-depth interviews with key personel in charge of medical waste management at the Ministry of Environmental Affairs, Ministry of Health, and Nablus municipality. Questionnaire forms were distributed to all cleaning per-

Table 1: Characteristics of Nablus city hospitals.

Characteristics of hospitals	Hospitals			
	Rafidia	Al-Watani	Al-Ittehad	Al-Injili
Number of beds	145	112	75	48
Total number of patients, 1998	15838	9922	5846	6785
Number of employees, 1999	328	193	152	103
Departments				
Surgery	A	NA**	A	A
Paediatrics	NA	A	A	A
Emergency	A	A	A	NA
Intensive care unit	A	A	A	A
Kidney dialysis	NA	A	NA	NA
Maternity	A	NA	A	A
Orthopaedic	A	NA	A	A
Burn unit	A	NA	NA	NA
Support departments and units				
Pharmacy, laundry, physiotherapy, X-ray unit, laboratory, maintenance, kitchen	A	A	A	A

A, available; NA, not available.

sonnel working in the four hospitals, as they were the individuals who dealt with medical waste on a daily basis. Current management practices of medical waste were also observed by the authors and entered on a checklist that included sources and types of waste generated in different hospitals, methods of collection, transport, storage and disposal, and more specifically incineration and the condition of incinerators. In this study, the term medical waste includes all types of healthcare waste but excludes general waste.

Blood sample collection

Blood samples were obtained from all cleaning personnel working at the four hospitals and tested for HBV. The blood samples were taken using disposable sterile syringes. The blood was left to clot at room temperature, and then centrifuged at 3000 rpm for 5 min. Serum was aspirated and four aliquots of each sample were transferred into screw-capped tubes and stored at –30 °C. Blood samples were tested for HBV during October and November 1999.

Quantitative determination of waste

The following steps were involved in the determination of the biomedical waste generated from different places in the four hospitals.

1. The supporting staff of each section in the hospital was briefed over the nature of assistance and support that was needed in determining the quantity of waste materials during the study period.
2. The staff was given colour-coded, high-density polyethylene bags to use for collection of the waste to facilitate the separation of generated solid waste at the source for the data collection.
3. The quantities of medical and general solid waste were recorded outside the hospital building for medical and general wastes, respectively.
4. Solid waste of both types (general and medical) was weighed individually on a suspension spring scale (± 100 g) with the assistance of the staff and the weight was recorded by the field workers.

The amount of general and medical waste materials generated in each hospital was determined and recorded for each day over 11 different days on Saturdays, Tuesdays and Thursdays, during March, April, May and June 1999, to represent the days of the week. Total medical waste generated from four hospitals was also determined on 11 consecutive days during December 1999. The answers provided by the questionnaires completed by the cleaning personnel were analysed using SPSS computer program version 8 (SPSS Inc., Chicago, IL, USA). In order to update the data collected in 1999 regarding healthcare waste management practices, all hospitals were re-visited during March and April 2008. Special observation sheets were designed for that purpose.

Results and discussion

Hospital waste management policy

The present study at Nablus hospitals revealed that Palestinian national legislation, policy, or regulations about handling and management of medical waste were lacking. No well-defined policies related to medical waste management were available in the hospitals surveyed. It is worth mentioning that this situation has not changed during the period 1999–2008. The medical waste management system for the city has been severely affected by the political conditions, particularly during the second Palestinian uprising (Intifada). Due to the greater needs in other sectors, the solid medical waste management sector does not receive the required attention and local governments and other related institutions do not have a sufficiently robust waste management policy and system. The national policy is not clearly addressing the real-world limits in medical waste treatment, especially the emission limits. The policy is forward-looking but the current political situation is not helping in this regard. However, Al-Injili hospital has some written instructions about handling and collection of medical waste. The hospitals have also received brief written instructions from Nablus municipality about medical waste off-site transportation from the hospitals to the incinerator. The administrative directors in all surveyed hospitals have the direct responsibility for monitoring medical waste management. In the West Bank, the Jordanian Health Law issued in 1957 is still applied. Some regulatory instructions or procedures are applied in some hospitals of the West Bank. The new Palestinian Environmental Law issued in 1999 designates medical waste as a part of hazardous waste without any special regulations or procedures for its safe management regarding (Ministry of Environmental Affairs 1999).

Waste production

Waste is produced from the various activities performed in the hospitals. General waste produced at the hospitals was related to administrative departments, food preparation and landscaping. This type of waste is similar to household waste and city waste. Within the hospitals, different kinds of therapeutic procedures such as surgery, delivery, chemotherapy, injections, dialysis, resection of gangrenous organs, biopsy, autopsy, etc., are carried out and result in the production of sharp objects contaminated with patients' blood and secretions, infectious waste materials, chemical materials and radioactive waste which are considered to be the hazardous waste (Pruss *et al*. 1999, Daschner 2000). The amount of waste generated in the hospitals depends upon various factors such as the number of beds, occupancy rate, types of health services provided, social, economic and cultural status of the patients and the general condition of the area in which the hospital is situated. For example, in governmental hospitals where normally a lower level of service is provided in comparison with non-governmental hospitals, most of the patients come from low socio-economic areas of the city or surrounding communities, most of the general waste consists of residues from fruits, which are voluminous and abundant, whereas in

non-governmental hospitals most of the patients come from high socio-economic areas of the city and surrounding communities and most of the general waste contains cans, single-use containers for food and flowers.

During the study periods medical waste (including sharp waste) generation rate in the hospitals varied from 0.60 to 0.93 kg bed^{-1} day^{-1}, 0.94 to 1.28 kg in-patient^{-1} day^{-1} and 0.33 to 0.84 kg total-patient^{-1} day^{-1} during March to June, respectively. This range was less during December and was between 0.59 and 0.79 kg bed^{-1} day^{-1}, 0.87 to 1.27 kg in-patient^{-1} day^{-1} and 0.32 to 0.46 kg total-patient^{-1} day^{-1} with mean values of 0.7 kg bed^{-1} day^{-1}, 1.12 kg in-patient^{-1} day^{-1} and 0.4 kg total-patient^{-1} day^{-1}, respectively. When considering the total number of patients attending the hospitals, the generation rate is much less than that when considering only in-patients, as the number of out-patients attending the external clinics in the hospitals is high, and normally little waste is generated during their consultations/treatment.

In a study performed in 1991 in hospitals of Tehran, the healthcare waste generation rate was reported to be 2.71 kg bed^{-1} day^{-1} (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^{-1} day^{-1} (Mato & Kassenga 1997). The generation rate in the present study was between 1.86 and 2.3 kg bed^{-1} day^{-1}. The hospitals studied can be said to have lower generation rates in comparison with modern hospitals. All of the hospitals lacked modern medical facilities but were said to still provide acceptable services. Another reason could be that not all of the hospitals were situated in a highly urbanized environment and most patients did not represent affluent communities. Affluent communities tend to generate more wastes as their lifestyle includes the consumption of a greater amount of goods and services (Gwebu, 2003). The generation rates for Canada and the USA were also reported to be higher because, as developed nations, they generally have modern facilities and good services. In Canada and the USA, the generation rates were reported to range from 4.3–5.8 kg bed^{-1} day^{-1} (Mato and Kassenga, 1997).

In Limpopo Province, South Africa, the generation rates were computed to be 0.55 and 0.65 kg patient^{-1} day^{-1} for Tshilidzini and Elim hospitals, respectively. This was equivalent to an average of 0.60 kg patient^{-1} day^{-1} for the two hospitals. The generation rates indicate the type of services offered at the two hospitals and suggest that they were not different (Nemathaga *et al*. 2008).

According to Pruss *et al*. (1999), the generation rate in general hospitals in Europe was between 2.1 and 4.2 kg bed^{-1} day^{-1}. In an Indian hospital with 574 beds, it was found that the medical solid waste generated ranged between 0.50 and 0.51 kg bed^{-1} day^{-1} (Patil & Pokhrel 2005). This clearly shows that in middle- and low-income countries, healthcare waste generation is usually lower than that in high-income countries.

The solid waste produced in the four hospitals was found to consist of 74% general waste and 36% medical waste. By comparison, in a study performed in Dar-es-Salaam, medical waste amounted to 60.2% of the total waste (Mato & Kaseva 1999). The WHO has estimated the amount of medical waste in developing countries to be about 16% (Pruss *et al*. 1999). This percentage agrees with that generated at an Indian hospital (16.4%) (Patil & Pokhrel 2005). In the capital city of Mongolia, it was found that the waste generation rate in the healthcare facilities was lower than in some other countries; however, the percentage of medical waste in the total waste stream was comparatively high, ranging from 12.5 to 69.3%, which indicated poor waste handling practices (Shinee *et al*. 2008).

In the present study, however, the amount of medical waste was higher in the studied hospitals than the amounts reported by the WHO. The density of medical waste at the four hospitals ranged between 144.9 and 188.4 kg m^{-3} with a mean value of 166.7 kg m^{-3}.

Waste segregation, packaging and containers

Table 2 summarizes the segregation methods of medical waste in the four hospitals. This study revealed that segregation of all waste materials was not conducted according to definite rules and standards. Sometimes hazardous waste was stored in the same containers as the domestic waste, and no control measures existed for the management of these waste materials. None of the hospitals provided strong plas-

Table 2: Segregation of medical waste in Nablus hospitals.

Waste type	Segregation procedures
Sharps	Put in plastic bottles in most hospital departments, but in Ittehad hospital laboratory sharp boxes were used. In Al-Injili hospital sharp boxes were used for needles.
Pathological	Fetus, amputated organs (sometimes placenta) were given to the patient's guardians and are buried according to religious customs. Sectioned organs (e.g., appendix, tumors, gallbladder, etc.), were disposed with medical waste after cytology test.
Infectious	Infectious cultures (plates, tubes) were autoclaved in some hospitals (Rafidia, Al-Watani, Al-Ittehad) before being disposed off in yellow bag with medical waste.
Chemical	Liquid pharmaceutical waste was poured into the drains along with liquid chemical waste through the public domestic wastewater sewerage network.
Pharmaceutical	Pharmaceutical waste materials were disposed with general waste. Expired drugs were disposed along with the general waste or returned to the factories.
Pressurized	Disposed off with medical or ordinary waste without any care.

tic bags for medical waste segregation, and most of the time used thin plastic bags that can easily tear. None of the hospitals used colour coding. The same kind and colour of domestic waste bags was used for medical waste The normal practice was to use any colour available in the markets, which was normally black or blue, for both general and medical waste materials. This is not in accordance with the proposal by the WHO (Pruss *et al*. 1999). In the four hospitals, most of the time radioactive, infectious and sharp waste containers were not separated from the general waste stream at the site of production so they were stored in similar containers and were disposed of together. The waste in containers specified for general hospital waste and located outside the hospitals is collected with other domestic waste in municipality trucks and disposed off at the dumping site of the Nablus municipality. Liquid medical waste was disposed of in the same pipelines as domestic waste.

The mixing of dangerous waste materials with general waste in the hospitals was justified by financial issues and the lack of comprehensive staff training and, to a lesser extent, due to the lack of facilities.

Hospital waste handling and treatment

A private waste care company was responsible for waste management in Rafidia and Al-Watani hospitals in 1999 and this is still the case. In these two hospitals, most departments disposed of sharps in plastic cans, except in the laboratory where they sometimes used carton sharp boxes when available. Other types of medical waste (e.g., cotton, gauze, pads, disposable towels, placenta, amputated organs and dialysis residues) were disposed off in light, easily punctured plastic bags. Culture plates and tubes were autoclaved and then disposed off in plastic sacks. The sacks and bags were stored in plastic containers in the departments. The processes of collection began at departments where workers on every floor started to collect waste from the plastic containers and place it in light transparent plastic sacks. Waste cleaning personnel collected these bags in the early morning every day and carried them around by hand. They either used lifts or the stairs when transporting the bags to the outside of the hospital building to place them in special containers belonging to the Municipality of Nablus in a temporary storage area.

In Al-Ittehad and Al-Injili hospitals, the waste handling was carried out by the cleaning personnel employed by the hospital. These workers, in addition to handling waste, also participated in laundry collection, floor sweeping, bathroom and toilet cleaning, and sometimes in serving food to the patients.

Hospital waste was collected by cleaning personnel who picked up the medical waste from different departments and transported it manually to a temporary storage area where the hospital waste was kept before being taken to the final disposal site. This area was poorly sanitized and not secure in any of the four hospitals. It was accessible to visitors or any person visiting the hospital. No special storage room for medical waste existed in any of the hospitals. There were two specified containers for each hospital; one was located at the temporary storage area for medical waste and the other at the side of the general waste collection point on the main street. At most times during the field work, both containers had the same contents: general waste mixed with medical waste. The container available outside the hospital was open and also used by the general public. From field observations conducted in 2008, this situation has not changed since 1999.

Transportation of containers from the temporary storage areas was on a daily basis (except Fridays); a special vehicle belonging to Nablus municipality transported the filled containers to the treatment station between 0730 and 1100 h daily. The vehicle was normally equipped with an empty container made of steel, similar to those available at the hospitals (500 kg empty weight and 2.875 m^3 in size) to replace the full container situated inside the hospital area. The medical waste transportation journey started at Al-Watani hospital at 0730–0800 h, then Al-Ittehad hospital, Rafidia and Al-Injili hospitals and ended at about 1100 h at the treatment station. The treatment station was located in the eastern part of Nablus city, where there was an incinerator for burning the medical waste at a temperature between 900 and 1200 °C.

At the incinerator facility, which belongs to Nablus municipality, the workers removed any pressurized items and any chemicals that could be dangerous if burned, and then burned the remaining medical waste. It is worth mentioning here that the incinerator was not equipped with filters, and so it endangered the health of the people living and working nearby. Incineration is one of the recommended methods (Johnson 1999); however, incineration has adverse effects on the environment (British Medical Association 1994) and the reliability of incinerators also has to be considered (Coutinho et. al. 2006). It was observed that on many occasions the temperature of the incineration did not comply with standard operation (Pruss *et al*. 1999). The resulting ash, pressurized items and any chemicals that were not incinerated were collected manually without protective devices – an action that did not comply with Environmental Protection Agency (1990) or World Health Organization (Pruss *et al*. 1999) standards – and disposed off at the unsanitary main solid waste dumping landfill belonging to Nablus municipality, which is situated to the east of Nablus city near Beit-Forik village.

In August 2000, the second Palestinian uprising started. Quickly, the whole priority list of Nablus municipality changed and the idea of establishing a sanitary landfill or developing a new medical waste management system was abandoned. The main goal became simply to continue the daily services of the municipality as much as possible. No new development projects were initiated and even the projects that had already been approved and funded, such as the wastewater treatment plant, were frozen (Arafat *et al*. 2006). In 2002, the only medical waste incinerator the city had was destroyed and removed from its location by the Israeli military forces during their activities, curfews, closures, etc. At present there is no special handling for the medical waste collected from hospitals, which is currently mixed with the municipal solid waste. By reducing the care given to this type of waste a dan-

gerous situation has been created, as it is well known that there is a strong epidemiological evidence that the main concern of infectious hospital waste is the transmission of HIV virus and, more often, of Hepatitis B or C virus through injuries caused by syringe needles contaminated by human blood (Al-Khatib 2003).

Alternative approaches to medical waste treatment should be considered. Currently, autoclaving has been considered as a positive alternative treatment method to incineration (Lee *et al*. 2004, Miyazaki *et al*. 2007, Soliman & Ahmed 2007). Due to the current financial difficulties, all healthcare centres in Nablus city are allowed to merge with each other in order to overcome their financial problems. Therefore, they can look for some cost-effective means of treatment or disposal of their waste materials. Nablus city has lots of well trained technicians and entrepreneurs, most of whom have their own small workshops and are able to manufacture highly sophisticated equipment. Some of these entrepreneurs have an engineering background and others obtained their training while working at Israeli industrial sites. While searching through these workshops it was observed that some of them have the capability to produce an outstanding quality autoclave at much lower cost than those produced in Israel or abroad.

Currently there are no clearly defined rules for the collection and handling of waste maerials from specific departments or wards such as laboratories, operating rooms, hemodialysis, pathology sections, chemotherapy units, and others. There is no training of the cleaning personnel or keeping of records about hospital waste management in any of the hospitals. In contrast, in developed countries definite regulations and rules exist at hospital, regional and national levels. For example, 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 in the University Hospital of Freiburg, Germany (Daschner 2000).

In Palestine, the economic deterioration that leaves 50% of the labor force unemployed and another 25% unable to get to their place of work (and therefore without wages); the widespread destitution that has over half of the population below the poverty line; and the physical destruction of vital Palestinian support infrastructure by Israelis have all contributed further to long-lasting changes in Palestinian society that cannot be conducive to either immediate or long-term reconciliation. Poverty, disenfranchisement and reduced education are the stamping grounds of extremism, anger and radicalization (Khatib 2003).

The new existing situation in terms of medical waste treatment can be considered as a scenario of a no-sort option of co-disposal of clinical wastes with the domestic fraction. This scenario has some benefits such as no costs of segregation, special handling and transportation and treatment, but, this approach is recognized as a serious problem that can have detrimental effects on both human beings and the environment through indirect or direct contact. Some of the health impacts originating from exposure to hazardous hospital wastes include reproductive system damage, tetragenogenic, mutagenic and carcinogenic effects, central nervous system effects, respiratory damage among others (Blackman 1993). Diseases such as leptospirosis, cholera, diarrhoea, typhoid, human immunodeficiency virus (HIV) and HBV can be transmitted through the mismanagement of especially hazardous hospital waste (Mato & Kassenga 1997). Environmental nuisance may also arise due to foul odour, cockroaches, flies, rodents and other vermin (Nemathaga *et al*. 2008).

Prevalence of HBV and health risks among cleaning personnel

Results of serological tests for HBV in cleaning personnel revealed that 61 cleaning personnel (12 in Rafidia, 10 in Al-Watani, 14 in Al-Injili and 18 in Al-Ittehad hospitals) were negative for HBV and only one worker was positive (at Rafidia hospital) for the disease (1.59%). It is worth mentioning here that none of the 62 cleaning personnel had been vaccinated for HBV. However, the incidence of the disease may be higher than revealed by the present study because cleaning personnel are usually employed by private companies for 1 year and many of them leave work during their first year. The disease has a long incubation period (up to 6 months) and hence some of the workers could have been positive but without showing the disease. In Palestine, the incidence rate of HBV cases per 100 000 ranged between five and nine in the period 1995–1999 (Ministry of Health 2002). This means that the incidence rate of HBV was much higher among the cleaning personnel than other Palestinians.

In addition, medical waste handlers in Palestine as well as those in other developing countries are exposed to many health risks. For example, in a study conducted in the hospitals of a Palestinian district, it was found that the level of occupational safety is below standard requirements, as protective equipment and clothing are not available for most workers. More than 40% of workers were pricked with needles while handling medical waste. It appeared that there was no clear policy for workers vaccination against infective diseases, and there was no medical examination for workers either before or during employment. Only 37.2% of the workers mentioned that they were trained in handling medical waste, and 23.2% of them were working 15 hours per day or more. It was found that there was no job stability for the workers, as 55.8% of them had spent only 1 year or less in their work at the hospital. It was found that the supervisors of the cleaning workers did not pay much attention to the workers' occupational safety and satisfaction. There was a huge lack of medical waste management infrastructure, and there were many items that the cleaning workers required in order to help them perform their work properly. Their overall requirements included occupational safety, job security and satisfaction (Al-Khatib, 2006).

Conclusions and recommendations

In Nablus city as in other Palestinian cities and other developing countries, the management and disposal of medical

waste have not received sufficient attention. There is a lack of any proper system of medical waste management, and the current practices are inappropriate. Medical waste materials are still handled manually and disposed of alongside generalh domestic waste, thus creating a great health risk to municipal workers, the public and the environment. Nearly all the hospitals in Nablus city promote segregation of most sharp waste items; however, little attention is given to the other types of waste, a large part of which is usually mixed with the general waste materials and collected through the municipal collection system. This situation has not changed since 1999. To ensure improvement and continuity in the management practices, hospitals in co-ordination with related institutions such as the Ministry of Health, Ministry of Environmental Affairs and Ministry of Local Governments should develop clear plans and policies for the proper management and disposal of waste. They need to be integrated into routine continuing education, employee training, increasing awareness among employees and management evaluation processes for systems and personnel. It is essential to develop a national policy and implement a comprehensive action plan for healthcare waste management providing environmentally sound technological measures to improve the management and disposal of healthcare waste in Nablus city and other Palestinian communities. Special attention should be paid to the occupational health and safety of cleaning personnel as most of them are exposed to health hazards and risks.

Future research that addresses the health risks to waste handlers including the determination of HBV antibody status for them, showing evidence for sero-conversion or lack of sero-conversion, after working with these wastes, taking into consideration the difficulties involved in this aspect, mainly the high turn-over of staff is recommended.

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