

Healthcare risk waste in Saudi Arabia

Rate of generation

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ABSTRACT

Objective: To assess the amount of healthcare risk waste generated by health establishments in Saudi Arabia.

Methods: A healthcare waste management questionnaire was applied in 27 hospitals, and 16 primary health centres and clinics. The total quantity of healthcare risk waste collected in 24 hours in each of these establishments was weighed. Calculations were carried out to get hospitals rate of healthcare risk waste generation and primary healthcare centres risk waste generation. The total national estimate of healthcare risk waste production in kilograms/year for the whole health establishments in the Kingdom was then calculated.

Results: The mean hospital healthcare risk waste rate of generation was 1.13 ± 0.96 kg/bed/day. The mean primary

healthcare centres and clinics healthcare risk waste rate of generation was 0.08 ± 0.08 kg/visitor/day. The estimated mean amount of all healthcare risk waste generated in the Kingdom of Saudi Arabia is 25,207 tons/year.

Conclusion: Healthcare establishments in Saudi Arabia produce healthcare risk waste. Much care is given by the responsible authorities for the management of that type of waste. A program is being established to formulate standards for healthcare waste management.

Keywords: Healthcare risk waste, medical-waste, classification, environmental health.

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For the past two decades, healthcare waste was considered as one of the major problems that negatively affected health and environment.¹ An increase in the understanding of the health hazards posed by poorly managed healthcare waste (HCW) has influenced many countries to develop national and local strategies to better manage this waste. To achieve a satisfactory approach to HCW management, a sound understanding of the prevailing situation from waste generation followed by its subsequent segregation, collection, transportation, treatment and disposal needs to be gathered and studied.

The objective of this study was to assess the amount of healthcare risk waste (HCRW) generated

by the health establishments in Saudi Arabia. It is hoped that the findings from the study will help further studies including different steps in HCRW management.

To manage and control HCRW, some countries issued their own laws and regulations, like the USA Medical Waste Tracking Act (MWTA).² Possible infections to hospital employees and those responsible for the collection and processing were from Hepatitis B or C, Tetanus, localized or general infection and AIDS. According to the American Hospital Association (AHA), about 15% of hospital waste is classified as infectious and its disposal is regulated.³

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Hospital wastes poses a serious public health problem.⁴ This is primarily caused by the diversity of the individual components of the waste, which constitute a risk to health if inadequately handled. Waste management problems at district hospitals in developing countries are usually caused more by lack of information than by financial or technical difficulties.⁵

For selecting the most efficient treatment method of hospital waste, the composition analysis is generally considered to be the fundamental information.⁶ The weight and volume of the waste is also important. One of the few studies, which evaluated the physical and elemental composition of the hospital waste, was carried out at the National Taiwan University Hospital (NTUH).⁶ The results should help them to design an incinerator for the treatment of infectious waste, plastic syringes, pathological waste and kitchen waste.

Incineration is currently being used for disposal of about 10% of the solid waste generated in the United States, and this percentage is likely to increase as land disposal declines.⁷ Medical waste generation reduction is very important and should be considered. Some of the suggested ways⁸ could be summarized in recycling of suitable materials, considering replacement of single-use items with materials intended for multiple uses.

Methods. There are 290 hospitals in Saudi Arabia⁹ (176 Ministry of Health (MOH), 39 other governmental sectors and 75 private sector) with a total number of 42,625 beds. The total number of primary healthcare centres and clinics is 3,097 (1,731 MOH and 1,366 private sector). The Kingdom is composed of 5 administration regions which is constituted of 20 provinces.

Twenty-seven (9%) hospitals (16 MOH, 3 other governmental sectors and 8 private sector) were selected on stratified random sampling basis from 15 provinces out of 20 provinces from all 5 regions of the Kingdom. This sample was considered representative of the different types of hospitals and geographical distribution across the country. So in hospital sampling all 5 regions were included. The stratification was carried out for provinces and finally for types of hospitals.

Sixteen PHC's and clinics (12 MOH, 1 other governmental sectors and 3 private sector) were also selected at random sampling basis from 3 regions. It is worth mentioning that the directions regarding HCW management in PHC's and clinics were standardized through MOH circulars in that respect. So to gain time, it was decided to survey 3 regions (Central, Southern and Western) which represent the 5 regions of the Kingdom. The included surveyed establishments were representative to MOH, other

governmental and private sectors.

The number of MOH PHC's was more compared to that of private sector because MOH cover the public services. Other governmental sectors (military and social insurance) have main hospitals and that is why only one other governmental PHC was included in the study.

As this is considered the first study in Saudi Arabia in the field of HCW, and the total number of hospitals and PHC's and clinics is large and our present investigation resources are limited, we are planning to carry out future surveys in order to include more hospitals and PHC's and clinics.

Data was collected using a HCW management questionnaire in Arabic based on a model produced by the WHO Centre for Environment Health Activities (CEHA).¹⁰ Some modifications were made to make it more compatible to the organization of health establishments in the Kingdom in addition to record the produced amounts of various types of healthcare risk waste (HCRW).

Two field visits to each included establishment were carried out over a 24 hour period. Five qualified trained personnel who covered all surveyed establishments administered the questionnaires. The purpose of the first visit was to brief the hospital or PHC or clinic management about the objectives of the survey. Also the technical staff of the hospital and PHC or clinic were instructed on the procedure of how to keep the HCRW separate for the next 24 hours so that the total quantity and its management practices could be recorded. There are several categories of HCRW as follows: Pathological, infectious, chemical, sharps, pharmaceutical, radioactive and pressurized containers.

The second visit was scheduled on the following day and the total quantity of the HCRW collected in the last 24 hours was weighed in kilograms using a German made SECA scale (spring based system) which ranged from 5 to 200 kg. A hook spiral balance was used to weigh weights, which ranged from 1 to 10 kilos. The required information by the questionnaire was completed.

The collected data weight measurements were analyzed using the WHO Epi Info Version 5 computer statistical package. Calculations were carried out for rates of HCRW generation and consequently for the total HCRW produced.

The rate of generation/year of healthcare risk waste in the Kingdom was calculated through the following steps: (a) Hospitals rate of the healthcare risk waste generation: Amount of healthcare risk waste on day of the survey in kilograms X by 365 and divided by the number of beds X by percentage of bed occupancy/100 X 365. (b) PHC's and clinics rate of healthcare risk waste generation: Amount of healthcare risk waste on day of the survey in kilograms X 365 divided by the annual number of

visitors seeking treatment. (c) Using the above two rates, calculations were made to estimate the annual total national HCRW production through the following steps: (i) All hospitals HCRW generation: National numbers of hospital beds X mean rate of HCRW generation in kg/bed/day X 365 (ii) All PHC's and clinics HCRW generation: National number of visitors to PHC's and clinics/year X the mean daily rate of waste generation in kg/visitors/day. (iii) The annual total national HCRW production: A+B kilograms/year.

Results. Hospitals HCRW rate of generation. The rates varied widely between one hospital to another. The hospitals' code number, region, sector and information about HCRW generation is given in Table 1. The minimum recorded rate was 0.067 kg/bed/day, and the maximum was 3.846 kg/bed/day. The mean rate of generation was 1.13 ± 0.96 kg/bed/day.

PHC's and clinics HCRW rate of generation. The rates varied widely between these establishments as seen in Table 2. The minimum recorded rate was 0.005 kg/visitor/day, and the maximum was 0.34 kg/visitor/day. The mean rate of generation was $0.08 \pm$

0.08 kg/visitor/day.

Total national HCRW production. As seen in Table 3 the estimated hospitals total national HCRW production was 17,581 tons/year, while that of the PHC's and clinics was 7,626 tons/year. So the estimated amount of all HCRW generated in the Kingdom is 25,207 tons/year.

Discussion. The HCRW is forming a problem for many countries, due to its dangerous effects on health and environment. The amounts produced and rate of generation and type of waste generated are very important in order to take health precautions and HCRW treatment procedures. In Saudi Arabia, healthcare risk waste (HCRW) production and the need to review more closely the generation and management practices that are acceptable, has become more urgent as a result of the rapid expansion of health services in the past 2 decades.

This is the first planned study, which was carried out in Saudi Arabia in order to estimate the amount of HCRW. It covered all geographical areas of the Kingdom represented by Regions. Different Sectors are included ie. MOH, other governmental and private sectors. The included hospitals have different

Table 1 - Hospitals: rate of generation of hazardous wastes/bed/day.

Code No.	Region	Province	Sector	No of beds	Ann. % bed occupancy	Daily waste quantity (kg)	Annual waste quantity (kg)	*Rate kg/bed/day
1	S	Gizan	A	437	74	200	73000	0.618
2	S	Gizan	A	51	47.5	50	18250	2.064
3	S	Abha	A	461	70	394	143810	1.221
4	S	Abha	C	80	**NA	164	59860	NA
5	C	Riyadh	A	295	83	155	56575	0.633
6	W	Taif	A	40	44	68	24820	3.846
7	E	Khobar	C	250	54	81	29565	0.604
8	W	Maninah	A	120	87	7	2555	0.067
9	N	Arar	A	30	20	8.5	3103	1.417
10	C	Riyadh	B	250	56	100	36500	0.710
11	W	Jeddah	A	733	70	546.5	199472	1.065
12	N	Hail	A	30	45	46	16790	3.407
13	C	Enaiza	A	345	52	114	41610	0.633
14	W	Jeddah	C	30	66	13	4836	0.669
15	E	Khafgi	B	68	78	66	23944	1.230
16	C	Riyadh	A	200	63	30	10950	0.238
17	W	Madinah	A	70	59	22	7910	0.522
18	W	Taif	B	52	79	124	45260	3.019
19	N	Tabuk	A	51	59	20	7300	0.665
20	S	Baha	A	78	50	24	8760	0.615
21	N	Jouf	A	71	24.5	27	9855	1.552
22	W	Jeddah	C	75	50	34	12410	0.907
23	W	Madinah	C	170	60	116.5	42523	1.142
24	W	Jeddah	A	147	87	165.5	60408	1.294
25	W	Jeddah	C	30	46	10	3650	0.725
26	W	Jeddah	C	100	50	15	5475	0.300
27	W	Mekkah	C	50	90	10	3650	0.222
Mean of rates/bed/day							1.130±0.96	
*Rate=Annual waste quantity divided by (No. beds X % bed occupancy/100) X 365								
**Not available								
NB. Sector A=MOH B=OTHER GOVERNMENT C=PRIVATE								
Region: S=Southern N=Nothorn W=Western E=Eastern C=Central								

Table 2 - PHC's and clinics rate: Rate of generation of hazardous wastes/visitor/day.

Code No.	Region	Province	Sector	Annual visitors	Daily waste quantity (kg)	Annual waste quantity (kg)	Rate kg/visitor/day
1	S	Gizan	A	26558	2	730	0.03
2	S	Gizan	A	118676	3	1095	0.01
3	S	Gizan	A	10855	3	1095	0.10
4	S	Gizan	C	18250	8	2920	0.16
5	S	Gizan	B	140993	30	10950	0.08
6	S	Abha	A	82297	22	8030	0.10
7	S	Abha	A	84120	19	6935	0.08
8	S	Khamis	A	78035	11	4015	0.05
9	S	Khamis	A	180065	14	5110	0.03
10	C	Riyadh	C	22500	21	7665	0.34
11	C	Riyadh	A	78453	3	1095	0.01
12	C	Riyadh	A	17433	5.5	2008	0.12
13	C	Riyadh	C	22192	5	1825	0.08
14	W	Mekkah	A	19303	2	730	0.04
15	W	Mekkah	A	7230	2	730	0.10
16	W	Mekkah	A	111485	1.5	548	0.005
Mean of rates (total rates 1.335 divided by No of PHC's 16)						0.08±0.08	
NB. Sector: A=MOH B=Other Government C=Private Region: S=Southern W=Western C=Central							

activities like general, chest, maternity pediatrics and psychiatric.

The reasonably high SD of (0.96) for the mean rate of hospital bed generation (1.13±0.96 kg/bed/day), appears to be influenced by high HCRW production from certain hospitals especially No. 2 (MOH chest), No. 6 (MOH general), No.12 (private general), No. 18 (Military general) and No. 21 (MOH general).

It is noticed that these hospitals are found in Gizan, Taif, Hail and Jouf regions. These areas are considered as semirural. Emergency and specific chronic cases of the whole area are referred to them. So this may explain the high rate of HCRW generations in these certain hospitals. Added to that separation, practices between risk and non-risk HCW undertaken by the staff in the surveyed establishments may contribute to the recorded amount of HCW produced by these hospitals. It should be noted that the total amount of HCW

generated at an institution would depend on numerous factors.¹⁰ (eg. specialization of the hospital or clinic, ratio of reusable and one-type items in use, ratio of day care and residential care patients), and differ significantly between countries and hospitals in the same country. In a study carried out at the National Taiwan University Hospital (NTUH),⁶ the estimated daily waste generation rate at NTUH was 4,600 kg/day, which consisted of 4,100 kg/day noninfectious refuse, 340 kg/day infectious waste, 70 kg/day kitchen waste, 50 kg/day pathological waste and 40 kg/day plastic syringes.

The WHO¹⁰ has listed approximate risk waste generation values as follows: Low income areas: less than 0.3 kg/bed/day. Middle income areas: less than 0.3 to 0.4 kg/bed/day. Higher income areas: less than 0.4 to 5.5 kg/bed/day.

Siting new incinerators, however, is often controversial because of concerns related to the

Table 3 - The annual total national HCRW production in the Kingdom of Saudi Arabia.

		Rate of HCRW generation	Total national HCRW/year
Hospitals	Total number of hospital beds= ⁹ 42625	1.13 kg/bed/day	(42625x1.13x365 days) 17580682 kg (17581 tons)
PHC's and clinics	Total number of visitors/year= ⁹ 95,319,061	0.08 kg/visitor/day	(95319061x0.08) 7625528 kg (7626 tons)
GRAND TOTAL		25,206,206 kg (25,207 Tons)	

possibility of adverse health effects and environmental contamination from long-term exposure to stack emissions. Specific concerns related to the adequacies of: a) Stack emission-testing protocols. b) Existing regulations. c) Compliance monitoring and enforcement of regulations.

US Environmental Protection Agency laboratories are cooperatively conducting research aimed at developing new testing equipment and procedures that will allow more comprehensive assessment of the complex mixture of organics that are present in stack emissions.⁷

The recorded figure of the mean rate of hospital bed generation in this study (1.13 ± 0.96 kg/bed/day) is higher compared to the above international figures for the low and middle-income areas, but it coincides with that of the higher income areas.

Regardless of the income level in Saudi Arabia, this recorded generation rate could be explained by another factor, which is that most of the companies that operate these hospitals are international. The contract implies that these companies should adopt certain high quality hygiene standards, so they have a tendency to use disposable equipment and materials, which is reflected in the high rate of the waste production.

Also the rates of HCRW generation varied widely between the PHC's and clinics. The high SD of 0.08 of the mean rate of generation (0.08 ± 0.08 kg/visitor/day) indicates that there is a wide difference between the surveyed establishments in the amount of HCRW produced. Another factor is that the separation practices, as mentioned before, between risk and non-risk HCW and the ratio of reusable and one type item in use may contribute to the recorded amount of HCRW produced by these establishments.

With the proliferation of blood born diseases in the United States more attention is being focused on the issues of infectious medical waste and its disposal. Home care organizations must be aware of the potential risks involved in handling the infectious wastes, and adhere to industry standards of disposal and transport. Education of staff, patients and community about the management of infectious waste is crucial in today's health arena.¹¹

Healthcare workers have an important opportunity to manage the environmental effects of their practice. Starting a hospital-recycling program is difficult. The 5 key steps are:¹² find out what exists, survey your needs, survey local recycling agencies, educate your staff and communicate your progress. Nursing is a powerful organization with strong educational, research and communication base. By raising the level of awareness, reducing, reusing, recycling and working with others, nurses can look toward

achieving a larger vision of a healthy planet.

Proper management of infectious waste containing radioactive material depends on 3 program elements.¹³ First, screening methods are required to identify medical waste containing radioactive material. Second, means of managing the volume of waste identified has to be developed. Management includes identifying the radioisotopes, dealing with the physical requirements of the waste (eg. the need for cold storage) and treating the material as a mixed waste. Finally, methods to limit production of waste at its source must be implemented. This includes educating the radioactive material users, enabling them with the means of reducing waste volume, and giving them feedback on how well they are implementing the waste reduction practices.

In conclusion, the government of Saudi Arabia is giving a great attention to health and environment aspects, which accompanied the growth in the economical and developmental sectors. The Ministerial Committee for Environment is giving top priority to healthcare waste management and issued many decisions to assure safe treatment and disposal of hazardous waste, and is putting a national strategy in collaboration with concerned ministries and bodies in order to formulate standards for HCW management.

The work program should include an efficient waste management plan, comprising assessment of existing waste situation, generation, practices, treatment practices, facilities and costs, staff responsibilities, review of available resources and possible options for improvement.

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