

Biomedical Waste Management in Private and Public Hospital: A Study on Assessment of Knowledge, Attitude and Practices among Health Care Professionals in Udaipur city

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Abstract- Biomedical waste (BMW) generated in our country containing infectious and hazardous materials in large quantity on daily basis. Biomedical waste (BMW) is waste generated during diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto, or in the production and testing of biological, and is contaminated with human fluids. The waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste. Employees like doctors and nurses must know about biomedical waste and its impact on their health as well on environment. In some hospital there is no proper training of the employees in hazardous waste management. This indicates the lack of even basic awareness among hospital personnel regarding safe disposal of Bio- Medical waste. Keeping in view the above scenario, the present study has been undertaken to assess the knowledge regarding different aspects of Bio-medical waste amongst staff of a large bedded tertiary care hospital in Udaipur, Rajasthan.

The scope of the present study shall extend to only Udaipur District of Rajasthan. The study comprises of assessment of the knowledge regarding BMW management amongst doctors, dentists and nurses of Tertiary care private Hospital and Tertiary care Government Hospital at city of Udaipur, Rajasthan. The present study is helpful to the Government authorities to take appropriate remedial measures to protect the occupational health of employees as well as public. Also, the analysis of secondary data gives growth rate of biomedical waste per annum.

Keywords: Biomedical waste, Knowledge, Attitude, Practice, Healthcare personnel.

INTRODUCTION

Bio-medical waste is one of the major environmental health concerns for the Udaipur city. A great majority of Udaipur hospitals not have policies and regulations governing the management of medical waste. The present method of biomedical waste management are potentially hazardous and pose health risk to hospital workers, hospital sanitation workers, the general public, solid waste handlers and the environment. The Udaipur city as a city is known for its "Lakes" and large numbers of tourists come in Udaipur and they are on high risk of viral, bacterial and protozoal infection rate and hence require a greater urgency to ensure effective management of biomedical waste to contain the spreading of contagious diseases.

At the same time there is no study which has been conducted at private as well as government hospital simultaneously. The study will indicate the factors affecting bio medical waste disposal amongst health care employees in health care industry.

OBJECTIVES

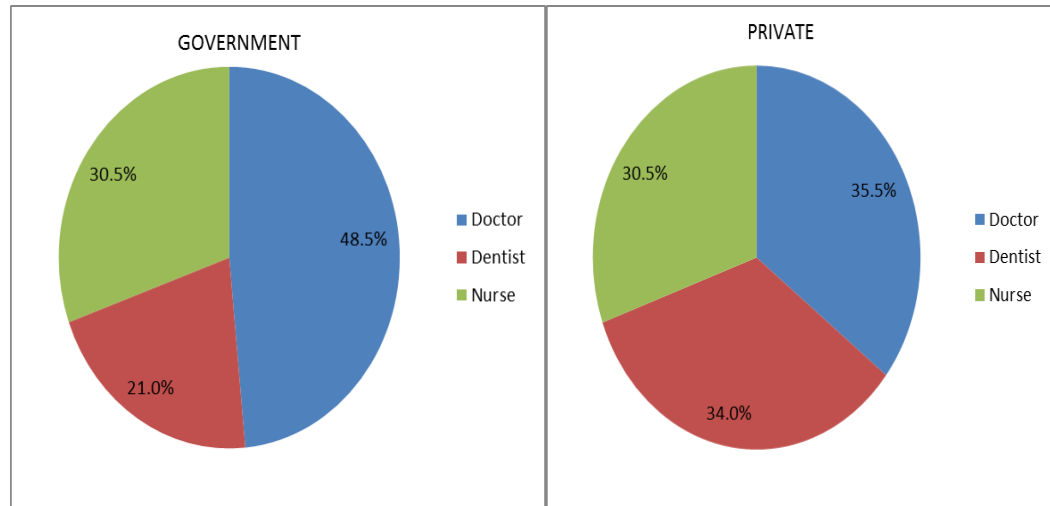
The prominent objectives of the study can be specified as:

- To assess the knowledge of the doctors and nursing staff in a private as well as Government hospital at city of Udaipur regarding biomedical waste management.
- To evaluate the effectiveness of structured teaching programme on knowledge and practice regarding biomedical waste management.
- To assess the perception of employee towards Bio Medical waste management.

Doctors, Dentists and Nurses [Government v/s Private]:

		Doctor / Dentist/Nurse			Total
		Doctor	Dentist	Nurse	
government	Count	97	42	61	200
	% within gov/pvt	48.5%	21.0%	30.5%	100.0%
	% within Doctor / Dentist/Nurse	57.7%	38.2%	50.0%	50.0%
	% of Total	24.3%	10.5%	15.3%	50.0%
Private	Count	71	68	61	200
	% within gov/pvt	35.5%	34.0%	30.5%	100.0%

	% within Doctor / Dentist/Nurse	42.3%	61.8%	50.0%	50.0%
	% of Total	17.8%	17.0%	15.3%	50.0%
Total	Count	168	110	122	400
	% within gov/pvt	42.0%	27.5%	30.5%	100.0%
	% within Doctor / Dentist/Nurse	100.0%	100.0%	100.0%	100.0%
	% of Total	42.0%	27.5%	30.5%	100.0%



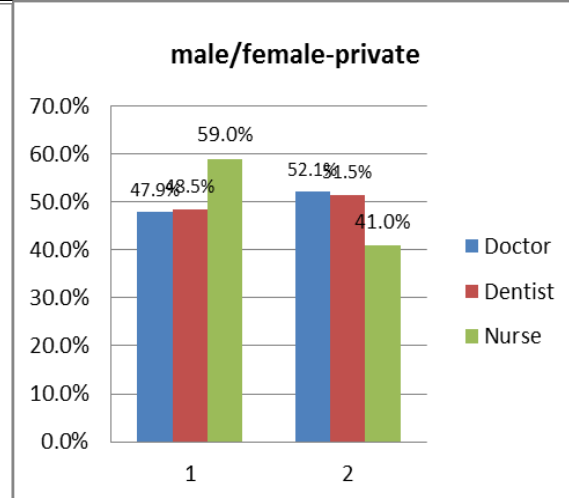
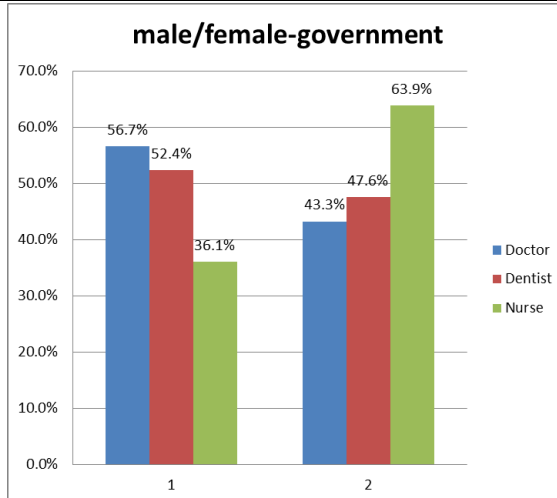
Out of 400 respondents, as mentioned above in table 1, two hundred employees [50%] [Doctor/Dentist/Nurses] represent Government hospitals and two hundred employees [Doctor/Dentist/Nurses] represent Private hospital. Therefore, 400 subjects participated in the study. Among a total of 200 respondents from government hospitals, 48.5%

($n = 97$) were doctors [MBBS AND PG QUALIFIED] , 21.0%. ($n = 42$) were dentists and the rest 30.5% ($n = 61$) were Nurses. Among a total of 200 respondents from private hospitals, 35.5% ($n = 71$) were doctors [MBBS AND PG QUALIFIED], 34.0%. ($n = 68$) were dentists and the rest 30.5% ($n = 61$) were Nurses.

GENDER ANALYSIS

Doctor / Dentist/Nurse - Gender M/F * gov/pvt Crosstabulation						
gov/pvt				Gender M/F		Total
				Male	Female	
government	Doctor / Dentist/Nurse	Doctor	Count	55	42	97
			% within Doctor / Dentist/Nurse	56.7%	43.3%	100.0%
			% within Gender M/F	55.6%	41.6%	48.5%
			% of Total	27.5%	21.0%	48.5%
		Dentist	Count	22	20	42
			% within Doctor / Dentist/Nurse	52.4%	47.6%	100.0%
			% within Gender M/F	22.2%	19.8%	21.0%
			% of Total	11.0%	10.0%	21.0%
		Nurse	Count	22	39	61
			% within Doctor / Dentist/Nurse	36.1%	63.9%	100.0%
			% within Gender M/F	22.2%	38.6%	30.5%
			% of Total	11.0%	19.5%	30.5%
	Total		Count	99	101	200
			% within Doctor / Dentist/Nurse	49.5%	50.5%	100.0%
			% within Gender M/F	100.0%	100.0%	100.0%
			% of Total	49.5%	50.5%	100.0%
Private	Doctor / Dentist/Nurse	Doctor	Count	34	37	71
			% within Doctor / Dentist/Nurse	47.9%	52.1%	100.0%
			% within Gender M/F	33.0%	38.1%	35.5%

		Dentist	% of Total	17.0%	18.5%	35.5%
			Count	33	35	68
			% within Doctor / Dentist/Nurse	48.5%	51.5%	100.0%
			% within Gender M/F	32.0%	36.1%	34.0%
		Nurse	% of Total	16.5%	17.5%	34.0%
			Count	36	25	61
			% within Doctor / Dentist/Nurse	59.0%	41.0%	100.0%
			% within Gender M/F	35.0%	25.8%	30.5%
		Total	% of Total	18.0%	12.5%	30.5%
			Count	103	97	200
			% within Doctor / Dentist/Nurse	51.5%	48.5%	100.0%
			% within Gender M/F	100.0%	100.0%	100.0%
Total	Doctor / Dentist/Nurse	Doctor	% of Total	51.5%	48.5%	100.0%
			Count	89	79	168
			% within Doctor / Dentist/Nurse	53.0%	47.0%	100.0%
			% within Gender M/F	44.1%	39.9%	42.0%
		Dentist	% of Total	22.3%	19.8%	42.0%
			Count	55	55	110
			% within Doctor / Dentist/Nurse	50.0%	50.0%	100.0%
			% within Gender M/F	27.2%	27.8%	27.5%
		Nurse	% of Total	13.8%	13.8%	27.5%
			Count	58	64	122
			% within Doctor / Dentist/Nurse	47.5%	52.5%	100.0%
			% within Gender M/F	28.7%	32.3%	30.5%
		Total	% of Total	14.5%	16.0%	30.5%
			Count	202	198	400
			% within Doctor / Dentist/Nurse	50.5%	49.5%	100.0%
			% within Gender M/F	100.0%	100.0%	100.0%
			% of Total	50.5%	49.5%	100.0%



Out of 400 respondents, as mentioned above in table 2, two hundred employees [50%] [Doctor/Dentist/Nurses] represent Government hospitals and two hundred employees [Doctor/Dentist/Nurses] represent Private hospital. Therefore, 400 subjects participated in the study. Among a total of 200 respondents from government hospitals, 48.5% ($n = 97$) were doctors [MBBS AND PG QUALIFIED] and among 97 numbers of doctors 56.7% were male and 43.3% were female. 21.0%. ($n = 42$) were dentists. Among 42 numbers of dentists, 52.4% were male and 47.6% were female. The rest 30.5% ($n = 61$) were Nurses. Among 61

numbers of nurses, 36.1% were male and 63.9% were female. Among a total of 200 respondents from private hospitals, 35.5% ($n = 71$) were doctors [MBBS AND PG QUALIFIED]. Among 71 numbers of doctors, 47.9% were male and 52.1% female. 34.0%. ($n = 68$) were dentists. Among 68 numbers of dentists, 48.5% were male and 51.5% were female. The rest 30.5% ($n = 61$) were Nurses. Among 6 numbers of nurses, 59% were male and 41% were female.

HYPOTHESIS TESTING

H01: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management.

$H_{01.1.1}$: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management.

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.002. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge about bio-medical waste generation and legislation factor of bio-medical waste. The significance value of the test for knowledge of doctors, dentists and nurses is 0.002. Since this value is less than 0.05, it can conclude that there is an association in the cross tabulation is real and not due to chance. While the chi-square test is useful for determining whether there is a relationship, it doesn't tell the strength of the relationship. Symmetric measures attempt to quantify this.

Phi is the ratio of the chi-square statistic to the weighted total number of observations. It is the most "optimistic" of the symmetric measures, and unlike most association measures, does not have a theoretical upper bound when either of the variables has more than two categories.

Cramer's V is a rescaling of phi so that its maximum possible value is always 1. As the number of rows and columns increases, Cramer's V becomes more conservative with respect to phi.

The **contingency coefficient** takes values between 0 and $\sqrt{(k-1)/k}$, where k = the number of rows or columns, whichever is smaller. It becomes more conservative with respect to phi as the associations between the variables become stronger.

The significance values of all three measures are 0.002, indicating a statistically significant relationship between doctors, dentists and nurses. However, the values of all three measures are under 0.002, so although the relationship is not due to chance, it is also very strong.

$H_{01.1.2}$: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management i.e. private/ government agency regulate waste generated health care facilities.

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.010. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.010. Since this value is less than 0.05, it can conclude that there is an association in the cross tabulation is real and not due to chance.

The significance values of all three measures are 0.010, indicating a statistically significant relationship. However, the values of all three measures are under 0.010, so although the relationship is not due to chance, it is also very strong.

$H_{01.1.3}$: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [It is important to know about BM waste generation, hazards and legislation]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.568. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.568. Since this value is more than 0.05, it can conclude that there is no association in the cross tabulation is real.

The significance values of all three measures are 0.568, indicating a statistically significant relationship. However, the values of all three measures are under 0.568, so although the relationship is due to chance, it is also not very strong.

$H_{01.1.4}$: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [Biomedical Waste (Management & Handling) Rules were first proposed]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.000.

This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.000. Since this value is less than 0.05, it can conclude that there is an association in the cross tabulation is real and not due to chance.

The significance values of all three measures are 0.000 indicating a statistically significant relationship. However, the values of all three measures are under 0.000, so although the relationship is not due to chance, it is also very strong.

H_{01.1.5}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [Amendments to the Biomedical Waste (Management & Handling) Rules were made in which year]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.937. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.937. Since this value is more than 0.05, it can conclude that there is an association in the cross tabulation is real and not due to chance.

The significance values of all three measures are 0.937, indicating a statistically significant relationship. However, the values of all three measures are under 0.937, so although the relationship is due to chance, it is also not very strong.

H_{01.1.6}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [biomedical waste is]

- The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.655. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.
- The significance value of the test for knowledge of doctors, dentists and nurses is 0.655. Since this value is less than 0.05, it can conclude that there is no association in the cross tabulation.

The significance values of all three measures are 0.655, indicating a statistically significant relationship. However, the values of all three measures are under 0.655, so although the relationship is due to chance, it is also not very strong.

H_{01.1.7}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [according to the Biomedical Waste (Management & Handling) Rules, waste should not be stored beyond]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.068. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.068. Since this value is more than 0.05, it can conclude that there is no association in the cross tabulation.

The significance values of all three measures are 0.068, indicating a statistically significant relationship. However, the values of all three measures are under 0.068, so although the relationship is not due to chance, it is also strong.

H_{01.1.8}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [one gram of mercury (source from dental amalgam) is enough to contaminate the following surface area of a lake]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.737. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.737. Since this value is more than 0.05, it can conclude that there is no association in the cross tabulation.

The significance values of all three measures are 0.737, indicating a statistically significant relationship. However, the values of all three measures are under 0.737, so although the relationship is due to chance, it is also not very strong.

H_{01.1.9}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste management [Who regulates the safe transport of medical waste]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.354. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.354. Since this value is more than 0.05, it can conclude that there is no association in the cross tabulation.

The significance values of all three measures are 0.354, indicating a statistically significant relationship. However, the values of all three measures are under 0.354, so although the relationship is due to chance, it is also not very strong.

H_{01.1.10}: There is no significant difference in the knowledge of doctors, dentist and nurses regarding Bio Medical waste

management [you need a separate permit to transport biomedical waste]

The significance value of the test for knowledge of doctors, dentists and nurses regarding bio-medical waste is 0.800. This is suggestive, but not conclusive, evidence of a relationship between *doctors*, *dentists* and *nurses* for the knowledge of bio-medical waste.

The significance value of the test for knowledge of doctors, dentists and nurses is 0.800. Since this value is more than 0.05, it can conclude that there is no association in the cross tabulation.

The significance values of all three measures are 0.800, indicating a statistically significant relationship. However, the values of all three measures are under 0.800, so although the relationship is due to chance, it is also very strong.

H02: There is no significant difference amongst doctors and nurses regarding the awareness of Bio Medical Waste.

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Colour coding segregation	400	1.26	.613	1	3
Follow colour-coding for BM waste	400	1.47	.775	1	3
The waste disposal practice correct in your hospital	400	1.40	.693	1	3
causing punctures or cuts	400	3.44	.966	1	4
confidential patient information are to be disposed of into the paper recycling bins.	400	1.32	.696	1	3
The colour code for the BM waste to be autoclaved, disinfected is:	400	3.50	.934	1	4
The approximate proportion of infectious waste	400	2.31	1.719	1	5
The colour code for disposal of normal waste from the college is:	400	2.67	.763	1	4
An exposure with infected blood/body fluid and contaminated sharps except	400	3.81	.533	2	4
About hazardous waste containers are true, except for:	400	3.95	.361	1	4

Kruskal-Wallis Test		
Ranks		
Doctor / Dentist/Nurse	N	Mean Rank

colour coding segregation	doctor	168	196.44
	dentist	110	196.76
	nurse	122	209.45
	Total	400	
Follow colour-coding for BM waste	doctor	168	196.58
	dentist	110	189.51
	nurse	122	215.81
	Total	400	
The waste disposal practice correct in your hospital	doctor	168	195.07
	dentist	110	190.50
	nurse	122	217.00
	Total	400	
causing punctures or cuts	doctor	168	205.51
	dentist	110	202.59
	nurse	122	191.73
	Total	400	
confidential patient information are to be disposed of into the paper recycling bins.	doctor	168	196.75
	dentist	110	200.80
	nurse	122	205.39
	Total	400	
The colour code for the BM waste to be autoclaved, disinfected is	doctor	168	202.63
	dentist	110	201.14
	nurse	122	196.99
	Total	400	
The approximate proportion of infectious waste	doctor	168	192.19
	dentist	110	202.51
	nurse	122	210.13
	Total	400	
The colour code for disposal of normal waste from the college is:	doctor	168	200.25
	dentist	110	199.21
	nurse	122	202.01
	Total	400	
An exposure with infected blood/body fluid and contaminated sharps except	doctor	168	203.16
	dentist	110	205.66
	nurse	122	192.18
	Total	400	
About hazardous waste containers are true, except for:	doctor	168	205.00
	dentist	110	205.00
	nurse	122	190.25
	Total	400	

Test Statistics ^{a,b}										
	Q.11	Q.12	Q.13	Q.14	Q.15	Q.16	Q.17	Q.18	Q.19	Q.20

Chi-Square	2.561	5.206	5.997	1.630	.850	.286	2.200	.063	2.853	20.925
Df	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	.278	.074	.050	.443	.654	.867	.333	.969	.240	.000

a. Kruskal Wallis Test

b. Grouping Variable: Doctor / Dentist/Nurse

On applying SPSS –Kruskal-Wallis H test for above hypothesis, a larger value indicates larger differences between the group.

- a. For above data chi square value is roughly 2.561 for awareness level of bio medical waste among doctors, dentists and nurses about colour coding at 2 degree of freedom. The asymp. significant value of 0.278 basically means there's a 27.8% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about colour coding doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (27.8%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 2.561, p = 0.278$), with a mean rank of 196.44 for the doctors, 196.76 for a dentist and 209.45 for nurses about colour coding segregation.
- b. Chi square value is roughly 5.206 for awareness level of bio medical waste among doctors, dentists and nurses about whether they follow colour-coding for BM waste at 2 degree of freedom. The asymp. significant value of 0.074 basically means there's a 7.4% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about whether they follow colour-coding for BM waste doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (7.4%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 5.206, p = 0.074$), with a mean rank of 196.58 for the

doctors, 189.51 for a dentist and 215.81 for nurses about whether they follow colour-coding for BM waste or not.

- c. Chi square value is roughly 5.997 for awareness level of bio medical waste among doctors, dentists and nurses about the waste disposal practice correct in your hospital at 2 degree of freedom. The asymp. significant value of 0.05 basically means there's a 5% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about the waste disposal practice correct in your hospital doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (5%) chance of finding such minor weight gain differences. If $p < 0.05$, it is usually conclude that above differences are statistically significant between the doctors, dentist and nurses ($H(2) = 2, p = 0.05$), with a mean rank of 195.07 for the doctors, 190.50 for a dentist and 217.00 for nurses about the waste disposal practice correct in your hospital.
- d. chi square value is roughly 1.630 for awareness level of bio medical waste among doctors, dentists and nurses about causing punctures or cuts at 2 degree of freedom. The asymp. significant value of 0.443 basically means there's a 44.3% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about causing punctures or cuts doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (44.3%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 1.630, p = 0.443$), with a mean rank of 205.51 for the doctors, 202.59 for a dentist and 191.73 for nurses about causing punctures or cuts.

- e. chi square value is roughly 0.850 for awareness level of bio medical waste among doctors, dentists and nurses about confidential patient information are to be disposed of into the paper recycling bins at 2 degree of freedom. The asymp. significant value of 0.654 basically means there's a 65.4% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about confidential patient information are to be disposed of into the paper recycling bins doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (65.4%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 0.850, p = 0.654$), with a mean rank of 196.75 for the doctors, 200.80 for a dentist and 205.39 for nurses about confidential patient information are to be disposed of into the paper recycling bins.
- f. chi square value is roughly 2.561 for awareness level of bio medical waste among doctors, dentists and nurses about the colour code for the BM waste to be autoclaved, disinfected at 2 degree of freedom. The asymp. significant value of 0.278 basically means there's a 27.8% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about the colour code for the BM waste to be autoclaved, disinfected doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (27.8%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant. between the doctors, dentist and nurses ($H(2) = 2.561, p = 0.278$), with a mean rank of 202.63 for the doctors, 201.14 for a dentist and 196.99 for nurses about the colour code for the BM waste to be autoclaved, disinfected.
- g. chi square value is roughly 2.200 for awareness level of bio medical waste among doctors, dentists and nurses about the approximate proportion of infectious waste at 2 degree of freedom. The asymp. significant value of 0.333 basically means there's a 33.3% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about the approximate proportion of infectious waste doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (33.3%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant. between the doctors, dentist and nurses ($H(2) = 2.200, p = 0.333$), with a mean rank of 192.19 for the doctors, 202.51 for a dentist and 210.13 for nurses about the approximate proportion of infectious waste.
- h. chi square value is roughly 0.063 for awareness level of bio medical waste among doctors, dentists and nurses about the colour code for disposal of normal waste from the college at 2 degree of freedom. The asymp. significant value of 0.969 basically means there's a 96.9% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about the colour code for disposal of normal waste from the college doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (96.9%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant. between the doctors, dentist and nurses ($H(2) = 0.063, p = 0.969$), with a mean rank of 200.25 for the doctors, 199.21 for a dentist and 202.01 for nurses about the colour code for disposal of normal waste from the college.
- i. chi square value is roughly 2.850 for awareness level of bio medical waste among doctors, dentists and nurses about an exposure with infected blood/body fluid and contaminated sharps at 2 degree of freedom. The asymp. significant value of 0.240 basically means there's a 24.0% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about an exposure with infected blood/body fluid and contaminated sharps doesn't

have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (24.0%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 2.850, p = 0.240$), with a mean rank of 203.16 for the doctors, 205.66 for a dentist and 192.18 for nurses about an exposure with infected blood/body fluid and contaminated sharps.

- j. chi square value is roughly 20.925 for awareness level of bio medical waste among doctors, dentists and nurses about hazardous waste containers are true at 2 degree of freedom. The asymp. significant value of 0.000 basically means there's a 00.0% chance of finding sample results if awareness level of bio medical waste among doctors, dentists and nurses about hazardous waste containers are true doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (0.0%) chance of finding such minor weight gain

differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant. between the doctors, dentist and nurses ($H(2) = 20.925, p = 0.000$), with a mean rank of 205.00 for the doctors, 205.00 for a dentist and 190.25 for nurses about hazardous waste containers are true.

H03: There is no significant difference in the perception of doctors and nurses regarding effective of Bio Medical Waste

The binomial test is used when an experiment has two possible outcomes (i.e. perception score of bio medical waste has average or good between doctors and nurses) and whether they have good perception about effectiveness of bio medical waste. A binomial test is run to see if observed test results differ from what was expected.

To test above hypothesis, binomial test is used, this has following assumptions:

Assumptions for the Binomial Test:

- Items are dichotomous (i.e. there are two of them) and nominal.
- The sample size is significantly less than the population size.
- The sample is a fair representation of the population.
- Sample items are independent (one item has no bearing on the probability of another).

Binomial Test						
		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
Perception	Average	2.00	186	.47	.75	.000 ^a
	Good	1.00	214	.53		
	Total		400	1.00		
a. Alternative hypothesis states that the proportion of cases in the first group < .75.						

Out of the two possible events, it gives us the least expected result. We expected 300 respondents (i.e. 75% of 400) have good perception about effectiveness of bio medical waste. As the p-value of 0.000 is very small (a 5% alpha level here, which would mean p-values of less than 5% would be significant), which means rejection of the null hypothesis

means there is significant difference in the perception of doctors and nurses regarding effective of Bio Medical Waste

H04: There is no significant difference in the attitude of doctors and nurses towards Bio Medical Waste.

Binomial Test						
		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
Attitude	Verv good	1.00	328	.82	.75	.001

	Good	2.00	72	.18		
	Total		400	1.00		

Out of the two possible events, it gives us the least expected result. We expected 300 respondents (i.e. 75% of 400) have very good attitude of doctors and nurses towards bio medical waste. As the p-value of 0.00 is very small (a 5% alpha level here, which would mean p-values of less than 5% would be significant), which means rejection of the null

hypothesis means there is significant difference in the attitude of doctors and nurses towards Bio Medical Waste.

H05: There is no significant impact of structured training program on practice adopted by doctors and nurses for BMW management.

Binomial Test						
		Category	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
Training	Group 1	1.00	301	.8	.8	.012 ^a
	Group 2	2.00	99	.2		
	Total		400	1.0		
a. Alternative hypothesis states that the proportion of cases in the first group < .8.						

Out of the two possible events, it gives us the least expected result. We expected 320 respondents (i.e. 75% of 400) have very good significant impact of structured training program on practice adopted by doctors and nurses for BMW management. As the p-value of 0.012 is very small (a 5% alpha level here, which would mean p-values of less than 5% would be significant),

which means rejection of the null hypothesis means there is significant

impact of structured training program on practice adopted by doctors and nurses for BMW management.

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Attitude	400	16.1525	1.74983	12.00	20.00
Perception	400	7.9850	1.55590	4.00	12.00
Training	400	12.0775	1.99410	6.00	17.00
Doctor / Dentist/Nurse	400	1.89	.845	1	3

Ranks			
	Doctor / Dentist/Nurse	N	Mean Rank
Attitude	Doctor	168	203.22
	Dentist	110	194.40
	Nurse	122	202.25
	Total	400	
Perception	Doctor	168	202.69
	Dentist	110	206.44
	Nurse	122	192.13

	Total	400	
Training	Doctor	168	196.94
	Dentist	110	207.54
	Nurse	122	199.06
	Total	400	

Test Statistics ^{a,b}			
	Attitude	perception	Training
Chi-Square	.441	1.025	.600
Df	2	2	2
Asymp. Sig.	.802	.599	.741
a. Kruskal Wallis Test			
b. Grouping Variable: Doctor / Dentist/Nurse			

Attitude: Chi square value is roughly 0.441 for the attitude of doctors and nurses towards Bio Medical Waste at 2 degree of freedom. The asymp. significant value of 0.802 basically means there's a 80.2% chance of finding sample results if the attitude of doctors and nurses towards Bio Medical Waste doesn't have any effect in the population at large. So if the attitude of doctors and nurses towards Bio Medical Waste does nothing whatsoever, there is a fair (80.2%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between the doctors, dentist and nurses ($H(2) = 0.441$, $p = 0.802$), with a mean rank of 203.22 for the doctors, 194.44 for a dentist and 202.25 for nurses about the attitude of doctors and nurses towards Bio Medical Waste.

Perception: Chi square value is roughly 1.025 for the perception of doctors and nurses regarding effective of Bio Medical Waste at 2 degree of freedom. The asymp. significant value of 0.599 basically means there's a 59.9% chance of finding sample results if the perception of doctors and nurses regarding perception of doctors and nurses regarding effective of Bio Medical Waste in the population at large. So if the perception of doctors and nurses regarding effective of Bio Medical Waste does nothing whatsoever, there is a fair (59.9%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant between

the doctors, dentist and nurses ($H(2) = 1.025$, $p = 0.599$), with a mean rank of 202.69 for the doctors, 206.44 for a dentist and 192.13 for nurses about the perception of doctors and nurses regarding effective of Bio Medical Waste.

Training: Chi square value is roughly 0.600 for significant impact of structured training program on practice adopted by doctors and nurses for BMW management at 2 degree of freedom. The asymp. significant value of 0.741 basically means there's a 74.1% chance of finding sample results significant impact of structured training program on practice adopted by doctors and nurses for BMW management doesn't have any effect in the population at large. So if awareness level of bio medical waste among doctors, dentists and nurses does nothing whatsoever, there is a fair (74.1%) chance of finding such minor weight gain differences. If $p > 0.05$, it is usually conclude that above differences are not statistically significant. between the doctors, dentist and nurses ($H(2) = 0.600$, $p = 0.741$), with a mean rank of 196.94 for the doctors, 207.54 for a dentist and 199.06 for nurses about significant impact of structured training program on practice adopted by doctors and nurses for BMW management.

Discussion:

The following recommendations provide strategic direction, possible actions and tools that can promote BMWM in hospitals of the Southern Rajasthan. Governments,

international organizations and other stakeholders can synergize their respective knowledge and expertise in the implementation of these strategies and actions.

Develop BMW policies and regulatory frameworks taking into account international conventions and agreements, as well as the practices of other countries. Tailor them to local needs with clear roles and responsibilities, thereby creating dedicated units for monitoring implementation and enforcement of BMWM.

Encourage integrated treatment facilities under build-operate-and-transfer or build- own-operate-and-transfer schemes. Select a low-cost BMWM plan adaptable to developing countries and implement it.

Synergize capacity-building and technical support activities to enhance partnerships among BMW sector and other stakeholders. Establish a network for capacity-building through periodic training and workshops that explicitly address BMWM and waste minimization. Conduct BMWM research and development covering best practices, lessons learnt, indicators, etc.

Carry out information, education and communication campaigns on BMWM to raise awareness of decision-makers and health-care facility staff in handling, safety and exposure to BMW.

Develop training tools, modules and packages focusing on best practices on BMWM.

Establish a waste minimization system and apply the savings to fund the overall BMWM system.

Possible strategies for the improvement of BMWM in the Southern Rajasthan Region include the following.

Given the various states of development of national BMWM systems in the region, three regional development clusters are proposed as follows:

- Consortium of private and public hospital
- Consortium of doctors and medical practitioners
- District wise clusters

For each of the three regions, a BMW working group should be established to share experiences on the practical management of BMW and to update each other on lessons

learnt. Additionally, a vertical experience exchange among these clusters should take place regularly.

The exchange of lessons learnt between systems in transition and advanced systems, and/or systems in transition and underdeveloped systems, could benefit less-developed region and help ensure better utilization of funds planned for the improvement of the systems.

It is recommended that WHO in cooperation with SPREP consider an application for an BMW project to be funded by GEF to reduce the unintentional production of POPs in South Pacific health-care facilities.

The analysis of available documents shows that a wide variety of potentially useful action plans, guidelines, policies, regulations, etc. are available but often difficult to find. It is recommended that these documents be made available on the WHO website or another platform for BMWM in the Region.

The study shows that a regulatory framework for BMWM does not exist in the South Rajasthan. Responsibilities for monitoring and supervision of BMW activities are not clearly defined and the monitoring capacities of enforcement authorities can be regarded as weak. As an immediate intervention, BMW policies and guidelines should be introduced to support subsequent implementation of national BMW strategies and plans. To ease implementation, templates for the development of policies, strategies and guidelines should be made available.

In an effort to standardize and harmonize training systems, it is recommended regional curriculums or training materials for BMW training be issued, as they are by WHO Regional Office for India, so they can be easily adapted and used by countries. This will also enable the training of participants from several countries to be conducted at the same time or in parallel and will avoid the unnecessary duplication of activities. Additionally, standardized training for treatment facility operators and inspectors should be developed.

BMW is defined as the total waste stream from a health-care facility, including all hazardous and non-hazardous waste streams. Within the region, management of

hazardous BMW tends to focus on so-called “medical waste”, which in most countries is defined as a waste stream that includes infectious waste, sharps and pathological waste but does not normally include chemical, pharmaceutical or radioactive wastes. It is strongly recommended that countries include these other categories of waste when developing BMW strategies, policies and actions plans. Considering that governments have adopted a global, legally binding treaty to realize mercury-free health care by 2020, it will be important that countries be ready to address the disposal of mercury when they begin substituting mercury-based medical devices with alternatives.

Management of BMW is an integral part of hospital hygiene and infection control. Infectious BMW contributes to the risk of nosocomial infections, putting the health of medical staff and patients at risk. Proper BMW practices should therefore be strictly followed as part of a comprehensive and systematic approach to hospital hygiene and infection control. A range of measures should be developed in relation with the handling and the treatment/disposal of BMW to promote personal hygiene and protective measures. These measures should also concern municipal staff operating in solid waste management at the city level. This chapter develops basic guidance that should be respected to limit the risks of injury/contamination linked to the management of hazardous/infectious BMW.

Basic personal hygiene is important in reducing the risks that occur from handling BMW. Hospital administrators and planning officers should ensure that washing facilities are made available to people handling BMW. This is particularly important at storage and treatment facilities.

One of the most basic measures for the maintenance of hygiene, and one that is particularly important in the hospital environment, is cleaning. As the hands are the most frequent vectors of nosocomial infections, hand hygiene is the primary preventive measure. Thorough hand washing with adequate quantities of water and soap removes more than 90% of micro-organisms encountered on the hands. However, the efficacy of the cleaning process depends

completely on this mechanical action, since neither soap nor detergents possess any antimicrobial activity and can be counterproductive if is done too superficially. Cleaning has therefore to be carried out in a standardized manner.

Staff handling BMW should be offered appropriate immunization, including hepatitis B and tetanus. As BMW are often found in municipal solid waste municipal staff should also be offered this immunisation.

As already mentioned, staff which are in contact with BMW should wear the following personal protective clothing:

- Suitable heavy-duty gloves when handling BMW containers;
- Safety shoes or industrial boots to protect the feet against the risk of containers being accidentally dropped;
- Industrial apron or leg protectors when container handling could cause wounds.

To be effective, a BMW policy has to be applied carefully, consistently and universally. Training is a crucial aspect to successfully upgrade BMW practices. The overall aim of training is to develop awareness of the health, safety, and environmental issues relating to BMW. It should highlight the roles and responsibilities of each actor involved in the management process of the BMW (duty of care).

Separate but equally important training programs should be designed for the following categories of personnel:

1. hospital managers and administrative staff responsible for implementing regulations on BMW,
2. medical doctors; nurses and assistant nurses,
3. cleaners, porters, ancillary staff, and waste handlers,
4. municipal solid waste labourers and waste pickers.

Staff education programmes should cover:

1. Information on, and justification for, all aspects of the BMW policy;
2. Information on the role and responsibilities of each hospital staff member in implementing the policy;
3. Technical instructions, relevant for the target group, on the application of waste management practices;
4. Information on monitoring techniques.

In HCFs, spillage is probably the most common type of emergency involving infectious or other hazardous material or waste. Response procedures are essentially the same regardless of whether the spillage involves waste or material in use, and should ensure that:

- Contaminated areas are cleaned and, if necessary, disinfected;
- Exposure of workers is limited as much as possible during the clearing up operation;
- The impact on patients, HCF staff and the environment is as limited as possible.

One person should be designated as responsible for the handling of emergencies, including coordination of actions,

reporting to managers and regulators. Staff should be trained for emergency response, and the necessary equipment should be readily available at all times to ensure that all required measures can be implemented safely and rapidly. Written procedures for the different types of emergencies should be drawn up.

Spillages usually require that only the contaminated area be cleaned-up. For spillages of infectious material, however, it is important to determine the type of infectious agent; in some cases, immediate evacuation of the area may be necessary. In general, the more hazardous spillages occur in laboratories rather than in HCF departments.

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