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Effectiveness of Educational Intervention on Knowledge and Practice among Bio-Medical Waste Handlers

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Abstract: ***Aim of study was to improve environmental sanitation, reduce the risk of infectious and toxic waste to the biomedical waste handlers and the community. Objectives: To assess the status of knowledge and practice among bio-medical waste handlers regarding disposal of biomedical waste before and after educational intervention, and to determine the association of knowledge and practice score with selected sociodemograpic variables. Material & methods: A before and after interventional study was carried out on 187 biomedical waste handlers. Results: There were 21(51.2%) female biomedical waste handlers above the age of 45 as compared to 6(14.6%) between 25 to 34years. Majority175 (93.6%) of the waste handlers were educated and had education from 1st to 12th standard. The mean pre training score was 9.3.with a S.D. Of 3.9, which improved to 20.0 with SD of 2.4.The mean pre training practice score was 7.8 with a S.D 3.8, which improved to 21.6 with a S.D. of 3.8 Initially there were 110(58.8%).workers in the poor category who all improved after educational intervention majority were 148(79.1%) in excellent category of knowledge after training. Initially there were 157(83.9%) in the poor category practice score, 83(44.3%) in excellent category of practices after educational intervention. Conclusion -Area wise effectiveness of educational intervention has shown an improvement in proportion of workers answering questions related to knowledge correctly. The percentage improvement has ranged from 6.4% to 78.1%. In all except two areas there has been improvement in proportion of biomedical waste handlers practicing them correctly.***

Keywords: Biomedical waste, Educational Intervention, knowledge, practice, waste handlers.

1. Introduction

The establishment of large hospitals where hundreds to thousands of patients are treated, it has created a serious problem of bio-medical waste management. The seriousness of improper bio-medical waste management was brought to the light during summer 1998.In India studies have been carried out at local/regional levels in various hospitals. Data available from these studies, mostly hospitals, indicate that roughly about 1-5kg/ bed/day of waste is generated [1].

Among all health care personnel, ward boys, sweepers, operation theatre and laboratory attendants have come into contact with biomedical waste during the process of segregation, collection, transport, storage and final disposal. The knowledge of medical, paramedical staff about the biomedical waste management is important to improve the biomedical waste management practices [2].

2. Importance of this Study

The bio-medical waste requiring special attention includes those that are potentially infectious, sharps, e.g. needle, scalpels, objects capable of puncturing the skin, also plastic, pharmaceutical and chemically hazardous substances used in laboratories etc[3]. A need clearly exists for education of at risk health care workers on the nature of the risk exposed by the medical waste and methods for their proper handling. Biomedical waste treatment facilitates are mostly licensed by the local government that have specified rules and laws regarding the possessing and disposal of waste. The laws ensure that general public is protected from any form of contamination [1].

Worldwide, approximately 2 million workers experience a needle stick injuries each year. A needle stick injury could transmit hepatitis-B, Hepatitis–C or the Human Immunodeficiency Virus HIV. The risk of infection after exposure to the infected blood varies with the type of pathogen. The risk of transmission after exposure to HIV – infected blood is about 0.3% whereas it is estimated to be up to 100 times greater for Hepatitis –B virus (30%) and could be as high as 10% for Hepatitis C virus. A similar risk is associated with pre-existing cuts or wounds on the hands of waste handlers not using gloves while handling the waste [4].

Recently a study conducted by the central pollution control board has been evaluated for the disposal procedure and found that almost 56% biomedical waste is disposed of with the municipal waste [4]. The investigator has experienced in his professional experience that, most of the bio-medical waste handlers are unaware of the categories of biomedical waste, color coding of the containers, segregation, transportation, treatment and disposal etc. Considering above mentioned factors, it was thought that there is a need to update their knowledge and practices of disposal of hospital waste through educational intervention. The training would equip the biomedical waste handlers with latest information and knowledge about disposal of hospital waste improving their work efficiency and enabling them to adopt safe practices of bio-medical waste disposal. A study was therefore undertaken at Krishna Hospital, Karad to find out effectiveness of the educational

intervention on knowledge and practices of biomedical waste handlers.

2.1 Goal

To improve environmental sanitation, reduce the risk of infectious and toxic waste to the biomedical waste handlers and the community.

2.2 Objectives

1)To assess the status of knowledge and practice among bio-medical waste handlers regarding disposal of biomedical waste in Krishna Hospital, Karad.
2)To assess the status of knowledge and practice among bio-medical waste handlers regarding disposal of biomedical waste after the educational Intervention.
3)To determine the association of knowledge and practice among bio-medical waste handlers with selected sociodemograpic variables.
4)To assess the extent of skin aberrations on the hands of biomedical waste handlers by using suitable objective methods.

2.3 Conceptual Framework

The conceptual framework provides a systematic approach to nursing research. The conceptual framework selected for the study was based on the general system theory by Ludwig Bertanlanffy (1969) as explained by Putt[5]. The system is composed of a set of interactive elements and yet each system is distinct from the environment in which it exists. In all systems, the activities can be resolved in to an aggregation of a feedback circuit such as an input, throughput and an output. The feedback circuit helps in the maintenance of an intact system.

2.4 Input

It is any form of energy, matter, information of the human being that enters into a system through its process. In this study the input refers to selection of subjects, i.e. biomedical waste handlers who have been working at Krishna Hospital and Krishna Institute of Medical Sciences. These biomedical waste handlers have been assessed and observed initially for biomedical waste handling and its management.

2.4 Throughput

It includes the intervention. In the present study the term throughput refers to an intervention which has been in the form of a structured planned teaching. Teaching consisted of one didactic lecture followed by discussion session of about two hours duration and showing of audio visual C. D. ROM presentation specially developed for training based on the guidelines for the health care workers in the biomedical waste management and the infection control. It is the process that occurs in between the input and the output processes, which enables the input to be transformed in to the output in such a way that it can be readily used by the system.

The term throughput refers to an intervention which in the present study has been of the planned teaching programme and the learning package audio- visual CD Rom. The investigator has given the planned teaching and displayed the learning package of audio-visual CD Rom to the biomedical waste handlers who have been initially assessed and observed for the biomedical waste handling and the management. This process would lead to the improvement in post-test scores of knowledge and practices in comparison with the pretest findings.

2.5 Output

Output refers to the gain in knowledge and improvement in practices of biomedical waste handlers regarding the biomedical waste handling and the management. The conceptual framework based on the general system model used in the present study shown in

2.6 Methodology

A before and after interventional study was carried out on the same group of participants' i.e. biomedical waste handlers at Krishna Hospital, Karad in the state of Maharashtra from October 2008 to September 2013.Location of Karad is shown in the state of Maharashtra in the map of India. The map of K.I.M.S &Krishna Hospital Shows, O.P.D.s, Operation theatres, blood bank, labour room, different wards biomedical waste and general waste collection room and incinerator.

2.7.1 Sample Size Calculation:

2.7Determination of Sample Size[6]: The sample size to evaluate change in knowledge and practice scores with an error of 6% i.e. the proportion of subjects having adequate knowledge to lie in the range of 78% to 90% with 95% confidence was determined as;

$$N = \frac{1.96^2 XpXq}{E^2}$$

Where p: proportion of subjects with adequate knowledge
q; proportion of subjects with no adequate knowledge
p=84, q=16, E=6

$$N = \frac{1.96^2 x\ 84x16}{6^2}$$

=144

Thus minimum 144 subjects were required to be studied. Since the study design was before and after type, considering chance of non response due to any reason, more subjects were needed to be included than the calculated minimum sample size.

2.7.2 Sample and sampling technique:

The biomedical waste handlers at Krishna Hospital attached to K.I.M.S. Karad were identified. There were 188 biomedical waste handlers who were either permanent or semi permanent as daily wage earners so all of them were decided to be included in the study. All biomedical waste handlers were contacted and plan & purpose of the study was explained to them. A written informed consent was

taken from all the willing workers. Enrollment of all biomedical waste handlers in the study was undertaken.

One worker refused to participate in the study due to personal inconvenience. Thus 187 biomedical waste handlers from Krishna Hospital attached to K.I.M.S. Karad were included in the study which fulfilled the sampling criteria.

Subjects: The participants of the present study comprised of all biomedical waste handlers, who were working during October 2008 to July 2010 in Krishna Hospital attached to K.I.M.S. Karad.

2.7.3 Variables

Independent variables- Independent variable was Educational Intervention that is planned teaching and audio-visual C D ROM presentation regarding biomedical waste management.
Dependent variables- The dependent variables of this study were age, sex, educational status, work place and experience of biomedical waste handlers.

2.8 Data collection

The present study aimed at assessing the effect of planned teaching and observing the effects of training with the help of Audio-visual C D ROM presentation on biomedical waste management in terms of knowledge and practice gained by the biomedical waste handlers. A pre-tested structured questionnaire and observational check list was prepared and used for data collection. A Planned teaching and Audio-visual C D ROM presentation for the biomedical waste management was prepared based on guidelines from Govt. of India which are supported by Dept. for International Development (DFID) India [7] and Training Module on Biomedical waste Management (2009) by Regional Center for urban and Environmental Studies (RCUSE), All India Institute Of Local Self Government, Mumbai For Maharashtra Pollution Control Board[8].

2.9 Development of the Tool

A structured questionnaire and observational check list was prepared for assessing the knowledge and practices regarding biomedical waste management for biomedical waste handlers. The planned teaching and Audio-visual C D ROM was prepared on recommended procedures for biomedical waste handling and its management.

2.9.1 Tool and Technique Structured Questionnaire
The researcher prepared a questionnaire and observational check list as a tool for the study. The structured questionnaire and observational check list consisted of three sections; A, B and C.

Section A- Dealt with the demographic data of the study population like, age, sex, educational status, experience, working place and previous in-service education regarding biomedical waste management of biomedical waste handlers.

Section B- Consisted of a 25 multiple choice questions to assess the knowledge of biomedical waste handlers regarding biomedical waste management. (Annexure-I) A maximum score of 25 and minimum sore 0 was given. One mark was given for each correct response and 0 mark was given for each wrong response. No negative marking was done.

The knowledge score was arbitrarily graded as follows:

Poor : 0 to10
Good : 11 to 18
Excellent: 19 to 25

Section C – Consisted of a 33 observational items as per check list to observe the practices of biomedical waste handlers regarding biomedical waste management. . One mark was given for each correct practice and 0 mark was given for each wrong practice. The range of possible score varied from a minimum of 0 to maximum 33. The practice score was arbitrarily graded as follows:
Poor : 0-11
Good : 12-22
Excellent: 23-33

2.9.2 Structured Planned Training

The training material was prepared in readable text i.e.in vernacular language, Marathi so that the biomedical waste handlers would understand it easily. The language of the planned teaching programme was kept as simple as possible. It included information about following topics related to biomedical waste management.

1. Introduction
2. Definition of biomedical waste
3. Meaning of biomedical treatment facility
4. Categories of biomedical waste and its treatment
5. Types of wastes
6. Routes of transmission of diseases.
7. Rules of biomedical waste management
8. Explanation of incineration

Relevant charts, posters, and OHP transparencies were prepared and used by the investigator followed by the discussions and clearing of doubts of the biomedical waste handlers.

Audio-Visual Aid Compact Disk Read Only Memory (A V Aid C D ROM) presentation was prepared as per guidelines for health care workers biomedical waste management and infection control guidelines for Govt. of India which was supported by Dept. for International Development (DFID) India.[7] (Annexure-III) and presented, The language of the audio-visual C D ROM was kept as simple as possible in vernacular i.e. Marathi. It included ideal practices about biomedical waste management and a commentary which included methodology of doing things their explanations and reasoning.
Following were the broad areas of good practices in relation to waste management-

I. Segregation
II. Collection and storage
III. Transportation
IV. Treatment and disposal
V. Sharp biomedical waste management
VI. Anatomical waste
VII. Sputum cups and slides
VIII. Discarded blood bags
IX. Plastic and liquid waste
X. Mercury spills
XI. Infection control measures
XII. Hand washing
XIII. Personal protective equipment
XIV. Use of disinfectants
XV. Soiled linen management
XVI. Cleaning of floor
XVII. Sterilization of reusable equipment
XVIII. Storing medicines and chemicals

In the discussion that followed the audio visual presentation, doubts were cleared by the investigator. A copy of A. V. Aid C D Representation is enclosed in annexure (II).

Inclusion criteria:

1. Biomedical waste handlers who could understand Marathi language.
2. Biomedical waste handlers who were working in the Krishna hospital and K.I.M.S. Karad on the basis of both daily wages and permanent employee.
3. Biomedical waste handlers who were willing to participate in the study.

2.10 Ethical clearance

The study was approved by the Institutional Ethical committee of the Krishna Institute of Medical Sciences Deemed University, Karad Maharashtra, before the commencement of the study. (Annexure-III). A written permission was obtained from the Dean of Krishna Institute of Medical Sciences, Karad. The pre-training interventional data were collected from 1st July 2009 to 30th April 2010. Filling up of multiple choice questionnaires to assess knowledge was undertaken. Observation of biomedical waste handling and management procedures was undertaken for each worker separately as per check list. Each biomedical waste handler was interviewed to assess the knowledge. The questionnaire was filled by the researcher as most of the workers were illiterates or neo-literates and were not able to fill up the questionnaire on their own. All wards were observed. The biomedical waste handlers were observed during their peak working time while they were handling biomedical waste between 5.00am to 7.00am, 1.00pm to 3.00pm and 9.00pm to 11.00pm.as per schedule.

To observe cuts and aberrations on the hands of biomedical waste handlers the workers were made to wash their hands thoroughly with soap and water. After drying the hands with clean towel observations with naked eye and observations under the 10 X lens were made. Application of India blue ink manufactured by Camlin Limited Taloja, India was undertaken after sterilization of the ink by autoclaving and cooling. Observations were made by naked eyes as well as by 10X magnifying lens after washing the hands with plain tap water. The blue ink was retained by the cuts and aberated skin surface where as it was washed away to a large extent from the undamaged skin surfaces.

1. Naked Eye Examination.

2. Examination of Skin by 10X Magnifying Lens

3. Examination of Skin After Applying and Washing of Blue Ink to the Skin Surface

3. Results

In all 187 biomedical waste handlers were enrolled. Out of them 146(78.9%) were males and 41(21.1%) were females.

Table 1: Distribution of Biomedical Waste Handler According Age and Sex

Age in years	Sex				Total	
	Male		Female			
	No.	%	No.	%	No.	%
18 to 24 years	15 -100	10.3	0 0	0	15 -100	8
25 to34 years	26 (81.2	17.8	6(18.8)	14.6	32 -100	17.1
35to 44 years	55 (79.7	37.6	14 -20.3	34.1	69 -100	36.8
>45 years	50 (70.4	34.2	21 -29.6	51.2	71 -100	37.9
Total	146 -78.10%	100	41 -21.10%	100	187 -	100

*Foot note*Row wise percentages are given in parenthesis.* χ^2=6.93, p=0.074

Age of male and female biomedical waste handlers ranged from minimum 18years to maximum 59years and minimum 25years to maximum 59years respectively. Participants were working in different wards from different clinical disciplines. There was no female biomedical waste handler below the age of 25 years. The proportion of female

biomedical waste handlers increased with increasing age. There were 21(51.2%) female biomedical waste handlers above the age of 45 as compared to 6(14.6%) between 25 to 34years.

Table 2: Educational Status of Biomedical Waste Handlers

Educational status	Sex				Total	
	Male		Female			
	No.	%	No.	%	No.	%
Illiterates	6 (50)	4.1	6 (50)	14.6	12 (100)	6.4
1 to 7thStd	35 (57.3)	23.9	26 (42.7	63.4	61 (100	32.6
8th to 10thStd	85 (91.3)	58.2	8 (8.7)	19.5	93 (100)	49.7
11th to 12ThStd	20 (95.7)	13.6	1 (4.8)	2.4		11.2
Total	146 (78.1)	100	41 (21.9	100	187 (100	100

. **Row wise percentages are given in parenthesis* $\chi 2 = 34.049$, $p<0.001$

Majority175 (93.6%) of the waste handlers were educated and had education from 1st to 12th standard. Only21 (11.2%) could reach up to 11th to 12th standard and 12(6.4%) of waste handlers were illiterate. It was observed that male biomedical waste handlers were more educated than the female waste handlers. ($\chi^2 = 34.049$, $p<0.001$). Majority 132(70.5%) of the waste handlers were experienced and had experience of more than 10 years.

There was no significant difference in the experience of male and female waste handlers. The average experience in years of male biomedical waste handlers was 15.2 years with SD of 8.22 years as compared to females of 16.4 years with a SD of 8.07years.

Table 3: Comparison of Knowledge and Practice Score of Biomedical Waste Handlers Before and After the Educational Intervention (EI)

Time of Assessment	Biomedical Waste Handlers Scores							
	Knowledge			df	Practice			
	N	Mean	SD		N	Mean	SD	diff
Before E.I.	187	9.3	3.9	2.0	187	7.8	3.8	0.6
After E.I.	187	20.0	2.4	0.3	187	21.6	3.8	0.2
t value	34.4				39.1			
P value	<0.001				<0.001			

Assessment of pre training and post training knowledge & Practice was undertaken for all biomedical waste handlers. The mean pre training score was 9.3.with a S.D. Of 3.9, which improved to 20.0 with SD of 2.4. ($t=34.4$, $p<0.001$). The mean pre training practice score was 7.8 with a S.D 3.8, which improved to 21.6 with a S.D. of 3.8 ($t= 39.1$, $p<0.001$).

Table 4: Distribution of Subjects According to Knowledge Scores Before and After Educational Intervention

Knowledge score	Pre-test		Post -test	
	Frequency	%	Frequency	%
Poor (00-10)	110	58.8	00	00
Good (11-18)	76	40.6	39	20.8
Excellent (19-25)	01	0.5	148	79.1
Total	187	99.9	187	99.9

The biomedical waste handlers were grouped in three categories according to their knowledge scores in to poor, good and excellent scores obtained in pre and post training assessment. (Table 4) Initially there were 110(58.8%).workers in the poor category who all improved after educational intervention as seen in the post test results showing no persons in poor category. There was only one worker in the excellent score category before intervention which increased to 148(79.1%) in excellent category of knowledge after training.

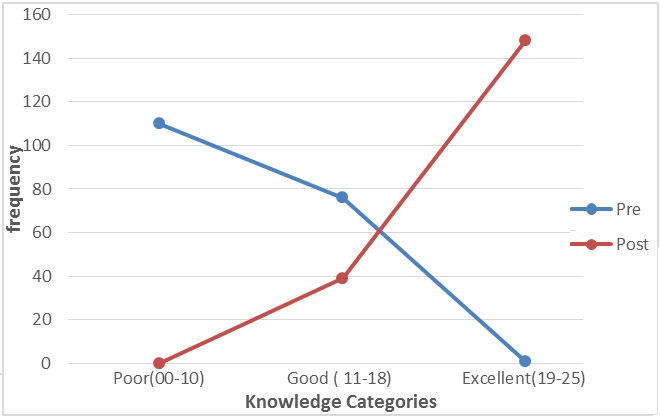

Figure1: Frequency Distribution of Subjects According to Knowledge Categories before and After Educational Intervention

Table 5: Distribution of Subjects According to Practices Scores Before and After Educational Intervention

Practices Scores	Pre-Training		Post-Training	
	Freq.	%	Freq.	%
Poor (00-11)	157	83.9	04	2.1
Good (12-22)	30	16.0	100	53.4
Excellent (23-33)	00	00	83	44.3
Total	187	99.9	187	99.8

The biomedical waste handlers were grouped in three categories according to their practice scores in to poor, good and excellent scores obtained in pre-training-observation and post training-observation. (Table 5) Initially there were 157(83.9%) in the poor category, who all improved after educational intervention as seen in the post training observation results showing only 4(2.1%) persons in poor category. There was not a single worker in the excellent category of score before intervention which increased to 83(44.3%) in excellent category of practices.

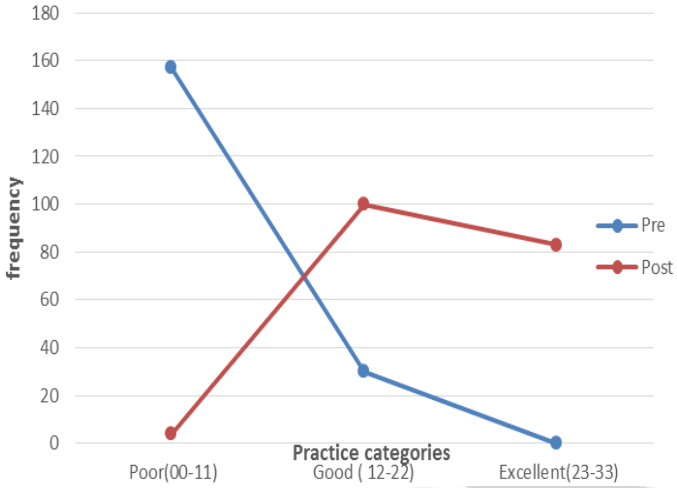

Diagram 2: Frequency Distribution of Subjects According to Practice before and After Educational Intervention

Out of all biomedical waste handlers, 103 (55.0%) were wardboys and wardayas followed by 60 (32.0%) sweepers and remaining 24(12.8%) were attendants. There was no woman in attendant category. The male biomedical waste handlers were more in each category of biomedical waste handlers than the female biomedical waste handlers.

Table 6: Comparison of Knowledge Score of Male and Female Waste Handlers Before and After the Educational Intervention (EI)

Knowledge scores	Gender								
	Male(M)			Female(F)			Diff. M&F	t value	p value
	N	Mean	SD	N	Mean	SD			
Before EI	146	9.7	3.6	41	7.7	4.5	2.0	2.63	0.00
After EI	146	20.0	2.3	41	19.8	2.8	0.2	0.66	0.5
t value	30.7			16.6					
P value	p<0.001			p<0.001					

In table 6, the effect of educational intervention on knowledge regarding biomedical waste was studied in both the sexes. The educational intervention was effective in both the sexes and improved the knowledge scores significantly. The mean knowledge score was 9.7 in males and 7.7 in females which increased to 20 and 19.8 respectively after training. The difference in before scores of two sexes was statistically significant and after scores not significant.

The effect of educational intervention on practices regarding biomedical waste handling and management was studied in both the sexes. The educational intervention was effective in both the sexes and improved the practice scores significantly. The mean practice score was 8 in males and 7.3 in females which increased to 21.7 and 21.5 respectively after training. The Pre-training practice score of male and female was statistically not significant (t=0.95, p=0.34) and after educational intervention the mean practice score of male and female was also not statistically significant (t=0.23, p=0.82). The age group wise effect of education intervention on knowledge and practices of male and female biomedical waste handlers is given in table 7 and 8.

Comparison of Age and Knowledge Score of Male and Female Waste Handlers Before and After the Educational Intervention (E.I)

The age groups were classified as <25 years, 25 to 34 years, 35 to 44years and >45years. There was no worker aged more than 59 years. It was observed that the educational intervention was effective in all age groups in both the sexes**.** There was no significant difference between the two sexes in all age groups in before and after educational training assessment of knowledge. The overall improvement in the mean knowledge scores occurred from 8.5 to 29.1 in males and 6.5 to 21.8 in females and there was no significant difference in increase in scores according to age groups.

Comparison of Age and Practice Score of Male and Female Waste Handlers Before and After the Educational Intervention (E.I)

It was observed that the educational intervention was effective in all age groups in both the sexes (p<0.001) for improving the practices of biomedical waste handlers. There was no significant difference in increase in scores according to age & sex of the biomedical waste handlers. The improvement in the mean practice scores was seen from 7.6 to 22.3 in males and 6.8 to 21.8 in females. There was no significant difference between the two sexes in all age groups in before and after educational training as per assessment of the practices.

Comparison of Educational Status Wise Knowledge Score of Male and Female Waste Handlers Before and After the Educational Intervention. (E.I)

The educational status was classified as illiterate, 1st to 7th, 8th to 10th and 11th to 12th standard for assessment of knowledge as well as practices. There was no worker educated more than 12th standard. It was observed that the educational intervention was effective in all educational status groups in both the sexes (p<0.001). The educational status wise gender differences in knowledge scores were not significant in any of the educational status group before and after educational training except the11th to 12th Std educational status group the mean scores were lower in females before training and higher after training than the corresponding mean scores in male. In 8th to 10thStd educational status group the difference between two series in mean knowledge scores of after educational intervention was statistically significant. (p=0.019).

Comparison of educational status wise practice score of male and female waste handlers before and after the Educational Intervention. (E.I)

It was observed that the educational intervention was effective in all educational status groups in both the sexes (p<0.001). The mean practice scores before intervention ranged from 7.9 to 8.5 in males and 6.6 to 7.8 in females which improved to 21.5 to 22.7 in males and 20.4 to 23.8in females. The educational status wise gender differences in practices scores were not significant in any of the educational status group before and after educational

training assessment. Initial scores as well as scores after the educational interventional package in knowledge and practice scores in both the sexes were not related to the educational status of the participants except knowledge score in illiterate group.

Comparison of Experience Wise Knowledge Score of Male and Female Waste Handlers Before and After the Educational Intervention

The work experience status was classified as <10 years, 11 to 20 years and 21 to 30 years in both knowledge and practice assessments. There was no worker with an experience of more than 30 years. It was observed that the educational intervention was effective in all experience status groups in both the sexes ($p<0.001$). The before mean knowledge scores ranged from 9.1 to10.4 in males and 4.9 to 8.7 in females which improved to 20.0 to 20.2 in males and 19.3 to 20.9in females.

The experience status wise gender differences in knowledge score had insignificant difference in all experience status groups before and after educational training assessments except 1 to 10 year experience status group. In <10 years experience status group the gender difference between average knowledge of before educational intervention was more in males and it was statistically significant. ($p=0.01$)

Comparison of Experience Wise Practice Score of Male and Female Waste Handlers Before and After the Educational Intervention (E.I)

It was observed that the educational intervention was effective in all the experience groups in both the sexes ($p<0.001$). The mean practice scores before educational intervention ranged from 7.5 to 8.4 in males and 6.1 to 7.7in females which improved after educational intervention ranging from 21.1 to 22.0 in males and 20.6 to 22.2 in females.

It was observed that the experience level of the workers was not related to the knowledge and practice scores before or after educational intervention. The improvement in the mean practice scores ranged from 7.5 to 8.4 in males and 6.1 to 7.7 in females of initial scores to 21.1 to 22.0 in males and 20.6 to 22.6 in females of after scores. All the differences were insignificant before and after training in scores in all knowledge groups. The experience status wise gender differences in practice scores were not significant in any of experience status group before and after educational training assessments. However a highly significant improvement was observed in both sexes in knowledge as well as practice scores after educational intervention at all levels of an experience.

To see the aberrations, cuts and ulcers on the hands of the biomedical waste handlers, naked eye examination, and examination by 10X magnifying lens and assessment after India ink application was undertaken.

Results of the Examination of Hands for Lesion/Cuts/ Abrasions by Naked Eye, 10 X Magnifications and After India -Ink Application

It was observed that naked eye examination could detect only 41(21.9%) of persons with aberrations, where as by 10Xlens the detection rate was (34.2%) and with blue India ink it was 51(27.3 %.).

During the study three persons had history of needle stick injury. Nobody had taken any antiretroviral treatment. Fortunately when post counseling Elisa test for HIV was done, none of them showed HIV+ve status but the ignorance about the risk as well as the management of needle stick injuries was 100% before training.

Both the hands of all 187 participants could be observed with naked eyes, 10X Lens and after application of blue India ink. Findings showed that a high proportion of workers 64(34.2 %) were found with various lesions like up to 7mm cracks, wounds with examination of 10Xlens.

Out of these51 (27.8%) could be identified with application of India blue ink and only 41(21.9%) were observed with naked eyes. These lesions were on palm, fingers as well as combined on palm and fingers on one or both hands. Size of cracks was from 1 to 7 mm. However according to the participants these injuries were not due to needle stick but due to their domestic activities. There was better detection of injuries when hands were observed by magnifying lens and application of sterile ink was made on the hands. Injuries were best identified by magnifying lens. These lesions on the hands of 25 biomedical waste handlers could have been missed if examination was not under taken by magnifying lens and in 14 biomedical workers if assessment with India ink was not done.

For all 25 questions there was an improvement in a proportion of workers answering them correctly. The percentage improvement ranged from 6.4 to 78.1%. Least improvement was observed in the area of categorization of human anatomical waste (Q.8.) and action to be taken after the needle stick injuries (Q.14).

For all except two areas there were improvements in proportion of biomedical waste handlers practicing them correctly. The two areas which did not show any change after training were immunization with hepatitis B and tetanus for protection, and addition of disinfection before sending the soiled linen for washing. The percentage improvement ranged from 1% to 86.6%. Those are on which has <20% improvement were 2.3, 2.4, 5.2, 5.11, 5.12 &5.15.

4. Discussion

The investigator has assessed the knowledge and observed practices of biomedical waste handlers pre and post training on the same group of biomedical waste handlers. The sample has been selected using purposive sampling technique. There is a male prepondevence (78.9%) among 187 workers participating in the study. A majority (37.9%) of biomedical waste handlers have been in the age group of 46 to 59 years. There have been no female biomedical waste handlers below the age of 25 years. The proportion of female biomedical waste handlers has increased with increasing age. The biomedical waste handlers have been

grouped in three categories according to their knowledge and practice scores as poor, good and excellent scores. There has been highly significant improvement in grades in both the knowledge and practice after training.

WHO regional office for Europe has convened a meeting of personnel for the hospital waste management at Bergen, Norway in 1983. This has been probably the first time that this issue has been discussed after recognizing AID as emerging disease in 1980s[1].

By 1998 the seriousness of unsafe biomedical waste management was apparent. The rules and regulations were imposed by the international, national and provincial bodies for ensuring safe disposal of biomedical waste. Many studies were undertaken thereafter to find out risks of transmission of various diseases, lacunae in the biomedical waste, knowledge level among hospital staff from doctors to biomedical waste handlers[1].

Sagoe-Moses C, et al[2] (2001) have conducted a study on risks to the health care workers in the developing countries which has revealed that protecting health care workers in developing countries is a challenge as even the basics of medical care are difficult to provide and where the protection of health care workers does not appear in any health care priorities. Clearly, health care workers in developing countries are at serious risk of infection from blood born pathogens particularly HBV, HCV and HIV because of the high prevalence of such pathogens in many poorer regions of the world. Although the prevalence of blood borne pathogens in many developing countries is high, documentation of infections caused by occupational exposure is poor. It is unlikely that surveillance and reporting of occupational exposure to infected blood will be undertaken in places where post exposure prophylaxis, treatment, and workers' compensation are lacking. The risk to the health care workers in developing countries is due to a lack of gloves, masks, and goggles to protect them from contaminated blood and body fluids.

Dement JM et al (2002) [9] has been carried out a study in North Carolina USA to find out risk for the HCWs when exposed to Blood and Body fluid (BBF). The study has reported 2730 blood and body fluid exposures among a population of 24,425 HCWs resulting in an overall annual rate 5.5 events and a rate of 3.9 for percutaneous exposures.

WHO (2005) has published a report in India, which has demonstrated that 25% of HIV and 40% of Hepatitis B and C infections occur among health care workers as a result of occupational exposure. In India (2005) approximately 3 million health workers experience percutaneous exposure to blood borne viruses each year[4] .

A study has been conducted by Kermode M, et al[10] (2005) regarding hospital waste management among the health workers in a hospital. A study has revealed that needle stick injury occurs during procedures while drawing of blood (22.6%), recapping (11%), needle disposal(10.5%), garbage disposal(12.5%) and the categories of staff exposed to needle stick injuries are staff nurses (34.6%), interns(15.7%), residents(11.7%), practical nurses(8.5%),technical staff(6%). In the present study around 30% of biomedical waste handlers have had aberrations on their hands, without being aware of them or knowing them or the danger associated with it. There have been three workers exposed to the needle stick injury while working. They have been ignorant about the risk associated with it, and have had no post exposure prophylaxis.

There are many studies undertaken on assessment knowledge, attitude and practice of HCWs which have uniformly indicated that the knowledge, attitude and practices to be very good among consultants and medical doctors and being very poor among the laboratory workers and biomedical waste handlers[3][11][14][16][18][22]. Most of the nurses in between the doctors and the waste handlers. A study carried out in AIIMS has observed excellent knowledge and practice among nursing staff [11].

The present study has taken in to consideration knowledge and practices among biomedical waste handlers only and the knowledge and practice scores have been very low among these workers before training.
Educational intervention has been given to the health care workers by many researchers they have found a significant improvement in the knowledge and practice after training[3][5][11][14][16][18][20][22].

In the present study we have also observed highly significant improvement among knowledge and practice scores after educational intervention. The effect of socieodemographic variables before and after educational intervention among various types of workers[15][22] has studies also been which has not shown any correlation between age, sex, education, experience and pre and post educational intervention scores in all the studies except two studies done by Sahar Hamdy EI [21] and Nagaraju B[22].

In one study carried out on nurses by Sahar Hamady EI–Syed et al (2012) [21] in Egypt researchers have been observed significant associations between education levels and practice score. As a study carried out Nagarajappa D[23] in Karnataka has observed significant association between total years of experience and the practice score. In our study we have not observed any correlation between sociodemographic variables and pre & post educational intervention scores.

In the present study educational intervention has consisted of the planned didactic teaching program use as well as audio-visual CD ROM prepared on recommended procedures for biomedical waste handling and its management as compared to the only didactic training given by N. Manthar Mohideen[3], Mostafa GM[14], Birder VS[15], Singh R[16] and Nagarajappa D[23]. It is expected that when dos and don'ts are audio-visually shown it have been higher impact than the didactic educational intervention. It has been observed that training with audio visual educational intervention has better impact than just telling the facts in a didactic manner.

There has been a history of needle stick injury among biomedical waste handlers before this study and the victim have been totally ignorant about post exposure prophylaxis

(PEP). measures. After educational intervention there have been needle stick injuries during study period and all of the biomedical handlers approached the Medical Director and an adequate post exposure prophylaxis like Hepatitis B and T.T. vaccine and ART has been provided to them.

Biomedical waste handlers have not been aware of the exposure due to injuries and skin aberrations on their hands and have not been using any personal protective devises (PPD) like hand glove and gum boots, mask, apron etc. After educational intervention and examination of The awareness about the risk associated with injuries and skin aberration while handling biomedical waste management has increased to some extent from 41(21.1%) to 64(34.2%) and use of personal protective devises like gloves, mask and gumboots has also increased from 6 (3.2%) to 22(11.7%). This indicates that the knowledge and awareness and their practices have changed but there is a scope for farther improvement. Repeated educational intervention emphasizing the higher prevalence of diseases like HIV/AIDS, Hepatitis B & C etc. among HCWs should be undertaken. Simultaneously good quality personal protective devises should be made readily available. In the present study screening for existing injuries/skin aberrations on the hands has been undertaken by three methods that has naked eye examination, 10X magnifying lens and observation after application of sterile India ink.

Observation under 10x magnifying lens has been most effective methods. It is very simple less time consuming and readily acceptable to the supervisors as well as biomedical waste handlers. Out of all biomedical waste handlers 41(21.1%) workers could be identified with naked eyes, 51(27.3%) after India ink application and 64(34.2%) by 10X magnifying lens.

5. Strong and weak areas of knowledge

The pre and post training score of knowledge have indicated that there have been 7 out of 25 questions which have been answered correctly by more than 50% of biomedical waste handlers.

These questions related to the responsibility of collecting all waste from the wards, what is mean by biomedical waste management treatment facility, What is biomedical waste management, sodium hypochlorite solutions should be changed., Importance of hand washing, how disinfection of plastic waste should be done, why biomedical waste handlers should segregate all waste from wards., meaning of biomedical waste treatment, importance of biomedical waste management protocol and process of biomedical waste management before educational intervention.

Weakest area of knowledge before educational intervention has been how to do disinfection in the wards? , which waste is included in solid biomedical waste management?, what is highest risk from biomedical waste?, what all things are included in non hazards non infectious waste?, Laundry waste is considered as which type of waste?, meaning of biomedical waste, human anatomical waste is included in which category of waste?, ideal container for collection of general waste., if there is a needle stick injury what is to be done?, general non hazardous waste includes what?, knowing symbol of label of biomedical waste, yellow plastic bag is used for which waste? and handling of biomedical waste.
After educational intervention significant improvement has been noted in all areas except the proper reporting authority after needle stick injury and human anatomical waste is included in which category of waste.

There has been a significant improvement in practice score also. The weak areas before educational intervention have been duration of storage of waste. strong areas among practices has been collecting waste in covered bins, infectious waste, non sharp to be disposed in red bin/ plastic bag, identification of infectious waste, Identification of non infectious waste and their color coding, not mixing infectious and non infectious waste.

The weak areas in practice have been many out of which washing of hands before and after handling waste or any other procedures, Use of personal protective devices. , Adding of disinfectants to soiled linen before sending it for washing. Cleaning of liquid waste was done by adding bleaching powder and leaving it for 30 minutes. Disposal of sputum cup in to burial pit after disinfection and disposal of liquid waste into sewage line after disinfection etc.
There has been significant improvement in all areas of practice except 2.4. Stores waste beyond 48hrs & 5.2. Finally disinfects and disposes the metal sharps in sharps pits practices. No improvement in 5.13 Takes immunization against Hepatitis B and Tetanus are important universal precautions and 5.14 adds disinfectant to soiled linen before sending it to washing in these areas. Repeated educational intervention in weak areas and supervision of the wards in those areas are indicated.

A study has been conducted by Prabhudeva SS[24] (2004) on the management of biomedical waste. In the study he has observed that although hospital has become serious concern throughout the world, in India only ten states have given adequate thought to the management of collection and disposal of hospital waste.

Similar study has been conducted by Hegde V, Kulkarni RD, Ajantha GS (2007) on disposal of bio-medical waste. This study has shown that proper handling, treatment and disposal of biomedical wastes are elements of health care infection control program. Correct procedure will help protect health care workers, patients and the local community [25]. Appropriately designed and applied waste management can be effective and efficient. Safe and effective management of waste is not only a legal necessity but also a social responsibility. Lack of concern, motivation, awareness and cost factor are some of the problems faced in the proper biomedical waste management. Bio-medical waste practice clearly needs education about the hazards associated with improper waste disposal[7]. Our study has been based on the Infection Management and Environment Plan Guidelines for Government of India which is supported by Dept., for International Development, NRHM Ministry of Health and Family Welfare Govt., India[7]. We have prepared (educational intervention) structured teaching and audio

visual C D ROM presentation for the biomedical waste handlers and all 187 biomedical waste handlers could be educated. With educational intervention there is a significant difference in knowledge and practice among them which is encouraging.

6. Conclusion

Findings reveal that there has been a highly significant knowledge and practice scores of all biomedical waste handlers except 5.13 takes immunization against Hepatitis B and Tetanus are important universal precautions and 5.14 adds disinfectant to soiled linen before sending it to washing in these areas.

There has been a significant difference between the pretest and post test scores which shows that the educational intervention is effective. There has been a pre educational intervention mean knowledge score of 9.3 ($p<0.001$) with SD 3.9 and mean practice score of 7.8 with S.D 3.8 with improved after educational intervention to the mean knowledge score of 20.0 with S.D. of 2.4. ($t=34.4$, $p<0.001$) and practice score 21.6 with S.D. of 3.8 ($t= 39.2$, $p<0.001$) which is highly significant. This improvement occurred without significant deference according to sociodemogrphic variables

Pre educational intervention knowledge has revealed that 01(0.5%) has had excellent knowledge, 76 (40.6%) of the participants have had good knowledge and majority 110(56.8) had poor knowledge. where as post educational intervention revealed that 148(79.1%) have had excellent knowledge, 39 (20.8%) of the participants have had good knowledge and no one has had poor knowledge post training.

Whereas in pre educational intervention practices it has been observed that no one has had excellent practices, 39 (20.8%) of the participants have had good practices and majority 148 (79.1%) have had poor practices before educational intervention. Post educational intervention has shown improvement in practices. It has been observed that 83(44.3%) have had excellent practices, 100 (53.4%) of the participants have had good practices and only 4 (2.1%) have had poor practices after educational intervention.

There has been a significant difference between the pre-test and post test educational intervention scores which shows that the educational intervention is effective ($t= 34.44$, $p<0.001$) in improving knowledge. Area wise effectiveness of educational intervention has shown an improvement in proportion of workers answering questions related to knowledge correctly. The percentage improvement has ranged from 6.4% to 78.1%. In all except two areas there has been improvement in proportion of biomedical waste handlers practicing them correctly. The percentage improvement ranged from 1% to 86.6%. Two areas which have not shown any change after educational intervention are immunization with hepatitis B and tetanus for protection, and addition of disinfection before sending the soiled linen for washing and mop disinfection after every use. Use of personal protective devises has increased only from 3.2% to 11.7%

It has been observed that naked eye examination could detect only 41(21.1%) with skin aberrations where as 10Xlens could detect an additional 23(12.29%) i.e. 64(34.2%) and with blue India ink additional 10 (.53%) i.e. 51(27.3 %.) i.e.10X lens is best method for screening of wound on hands.

It can be concluded that based on pre and post educational intervention assessment of knowledge and observation of practices the structured teaching programme and audio visual C D ROM on biomedical waste management educational learning package on knowledge and practices in Krishna Hospital, Karad was very excellent. Repeated educational intervention (training) would enhance improvement in knowledge and practices with due emphasis on identified respective weak areas.

References

[1] Mukesh Yadav. Hospital Waste - A major problem. *Practitioner JK* 2001; 8(4)276-202.
[2] Sagoe-Moses C, Pearson RD, Perry J, Jagger J. Risks to health care workers in developing countries. *N Engl J Med* 2001; 345(7):538-41.
[3] N. Mathar Mohideen. Hospital Waste Management A Burning Problem. *Nightingale Nursing Times* 2007; 3(3):21-23
[4] World Health Organization. Safe Management of Biomedical Sharps in India. New Delhi. WHO Health Care Waste Policy: 2005
[5] Julia BG. Nursing Theories. The base for professional nursing practice. 3rd Ed. Morwaalk, Connecticut Appleton and Lange a Publishing Division of Prentice Hall. 1990: 381.
[6] Lwanga SK, Lemeshow S. Sample size determination in health studies: A practical manual. *World Health Organization* 1991:1–3.
[7] Govt. of India. Ministry of Health & Family Welfare, National Rural Health Mission. Infection Management and Environment Plan: Guidelines for Healthcare Workers for Waste Management and Infection Control in Community Health Centres.2005-2012.
[8] Training Module on Biomedical waste Management (2009) by Regional Center for urban and Environmental Studies (RCUSE), All India Institute of Local Self Government, Mumbai for Maharashtra Pollution Control Board
[9] Dement JM, Epling C. Truls S, Pompeii LA & Hunt DL. Blood and body fluid exposure risks among health care workers: Results from the Duke Health and safety surveillance system. *Am J Ind Med* 2004; 46: 637-648.
[10] Kermode M, Jolley D, Langkham B, Thomas MS, Crofts N. Occupational exposure to blood and risk of bloodborne virus infection among health care workers in rural north Indian health care settings. *Am J Infect Control* 2005; 33(1):34-41.
[11] Sharma RK, Nagarajan S, Saini S. Waste: Attitude and Actions. *Asian Hospitals and Health Care Management* 2004; 10(2): 10-3.
[12] MC Yadavannavar, Aditya S Berad, and PB Jagirdar. Biomedical Waste Management: A Study of Knowledge, Attitude, and Practices in a Tertiary

Health Care Institution in Bijapur. *Indian J Community Med* 2010; 35(1): 170-171.
[13] Ramokate T & Basu D. Knowledge and practices of doctors and nurses about management of health cart waste at Johannesburg Hospital in the Cauteng Province, University of the Witwatersrand, Johannesburg South Africa 2008: 1-25.
[14] Mostafa GM, Shazly MM, Sherief WI. Development of a waste management protocol based on assessment of knowledge and practice of healthcare personnel in surgical departments. *Waste Manag* 2009; 29(1):430-9.
[15] Biradar VS. Biomedical waste management and role of class–IV Staff. *Nightingale Nursing Times* 2010; 5(10): 58-62.
[16] Singh R, Kishore J, Mathur RG, Mandal K, Puri S. The role of an information booklet on bio-medical waste management for nurses. *Nurs J India* 2002; 93(12):271-272.
[17] Ashima Garg Sood, Abhinav Sood. Dental perspective on biomedical waste and mercury management: A knowledge, attitude and practice survey. *Indian Journal of Dental Resarch* 2011; 22(3): 371-375.
[18] Rekha Sachan, Patel ML, Anuradha Nischal Assessment of the Knowledge, Attitude and Practices Regarding Biomedical Waste Management amongst the Medical and Paramedical Staff in Tertiary Health Care Centre. *International Journal of Scientific and Research Publications* 2012; 2(7):1-6.
[19] Suwarna Madhukumar, Ramesh G. Study about awareness and practices about health care waste management among hospital staff in a Medical College Hospital, Bangalore. *IJBMS* 2013; 4(3).
[20] Mathur V, Dwivedi S, Hassan MA, Misra RP Knowledge attitude and Practices about Biomedical Waste Management among Healthcare personnel: A cross-sectional study. *Indian J Community Med* 2011; 36(2): PG143-145.
[21] Sahar Hamdy El-Sayed, Abeer Mohamed Zaaria and Nervana Abdel-Rehman Gheith Intervention Program for Nurses about Health Care Waste Management. *Res J Medicine & Med Sci* 2012; 7(1): 25-37.
[22] Nagaraju B, Padmawath GV, Puranic DS, Shantharaj MP, Sampultha SP A study to assess the knowledge and practice on bio-medical waste management among the health cae providers working in PHC s of Bageplli Taluk With the view to prepare information booklet. *International Journal of Medicine and Biomedical Research* 2013(2)1: 28-34.
[23] Nagarajappa D. Biomedical waste management practices at primary health centers. *Nightingale Nursing Times* 2013; 8(12):31-32 & 64-65.
[24] Prabhudeva SS. Biomedical Waste Management. *Nightingale Nursing Times* 2004; 10: 17-19.
[25] Hegde V, Kulkarni R D, Ajantha G S. Biomedical waste management. *J Oral Maxillofac Pathol* 2007;11:5-9

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