Impacts of health education on knowledge and practice of hospital staff with regard to Healthcare waste management at White Nile State main hospitals, Sudan

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Abstract:

Objectives: The present study aims at assessing nursing and sanitation staff knowledge and practice regarding Healthcare Waste (HCW) management before and after the implementation of an educational intervention program at the main hospitals of the White Nile State in Sudan.

Methodology: Quasi-experimental study design was applied to assess the impact of an intervention program on knowledge and practice regarding HCW management. The same questionnaire used in the pre-test was used immediately after the end of the intervention program and then again three months later for a second post-test.

Results: The results showed that the majority of nursing and sanitation staff had fair knowledge regarding HCW management before the educational intervention program (17% good, 58% fair, and 25% poor). After implementation of the educational program, the majority had good knowledge (56% good, 34% fair, and 10% poor) in the immediate post-test, and also in the post-test three months later (59% good, 35% fair, and 6% poor). More than half the nursing and sanitation staff had fair level of practice before the educational intervention program (42% good, 55% fair, and 3% poor). After the implementation of the intervention program, the immediate post-test showed a similar result (45% good, 54% fair, and 1% poor), while the post-test three months later showed that the majority demonstrated good practice level (55% good, 42% fair, and 3% poor).

Conclusion: The nursing and sanitation staff at the main hospitals of the White Nile State in Sudan recorded significant improvement in their knowledge and practice with regard to HCW management immediately after the educational intervention program and three months later.

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Introduction

Knowledge is usually gained through information provided by teachers, parents, friends, books, newspapers etc. [1] In many countries, knowledge about the potential for harm from HCW has now become more prominent to governments, medical practitioners and civil society. Increasingly, managers and medical staff are expected to take more responsibility for the wastes they produce from their medical care and related activities. Knowledge of staff regarding Healthcare Waste (HCW) can help patients and visitors to understand their role in maintaining good hygiene, and to become more responsible for the wastes they produce. [2] Practices of HCW management should be a part of total hygiene practice of the society rather than confining it to hospital and healthcare facilities. It is also very important that strict supervision and surveillance is followed in day-to-day HCW management activities. [3]

Nurses play a key role in the management of HCW. They should be able to segregate the waste and store it in the correct bins at the point of generation; and in order for them to fulfill this function efficiently, it is important that they have adequate knowledge about the importance of segregation and how to distinguish the different containers and bins for the various types of HCW. [4] Nurses and all the sanitation staff working in a hospital need to know the health hazards of hospital waste and the proper techniques and methods of handling the waste. This knowledge and proper practice can go a long way towards the safe disposal of hazardous hospital waste and the protection of healthcare personnel, patients, as well as the community at large and the environment. [5]

According to Madhukumar and Ramesh (2012), [6] education programs about HCW management should include the following items: information on, and justification for, all aspects of the HCW policy; information on the role and responsibilities of each staff member to follow waste-management procedures; technical instructions on the application of waste-management practices relevant to particular types of work by some medical or support staff; information on monitoring, record keeping and maintenance of equipment; awareness raising about the potential hazards from waste; the purpose of immunization; safe waste-handling procedures; reporting of exposures and injuries; preventing infection following an exposure; and the use of personal protective equipment (PPE). [6]

The aim of the current study was to assess nursing and sanitation staff knowledge and practice regarding HCW management in the White Nile State main hospitals in Sudan before and after implementation of an educational intervention program.

Methods

The present study was carried out at the three main hospitals in White Nile State, Sudan: Kosti hospital, Rabak hospital and Eduiem hospital. A quasi-experimental study design was applied to assess the impact of an educational intervention program on knowledge and practice regarding HCW management.

For the intervention program, 200 nurses and sanitation staff at the three hospitals were chosen randomly; 50% of participants (100) was subjected to the pre-developed educational program (Intervention group) while the other 50% (100) was not and was designated as (Control group). Both groups were subjected to a pre-test and two post-tests, one immediately after the end of the intervention program, and the other, three months later.

A predesigned and pre-coded self-administered questionnaire was filled by the nursing and sanitation staff included in the study, in order to assess their knowledge and practices with regard to HCW management at the three hospitals under study. [7, 8]

The knowledge questions were scored as follows:

- Score "1" for a correct answer
- Score "0" for an incorrect answer and for 'don't know'

The total mean knowledge score was calculated for each question by summing up every category; and total scores were calculated (14x1=14) ranging from (0- 14 points), then were adjusted out of 100 (0%-100%) and were graded as follows:

- Good knowledge (11-14 points) ≥ 75%
- Fair knowledge (7-10 points) 50% - <75%
- Poor knowledge (0-6 points) < 50 %

The practice questions were scored as follows:

- Score "3" for 'always' answer
- Score "2"for 'sometimes' answer
- Score "1"for 'never' answer

The total mean practice score was calculated for each question by summing up every category; and total scores were calculated (11x3=33) ranging from (0 - 33 points), then were adjusted out of 100 (0%-100%) and were graded as follows:

- Good level of practice (25-33 points) ≥ 75%
- Fair level of practice (17-24 points) 50% - <75%
- Poor level of practice (0-16 points) < 50%

Intervention program:

An intervention program was designed according to the results of the pre-test. The program was tailored according to the needs of the nursing and sanitation staff at the three hospitals under study. Educational materials were prepared, reviewed and tested before using them.

Six educational sessions were delivered over two weeks, with the participants divided into different groups, so that some participants' attended the sessions in the morning from 10:00 am to 11:30 am, others in the afternoon from 12:00 pm to 1:30 pm, while others attended in the evening from 5:00 pm to 6:30 pm. The methods used in the intervention program included: lectures, group discussions, videos, demonstrations, health talks, and power point presentations.

The contents of the six sessions of the health education intervention program were as follows: Definition, sources and categories of HCW; The public health impacts of improper HCW management; Regulations of healthcare waste management; Operations of HCW management; Case studies; and Planning for HCW management.

Ethical considerations:

- Approval of hospitals administrators was taken.
- Informed consent was taken from all participants in the study.

Statistical analysis:

Data were collected, revised, coded and fed to the statistical software SPSS (Statistical Package for the Social Sciences) version 21.

- Descriptive statistics including frequency distribution and percentages were performed.
- For quantitative variables, mean and standard deviation were calculated.
- Tests for normal distribution were done to select the suitable statistical analysis methods
- For intervention and group samples in intervention program the percent columns were ignored due to equality of the sample size number and percent. (sample size=100)
- The non-parametric Mann-Whitney test was used to assess the difference between intervention and control groups, while Wilcoxon test was used to compare intervention group's improvement pre and post educational program immediately and after three month after the end of the program.
- The two tailed tests, alpha error of 0.05, and p-value less than 0.05 were considered significant.

Results

The following tables and figures explain the results of nursing and sanitation staff at the three hospitals under study with regard to their knowledge and practice of HCW management. The results of the three phases (pretest, post-test immediately after intervention, and post-test three months later) are presented.

Table 1: Pre and post-test knowledge of nursing and sanitation staff regarding HCW management at the selected hospitals in White Nile State, Sudan, 2013.

Knowledge items	Control group n=100				Intervention group n=100					
	Pre-test		Post-test		Pre-test		Post-test -Immediate		Post-test- After three months	
	Correct answers	Incorrect answers and Don't Know	Correct answers	Incorrect answers and Don't Know	Correct answers	Incorrect answers and Don't know	Correct answers	Incorrect answers and Don't know	Correct answers	Incorrect answers and Don't know
Definition of HCW	78	22	89	21	80	20	85	15	91	9
Different types of HCW	58	42	76	24	59	41	76	24	71	29
Correct collection and segregation of the HCW	49	51	56	44	55	45	67	33	80	20
Quality of HCW containers	61	39	77	33	71	29	72	28	78	22
HCW colors coded containers	29	71	24	76	14	84	50	50	45	55
Disposal of HCW container contents correctly	30	70	23	77	14	84	68	32	71	29
HCW disposal frequency times	42	58	47	53	48	52	55	45	50	50
Most important diseases transmitted through HCW	49	51	45	55	55	45	81	19	87	13
Best method used for HCW disposal	23	77	13	87	13	87	68	32	52	48
Personal protective measures used in HCW collection	78	22	86	14	83	17	88	12	89	11
Specifications of HCW storage rooms	67	33	68	32	72	28	85	15	88	12
Appropriate method used to clean the HCW container that may cause infection	82	12	75	25	74	26	81	19	89	11
Maximum time to store the HCW in hospitals	85	15	86	14	84	16	93	7	91	9
Quality of HCW transport vehicles	78	22	83	17	85	15	89	11	90	10

Table 2: Pre and post-test knowledge scores of nursing and sanitation staff regarding HCW management at the selected hospitals in White Nile State, Sudan, 2013.

Knowledge items	Control group n=100						Relation test(Wilcoxon)		Intervention group n=100									Relation test(Wilcoxon)					
																		Pre-test& Post-test Immediate		Pre-test& Post-test Three months		Post-test Immediate& Post-test Three months	
	Pre-test			Post-test			Z-value	P-value	Pre-test			Post-test - Immediate			Post-test- After three months			Z-value	P-value	Z-value	P-value	Z-value	P-value
	G	F	P	G	F	P			G	F	P	G	F	P	G	F	P						
Definition of HCW	√			√			2.043	**0.041***	√			√			√			0.870	0.384	2.117	**0.034***	1.279	0.201
Different types of HCW		√		√			2.777	**0.005***		√		√				√		2.546	**0.011***	1.857	0.063	0.801	0.423
Correct collection and segregation of the HCW			√		√		1.021	0.307		√			√		√			1.664	0.96	3.501	**0.000***	1.982	**0.047***
Quality of HCW containers		√		√			2.412	**0.016***		√			√		√			0.164	0.869	1.183	0.237	1.000	0.317
HCW colors coded containers			√			√	0.870	0.384			√		√				√	4.811	**0.000***	4.341	**0.000***	0.801	0.423
Disposal of HCW container contents correctly			√			√	1.067	0.286			√		√			√		6.750	**0.000***	6.862	**0.000***	0.507	0.612
HCW disposal frequency times			√			√	0.674	0.500			√		√			√		1.043	0.297	0.272	0.785	0.674	0.500
Most important diseases transmitted through HCW			√			√	0.544	0.586		√		√			√			3.753	**0.000***	4.619	**0.000***	1.134	0.257

Continued table (2)

Best method used for HCW disposal			√			√	1.768	0.077			√		√			√		6.822	**0.000***	5.689	**0.000***	2.412	**0.016***
Personal protective measures used in HCW collection	√			√			1.414	0.157	√			√			√			1.000	0.317	1.177	0.239	0.209	0.835
Specifications of HCW storage rooms		√			√		0.140	0.889		√		√			√			2.197	**0.028***	2.744	**0.006***	0.577	0.564
Appropriate method used to clean the HCW container that may cause infection	√			√			1.219	0.223		√		√			√			1.257	0.209	2.887	**0.004***	1.512	0.131
Maximum time to store the HCW in hospitals	√			√			0.192	0.847	√			√			√			2.085	**0.039***	1.400	0.162	0.577	0.564
Quality of HCW transport vehicles	√			√			0.898	0.369	√			√			√			0.853	0.394	1.043	0.297	0.243	0.808

G= Good (≥75%) F=Fair (50% ≤ 75%) P=Poor (<50%)
*** Significant (p<0.05)**

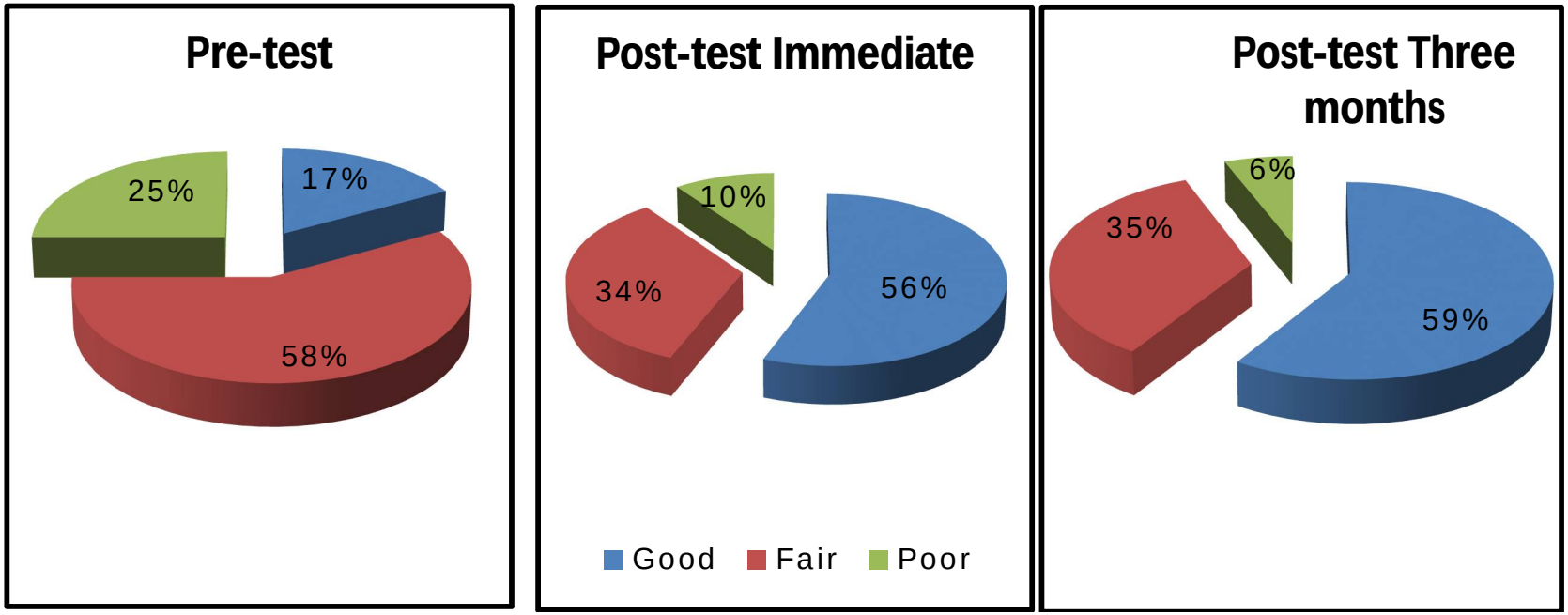

Figure 1: **Total knowledge scores among intervention groups pre-test and post-test regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Table 3. **Pre-test and post-test total knowledge scores regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Total Knowledge scores	Control group n=100		Intervention group n=100		
	Pre-test	Post-test Three months	Pre-test	Post-test Immediate	Post-test Three months
Good	23	27	17	56	59
Fair	46	46	58	34	35
Poor	31	27	25	10	6

Good (≥75%) Fair (50% ≤ 75%) Poor (<50%)

Table 4: **Relations between total knowledge scores (Wilcoxon test) regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Control group n=100		Intervention group n=100					
Pre-test& Post-test Three months		Pre-test& Post-test Immediate		Pre-test& Post-test Three months		Post-test Immediate& Post-test Three months	
Z-value	P-value	Z-value	P-value	Z-value	P-value	Z-value	P-value
0.094	0.925	3.297	**0.001***	3.297	**0.001***	0.913	0.362

*** Significant (p<0.05)**

Table 5: Pre and post-test practice scores of nursing and sanitation staff regarding HCW management at the selected hospitals in White Nile State, Sudan, 2013.

Practice items	Control group n=100						Intervention group n=100								
	Pre-test			Post-test			Pre-test			Post-test –Immediate			Post-test- After three months		
	Always	Some times	Never	Always	Some times	Never	Always	Some times	Never	Always	Some times	Never	Always	Some times	Never
Collection of HCW in colour coded containers	48	17	35	47	36	17	45	29	26	49	32	19	47	25	28
Storage of HCW	31	29	40	27	35	38	12	31	57	24	27	49	16	26	58
Proper disposal of HCW	45	28	27	52	31	17	55	29	16	54	27	19	60	18	22
Follow guidelines and legislation of HCW	56	22	22	53	35	12	62	29	9	68	25	7	60	32	8
Wearing protective clothes during HCW operations	54	18	28	53	37	10	50	31	19	59	28	13	58	16	26
Attending training courses on HCW management	31	14	55	24	15	61	14	23	63	20	15	65	37	38	25
Wearing gloves when dealing with HCW	61	28	11	54	38	8	67	25	8	70	22	8	70	27	3
Proper hands washing when collect and segregate HCW	76	20	4	79	16	5	83	13	4	83	11	6	83	15	2
Registration of HCW accidents in hospitals records	36	19	45	32	29	39	15	27	58	21	31	48	28	24	48
Practice health education on HCW risks	52	34	14	54	34	12	51	31	18	55	38	7	63	27	10
	Yes	No		Yes	No		Yes	No		Yes	No		Yes	No	
Had previous vaccination to hepatitis B	30	70		38	62		31	69		31	69		38	62	

Table 6: Pre and post-test practice scores of nursing and sanitation staff regarding HCW management at the selected hospitals in White Nile State, Sudan, 2013.

Practice items	Control group n=100						Relation test(Wilcoxon)		Intervention group n=100									Relation test(Wilcoxon)					
																		Pre-test& Post-test Immediate		Pre-test& Post-test Three months		Post-test Immediate& Post-test Three months	
	Pre-test			Post-test			Z-value	P-value	Pre-test			Post-test Immediate			Post-ztest-After three months			Z-value	P-value	Z-value	P-value	Z-value	P-value
	G	F	P	G	F	P			G	F	P	G	F	P	G	F	P						
Collection of HCW in colour coded containers			√			√	1.489	0.139			√			√			√	0.881	0.378	0.117	0.907	1.015	0.310
Storage of HCW			√			√	0.180	0.857			√			√			√	1.883	0.062	0.365	0.715	1.422	0.155
Proper disposal of HCW			√			√	1.579	0.114		√			√			√		1.579	0.114	1.632	0.103	0.366	0.715
Follow guidelines of HCW		√			√		0.192	0.848		√			√			√		0.846	0.397	0.014	0.989	1.169	0.243
Wearing protective clothes during HCW operations		√			√		1.550	0.121		√			√			√		1.311	0.190	0.071	0.944	1.393	0.164
Attending training courses on HCW management			√			√	1.267	0.205			√			√			√	0.277	0.781	5.356	**0.000***	4.446	**0.000***
Wearing gloves when dealing with HCW		√			√		0.263	0.793		√			√			√		0.303	0.762	0.998	0.318	0.691	0.489
Proper hands washing when collect and segregate HCW	√			√			0.228	0.819	√			√			√			0.360	0.719	0.321	0.748	0.646	0.518
Registration of HCW accidents in hospitals records			√			√	0.276	0.783			√			√			√	1.478	0.139	1.997	**0.046***	0.581	0.561
Practice health education on HCW risks		√			√		0.507	0.612		√			√			√		1.670	0.095	1.865	0.062	0.574	0.566
Had previous vaccination to hepatitis B			√			√	1.234	0.217			√			√			√	0.617	0.537	1.061	0.289	1.621	0.105

G= Good (≥75%) F=Fair (50% ≤ 75%) P=Poor (<50%)

*** Significant (p<0.05)**

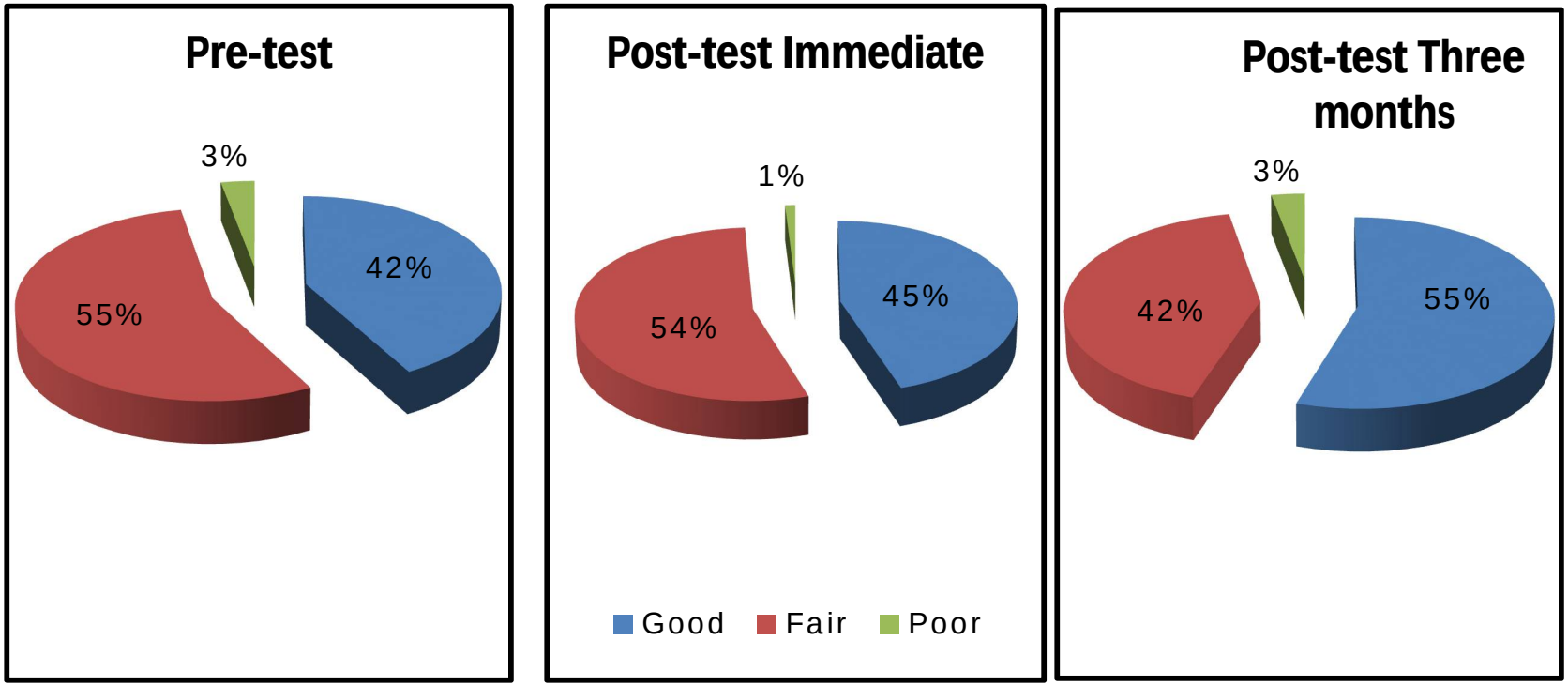

Figure 2: **Total practice scores among intervention groups pre-test and post-test regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Table 7. **Pre-test and post-test total practice scores regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Total practice scores	Control group n=100		Intervention group n=100		
	Pre-test	Post-test Three months	Pre-test	Post-test Immediate	Post-test Three months
Good level	48	48	42	45	55
Fair level	41	49	55	54	42
Poor level	11	3	3	1	3

Good (≥75%) Fair(50% ≤ 75%) Poor (<50%)

Table 8. **Relations between total practice scores (Wilcoxon test) regarding HCW management at White Nile State main hospitals, Sudan, 2013.**

Control group n=100		Intervention group n=100					
Pre-test& Post-test Three months		Pre-test& Post-test Immediate		Pre-test& Post-test Three months		Post-test Immediate& Post-test Three months	
Z-value	P-value	Z-value	P-value	Z-value	P-value	Z-value	P-value
1.742	0.082	2.048	**0.041***	2.652	**0.008***	0.802	0.423

*** Significant (p<0.05)**

Discussion

The findings of the present study showed that, before the implementation of the educational intervention program,58%of the intervention study group had fair knowledge, while 25% and 17% had poor and good knowledge, respectively, regarding HCW management (table 3, figure 2). This may be due to a lacking curriculum with regard to HCW management in higher secondary school and undergraduate studies, lack of training, and/or unavailability of HCW management handouts and tools in the three hospitals. A similar study, conducted in Al-Mansoura University Hospital in Egypt in 2012, [9] showed that nurses had unsatisfactory knowledge regarding HCW management before the implementation of the educational intervention program. On the other hand, many studies, like those done by Godduet al. in England and India hospitals in 2007, [10] and Saini et al.at a tertiary level hospital in India in 2005, [11] revealed higher level in knowledge in nurses about HCW management. This was not in agreement with the findings of the current study, and indicated the necessity of an education program to improve the knowledge of the nurses and sanitation staff included in the present study.

The results of the present study reported fair knowledge in intervention group regarding, correct collection and segregation of HCW (55%) and poor knowledge regarding HCW colour coded containers (14%) and correct disposal of HCW container contents (14%) as shown in table1. Similar studies in Ethiopia in 2012[8] and by Bansal et al. in the district of Madhya Pradesh in India in 2011[12] reported poor knowledge regarding colour coding and HCW segregation. On the other hand, a study conducted in four private hospitals in Udupi City in India in 2012, [7] the study by Mathuret al. at Allahabad city in Pakistan in 2011, [13] and the study by Deoet al. in India in 2006 [14] were not in agreement with the findings of the present study. The previously mentioned studies found that hospital staff had good knowledge regarding HCW segregation at source and the use of colour coded containers.

The findings of the present study also showed fair knowledge (55%) regarding infectious disease transmission due to improper HCW management in intervention group study (table 1); however, there was a significant improvement in knowledge after the educational intervention program, with the participants showing good knowledge (81%) immediately and (87%) after three months (table 1, figure 1). Contrarily, the majority (77.51%) of study participants in the Udupi City study in India in 2012 [7] had good knowledge about the transmission of various diseases through HCW without the need for an education program.

The present study revealed highly significant improvement in nursing and sanitation staff knowledge total score about HCW management (Z value=3.297, p =0.001), (table 4), as the proportion of participants showing good knowledge rose from 17% before intervention to 56% immediately and to 59% after three months of the intervention program (table 3, figure 2). The improvement in knowledge scores indicates that the program had a very good effect. This may be due to the content of the educational intervention program; the written handouts distributed during the program, which serve as reference; and the participatory group discussions that the staff had with the researcher. The findings of the present study are supported by Tyson and York (2002), [15] who stated that a significant improvement in nurses' knowledge after attending a program emphasized the need of hospital nurses to attend more educational opportunities to strengthen their skills and update their knowledge. The finding of the present study was also in agreement with El-Sharkawy study in Zagazig University Hospital in Egypt in 2009, [16] where an educational program about HCW management was implemented. That study also revealed significant improvement in nurses' knowledge, with the proportion having good knowledge rising from 25% before intervention to 78% after implementing the intervention program.

Concerning the practice scores for nursing and sanitation staff, the results of the present study showed that more than half (55%) of the study sample intervention group had fair practice scores regarding HCW management before intervention (table 7, figure 2). This result may be due to lack of knowledge regarding the HCW management combined with lacking supervision. This finding was in agreement with the result by Singh et al. in Indian hospitals in 2002, [17] who also reported fair practice regarding HCW management. After the implementation of the intervention

program in the present study, the proportion of hospital staff with good practice scores rose from 42% to 55% three months later.

Regarding segregation and collection of waste in color coded containers, the present study revealed that a poor level of practice persisted in the pretest (45%), immediate post-test (49%), and in the post-test after three months of educational intervention program (47%) (table5). This may be due to improper segregation at the site of origin, unavailability of appropriate technologies, inadequate finances and a lack of waste management training programs. These findings show similarities to previous studies in Al-Mansoura in Egypt in 2012, [9] and in India in 2010, [18] in 2009, [19] and in 2005. [20] These studies showed low practice mean scores for nurses regarding segregation and collection of HCW in colour coded containers. In the same respect, Yadavannavaret al. in Ethiopia in 2010, [21] mentioned that HCW collection and proper disposal has become a significant concern for both the medical and the general community.

The present study findings also showed poor practice score in 57% of the participants for HCW storage before the intervention program, and this result did not improve after the intervention (table 5). This finding was not in agreement with a previous study by Shafeeet al. in 2010[18] and a study in Pakistan in 2005. [20] These studies concluded that the process of segregation, collection, transportation, storage and final disposal of infectious waste was done in compliance with the standard procedures, and the nurses showed good practice scores for these tasks. The poor results of the current study necessitate continuous training of nurses and hospital staff in the White Nile State main hospitals with regard to HCW management operations, and also require that appropriate storage spaces be maintained and continuously supervised in these hospitals.

On the other hand, the present study revealed that the majority of nursing and sanitation staff always wore gloves when dealing with HCW (67% in the pre-test and 70% in the post-tests) (table 5, figure 2). This result was in agreement with the previous studies conducted in Mansoura in Egypt in 2012 [9] and in England and India in 2007. [10] These studies reported that staff nurses were handling HCW with appropriate health and safety measures by using impervious gloves.

Concerning hand washing practice after collection and segregation of HCW, the majority (83%) of the study group showed good practices cores before and after intervention (table 5). The finding of the present study was consistent with two studies implemented in Egypt in Damietta city in 2009 [22] and in Mansoura International Specialized Hospital in 2008. [23] These studies revealed that the majority of nurses wash their hands after dealing with blood or patient body secretion and after using infected equipment. On the other hand, the study by El-Sayed, Zakaria, and Gheith in Egypt in 2012 [9] reported a low percentage of nursing and sanitation staff washing their hands (12.8%). Potter and Perry in 2009[24] mentioned that hand washing is the most basic and effective infection control measure that prevents and controls the transmission of infectious agents, and that barrier precautions are also used to minimize the risk of exposure to blood and body fluids.

Barrier precautions mainly consist of using personal protective measures, such as masks, gowns, and gloves to create a barrier between the person and the microorganisms. In the current study, half of the nursing and sanitation staff (50%) reported always wearing protective clothes during HCW operations, and this proportion increased to 58% after intervention (table 5). While the majority of hospital staff wore gloves regularly, the proportion reporting wearing other protective clothing is not satisfactory. This may be attributed to inadequate knowledge about the importance of wearing personal protective clothing, lack of sufficient training in infection control, and/or shortage of disposable supplies and protective personal equipment (PPE). These explanations are generally supported by previous study findings in Egypt in 2012, [9] and in 2004, [25] where a low percent of nurses regularly wore protective clothing. The study by Ibrahim in Cairo University Hospital, Egypt in 2009 [26] concluded that wearing gloves and hand washing were two areas of weakness that needed more training among staff nurses.

The findings of the current study revealed that (62%) of the participants in the intervention group followed the guidelines and regulations of HCW management before the

intervention program (table 5). This proportion increased slightly and insignificantly to 68% immediately after intervention, then dropped again to 60% three months later. This percentage is slightly higher than the result reported in the study conducted in Tertiary care hospital in Bhopal in India in 2012 [27] which showed that only 54.5% of nurses were practicing HCW management according to guidelines and rules. On the other hand, another study done at Bangalore in India in 2012 [3] showed that 87.5% of study subjects were in the favor of segregation of HCW at source of generation according to guidelines and waste handling rules. This controversy in literature hints at the importance of continuous training and supervision of hospital staff as the main factor affecting their practice.

Regarding previous vaccination to Hepatitis-B virus, 69% of the study participants in the intervention group were not vaccinated for hepatitis B before intervention (table 5). Three months after the intervention program, the number of vaccinated hospital staff grew to 38 out of 100. This result is still lower than the result reported by the study conducted by Assadallah in India in 2013, [7] which showed that 74.5%of the study respondents were vaccinated for the Hepatitis-B virus.

In support of the foregoing explanations regarding deficient nursing and sanitation staff knowledge and practice, the current study revealed that 86% of the participants had not attended any training program related to HCW management (table 5). This finding may be due to the absence of ongoing in-service training programs in the hospitals under study, and/or the low perception of the importance of HCW management by the hospitals administrations. Similar findings were reported in several studies, in Al-Mansoura study in 2012, [9] in the study done in Hawassa city of Ethiopia in 2011, [28] and in the study carried out in India in 2002. [17] These studies reported that the majority of the hospitals' staff did not receive any training on HCW management, which explained their poor knowledge and practice results. In a report by the WHO, it is concluded that the overall aim of training in relation to HCW management is both to create a competent workforce and develop awareness of the health, safety and environmental issues relating to HCW management, and how these can affect nurses in their daily work. [29] Also, Marquis and Huston in 2009, [30] demonstrated that an adequate orientation program minimizes the likelihood of rule violation and confusion, fosters the feelings of belonging, motivation, and enhances the moral state of the new employee. In addition, Cherry and Jacob in 2011 [31] mentioned that orientation programs are required for unprepared new nurses to avoid stress and frustration in the work place and to help them gain necessary skills and confidence.

The findings of the current study showed that 42% of nursing and sanitation staff had good practice scores in most areas of waste management before the implementation of the educational intervention program (table 7). After the implementation of the program, there was improvement in the total practice score from 42% good in the pre-test to 45% good in the immediate post-test (Z value=2.084, p=0.041) then to 55% in the post-test three months later (Z value=2.652, p=0.008) (table 8). Much lower results were reported by Mostafa et al. in a study conducted at Al-Mansoura University Hospital in Egypt in 2007, [32]where poor nursing practices were observed in most areas of HCW, with only 18.9% of the nurses and 7.1% of the housekeepers showing adequate practices before the implementation of any intervention. Intervention and training programs seem to play a very important role in improving practice, as shown in the study done by El-Sharkawy in Zagazig University Hospital in Egypt in 2009. [16] The study reported that all participants (100%) correctly described the skills needed for dealing with HCW after the implementation of a health educational intervention program.

While the result of the above mentioned study by El-Sharkawy seems to be overly optimistic, the improvement in practice of nursing and sanitation staff regarding HCW management would need time, resources and facilities for training programs targeting their practice apart from educational programs that target their knowledge. This conclusion is supported by Lewiseet al. (2004), [33] who reported that good practice is the result of theoretical understanding that helps nurses to acquire new skills in relation to HCW management.

Conclusion

Based on the results of the present study, there was a highly significant improvement of nursing and sanitation staff knowledge total score regarding HCW management immediately after implementation of an educational intervention program (Z= 3.297, p= **0.001***) and after three months (Z= 3.297, p= **0.001***).There was also a significant improvement of nursing and sanitation staff practices total score in relation to HCW management immediately after implementation of the educational intervention program (Z= 2.048, p= **0.041***) and three months later (Z= 2.652, p= **0.008***).

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