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Original Article

Impact of Intervention on Healthcare Waste Management in a Reference Laboratory

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ABSTRACT

Objective: To assess the effect of interventions on knowledge and practices of healthcare staff regarding healthcare waste management, in the department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi.

Study Design: Quasi-experimental study

Place and Duration of study: Department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi Pakistan, from July-December 2022

Methodology: This study was conducted over 33 participants including laboratory technologists, sanitary workers and Medical laboratory technology (MLT) students. The baseline knowledge and practices were checked by using an "Awareness questionnaire" and an "Observation checklist" respectively. Interventions included lectures, posters and on-spot checks. The same questionnaires were used to assess the post-intervention knowledge and practices. The pre-and post-intervention awareness scores were compared using and a *p*-value of <0.05 was considered statistically significant.

Results: Out of total 33 participants, 22(67%) were males and 11(33%) were females. An improvement in the knowledge and practices of the participants was noted. The improvement in knowledge between the pre and post-intervention awareness scores was found to be statistically significant with a *p*-value of <0.001. The on-spot practices assessed through an observation checklist revealed that pre-intervention percentage scores ranged from 38-83% while the post-intervention percentage scores ranged from 83-100%, in the nine sub-sections of the Microbiology Department.

Conclusion: The three interventions, including training, display of posters and spot checks resulted in a statistically significant improvement in the awareness and marked improvement in practices of most of the laboratory staff regarding implementation of waste management policy

Keywords: Healthcare, Intervention, Knowledge, Practice, Training, Waste management.

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INTRODUCTION

Health care waste is defined as all types of waste produced in health care facilities such as hospitals, laboratories and pharmacies.[1] As per World Health Organization (WHO) 75–90% of health care waste is non-hazardous and 10–25% is hazardous. The term non-hazardous waste refers to waste that does not pose a threat to human health and does not need specific handling or disposal procedures.[2] The hazardous waste, on the other hand is the type of waste, which is a potential threat to human health and includes Infectious, Sharps, Pathological, Pharmaceutical and Radioactive wastes.[2] This waste has to be disposed of properly.[2] All activities involved in creation, segregation, transportation, storage, treatment, and final disposal of all sorts of waste produced in healthcare facilities are referred to as "healthcare waste management.[3] Handling medical waste is a risky task that calls for extensive training. It requires specialized training regarding knowledge of types of waste, potential dangers and precautions in handling waste.[4] Final disposal of waste can be carried out through recycling, composting, incineration and landfills.[3]

Hospitals of lower middle-income countries fail to implement proper waste management.[5] Poor infectious waste management techniques in their hospitals poses a risk to both public and occupational health which contributes to a high incidence of hospital acquired infections among patients, waste handlers and nursing staff. This in turn may serve as a source of spread of these infections to the community.[6] With every passing day, environment is being contaminated with an enormous quantity of waste produced at ever-increasing rates.[7] The lack of segregation, insufficient rules, improper waste treatment, inadequate staff training and lack of personal protective equipment (PPE) are some of the factors that contribute to the problem.[8]

A new standard operating Procedure (SOP), with segregation of waste into Infectious, sharps, and three

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categories of Non-infectious waste, was approved for implementation in Armed Forces Institute of Pathology (AFIP) Rawalpindi, in 2021. However, problems were faced in the implementation and compliance to the SOP. Therefore, it was required to carry out a consolidated effort to improve the weak areas of adherence to the protocol. The current study was planned to assess the effect of interventions on knowledge and practices of healthcare staff in the department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi.

METHODOLOGY

This Quasi-experimental study was conducted at Microbiology department, AFIP Rawalpindi (RWP) from July to December 2022. The WHO sample size formula for hypothesis test for a population proportion (one-sided test) was used to calculate sample size at the desired 5% level of significance and power of test at 95%. The prior proportion of subjects with healthcare waste awareness was considered to be 29.3% and it is expected to approximately double up to 58% as a result of intervention.[9]

Inclusion Criteria: Laboratory staff including laboratory technologists, sanitary workers, and medical laboratory technology (MLT) students involved in any aspect of healthcare waste management of either gender with age ranging from 21 to 43 years were included in the study.

Exclusion Criteria: Clerical and non-clinical staff members who were not involved in healthcare waste management at any level were excluded.

Awareness of laboratory staff regarding the types, segregation, collection, transport, and disposal of healthcare waste was assessed through semi-structured, questionnaire-based interviews. The 20-item awareness questionnaire was adapted from a study by Lehto *et al*.[10] For the awareness questionnaire, each "Yes" was scored as 1 and "No" as 0 (max score: 20). Individual participant scores were calculated by summing positive responses to 20 items and could range from 0 to 20.

Compliance with waste disposal SOPs was assessed pre-intervention via direct observation at 13 waste collection points across nine sub-sections of the Microbiology Department, including Clinical Pathology, Serology, Food and Water Microbiology, Microbiology PCR, Media Room, Mycobacteriology (×2), Bacteriology-I (×2), Bacteriology-II (×2), and Mycology (×2). Observations were recorded on an 18-item checklist derived from Kumar *et al*. and modified per the SOPs of AFIP, Rawalpindi. [11] Each "Yes" was scored as 1 and "No" as 0 (max score: 18). Sectional scores were calculated by summing checklist items at each point; for sub-sections with multiple points, mean scores were used. These were converted into percentages and analyzed using descriptive statistics.

Intervention included educational sessions for laboratory technicians and sanitary staff, using lectures and pictorial posters. The SOP was read aloud in Urdu during weekly sessions. Spot checks and immediate instruction were also conducted weekly in each sub-section over four months.

Post-intervention data were collected using the same awareness questionnaire and observation checklist. All forms were completed by the principal investigator to minimize self-reporting bias. Means and standard deviations were calculated for continuous variables (e.g., age), while frequencies and percentages were reported for categorical variables (e.g., gender, designation, sub-section). Pre & post intervention awareness and practice scores were analyzed using appropriate tests for statistical significance. A p-value<0.05 was considered statistically significant.

Data analysis was performed using SPSS version 26. The primary study variables included awareness scores based on questionnaire responses and compliance scores from an observation checklist. Normality of continuous data was assessed using the Shapiro–Wilk test. Pre intervention scores were normally distributed while post intervention scores were non normally distributed. For paired comparisons, the Wilcoxon signed-rank test was applied due to non-normal distribution of post-intervention scores. A p-value of less than 0.05 was considered statistically significant

RESULTS

A total of 33 participants were included in the analysis (Table-I). Out of the total 33 participants, 22(67%) were males and 11(33%) were females. The difference was not statistically significant (χ^2 =3.67, p=0.055). The participants' ages ranged from 21 to 43 years (Mean=29.94±6.76 years). The mean years of laboratory experience was 8.22±6.70 years, ranging from 0.50 to 20.00 years. The study group included 20(60.6%) laboratory technicians, 11(33.3%) MLT

students, and 2(6%) sanitary workers from nine sub-sections of the microbiology department. The participants were distributed across the following nine sub-sections: 2 from Mycobacteriology, 3 from Media Room, 6 from Bacteriology-1, 5 from Bacteriology-2, 4 from Serology, 7 from Clinical Pathology, and 2 each from Molecular, Mycology, and Food and Water Microbiology.

Table-I: Summary of Findings (n=33)

Category	Value
Male: Female	2:1
Age range	21 – 43 years
Mean age	29.94+ 6.76 years
Years of lab experience	8.22 ± 6.70 years

Total awareness scores were calculated based on 20 questionnaire items. On checking for normality, pre-intervention scores followed a normal distribution (p=0.518), so the mean pre-intervention score was calculated which was 11.15±3.45. Post-intervention scores did not follow a normal distribution (Shapiro Wilk test, p=0.002), so these were reported using median (IQR).

The post-intervention median awareness score was 19.00 (IQR 2.00), compared to a pre-intervention median of 11.00 (IQR 5.00). This improvement was statistically significant (p=0.00) (Table-II). An improvement was statistically significant in 26(78.8%) of participants, while 7(21.2%) showed no significant change. The narrower IQR in post-intervention scores reflects greater consistency in awareness levels after intervention. The average number of correct responses per participant before the intervention was 11.67±3.67, and after the intervention was 18.61±1.39 (out of a maximum of 20), based on the 20-item awareness questionnaire.

Table II: Comparison of Pre- and Post-Intervention Awareness and Practice Scores (Wilcoxon signed Rank Table)

Parameter	Study Groups		*p*-value
	Group A (Pre) n=33	Group B (Post) n=33	
Awareness Score	11.0 (IQR 5.0)	19.0 (IQR 2.0)	0.00
Practice Score	60.0% (IQR 2.0)	94.0% (IQR 2.0)	0.007

Practice was assessed using an observation checklist across nine sub-sections. These scores were not normally distributed and are reported using median (IQR). The cumulative median pre-intervention score was 58.00% (IQR 5.00%), and the post-intervention score rose to 94.00% (IQR 3.00%). This was found to be statistically significant (p=0.007) (Table-II). Sub-section scores ranged from 38–83% before the intervention and 83–100% after. The highest post-intervention score was observed in the Media Room, and the lowest in Bacteriology-2.

DISCUSSION

Lab waste management is a critical component of safety in a healthcare set up.[12] Ineffective healthcare waste management can have negative health implications including infection transmission and environmental contamination both within and outside of the healthcare institutions that produce these wastes.[13] Any laxity in compliance to the waste disposal SOP may lead to serious consequences on the health of the healthcare staff, patients and the community.[14] An effective system of implementation of healthcare waste disposal procedures can result in positive impact not only on the ambience, health of staff but also in the conservation of monetary resources.[15]

This study gave an insight to the existing state of compliance to the waste disposal SOP and the improvement occurring as a result of intervention. The improvement in the overall awareness of 78.8% of lab staff was found to be statistically significant. Similarly, when individual parameters in the awareness questionnaire were assessed, the improvement was found to be statistically significant in 80%. The reason for insignificant improvement in some cases was that these participants mostly had a good pre-intervention score and there was little room for improvement. An assessment of the on-spot practices also revealed a considerable improvement as a result of interventions.

A comparison of our study with other studies revealed a concordance of our findings with other studies. Ashtari *et al*., evaluated the effect of interventions in 27 researches and found that educational interventions were more effective than managerial interventions.[16] The improvement in awareness, attitude and practices was found to be statistically significant. Awareness and attitude component showed even better improvement than the practice component. This was similar to our finding indicating a significant improvement in the awareness. Ashtari *et al*., also found that interventions had a significant positive impact on the metrics for waste production volume, waste management expenses, and overall waste management performance.[16] However,

expense and waste volume were not in the scope of our study.

Our study is also in coherence with a study conducted in Iran by Robat *et al*., They evaluated the effect of training on behavior of the healthcare staff.[17] The training was carried out through a comprehensive Health Action Model and the improvement in different aspects of behavior was assessed through a questionnaire.[17] They found a statistically significant improvement in the knowledge, belief and motivation of the healthcare staff regarding the healthcare waste management policy.[17]

A quasi-experimental study was conducted in two tertiary care teaching hospitals in Rawalpindi in October 2013.[11] A total of 138 hospital employees at a hospital received instructions, hands-on practice, and reminders on proper waste management, and their numbers were compared to 137 employees in the control hospital. The data was collected via a systematic questionnaire 18 months following the intervention in order to evaluate its effectiveness.[11] Post-intervention the mean scores on knowledge, attitude, and behaviors improved substantially from baseline. The difference was also significantly different from the control group (p<0.001).[11]

Our results were found in contrast to a study conducted in 2014 by McKeon.[18] He evaluated the effect of two interventions including education and signage (pasting pictorial posters near color-coded waste collections receptacles).[18] His study revealed there was no statistically significant difference in the pre- and post-intervention compliance of the participants to the desired waste disposal protocol.[18] He attributed this lack of significance to the small sample size and ineffective interventions. In our study, two of the interventions were similar to McKeon's study i.e. training (education) and displaying posters while we also incorporated a third intervention in the form of "random spot checks.[18] This highlights the importance of "spot checks" in the process of implementation. Another difference is that McKeon's study was conducted on the residents of the sorority houses of University of California with a limited sample size while our study was conducted in a section of a healthcare set up, on an appropriately calculated sample size.

To summarize, the interventions carried out in our study, resulted in considerable improvement in the knowledge and compliance to waste management SOP. Literature review also indicates similar results. However these encouraging results of our study carried out in Microbiology Department give us an indication that similar interventions if carried out in other departments of the same institute or other healthcare laboratories are likely to improve the compliance to waste management standard practices. This is expected to result in prevention of spread of infection in healthcare staff and community at large.

LIMITATION OF STUDY

The study was conducted on a relatively small sample size in one out of 9 departments of a reference laboratory. We recommend larger scale studies to be carried out in future.

CONCLUSION

The three interventions including training, display of posters and spot checks resulted in a statistically significant improvement in the awareness and marked improvement in practices of most of the laboratory staff regarding implementation of waste management SOP. Therefore these interventions may be implemented in any healthcare set up for ensuring improved compliance to the waste management policy.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

JQ & MMG: Data acquisition, data analysis, critical review, approval of the final version to be published.

IAM & MOR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SHN & RS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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