ORIGINAL ARTICLE

# Effect of training on awareness of Biomedical Waste Management among nursing staff at a tertiary health care facility of Uttar Pradesh: An interventional study

**Divyata Sachan[1], Gagan Garg[2], Bhavna Jain[3]**

[1]Department of Community Medicine, Amar Shaheed Jodha Singh Atayiya Thakur Dariyao Singh Medical College, Fatehpur, Uttar Pradesh

[2,3]Department of Community Medicine, Shaikh-Ul-Hind Maulana Mahmood Hasan Medical College, Saharanpur, Uttar Pradesh

**CORRESPONDING AUTHOR**

Dr Bhavna Jain, Assistant Professor, Department of Community Medicine, Shaikh-Ul-Hind Maulana Mahmood Hasan Medical College, Ambala Road Saharanpur, Uttar Pradesh 247232

Email: drbhavnajain@yahoo.co.in

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## ABSTRACT

**Background:** Effective Biomedical waste management reduces the risks to healthcare workers, patients, and the community while promoting sustainability. As healthcare services expand, addressing biomedical waste challenges remains vital for a healthier future. **Aim & objectives:** To educate the staff nurses on the latest developments on Biomedical waste management and thereby evaluating the effectiveness of the training session. **Methodology:** A quasi- experimental study was conducted among 119 staff nurses for four sessions on four consecutive days. Data was collected on a structured questionnaire to assess awareness of staff nurses regarding BMW management. After pre-intervention data collection the study participants were trained on BMW management and then posttest was done. **Results:** The study showed majority of the participants had an average knowledge in terms of BMW management. A significant improvement was observed in the knowledge after the intervention. Discussions made regarding the problems faced during BMW segregation helped in finding a solution which was reflected in the practices of the staff nurses. **Conclusion:** Implementing guidelines for regular training session on BMW management can help in adherence to the BMW rules and regulation. Timely availability of the BMW consumables will help in the practical application of the knowledge which will assure the ideal practices for BMW management.

## KEYWORDS

Health Personnel; Waste Management; Delivery of Health Care

## INTRODUCTION

Biomedical Waste Management rules were first implemented in India in 1998 and have been continuously revised, with the latest amendment dating to 2018. It has been a quarter- century and yet 54% of the tertiary health care facilities in India do not have a credible BMW management system. It has been estimated that every year, more than 5.2 million people die due to diseases caused by medical waste (1,2,3). Needle prick injuries caused due to improper disposal of syringes lead to deadly diseases like HIV, Hepatitis B and C. Improper disposal of healthcare waste not only contaminates the ground and surface water but also the atmosphere. Development of antibiotic resistance due to improper medical waste management has emerged as one of the deadliest consequences of lack of adherence to BMW rules & regulations (4).

The literature suggests strong association between good knowledge and adherence to standard guidelines for BMW management yet the healthcare staff who handles the medical waste are

unaware of the waste management protocols (5,6). The BMW guidelines necessitates to conduct annual training sessions for BMW handling as the studies have revealed that repeated training of the hospital staff plays a crucial role in the improvement of knowledge and awareness (7,8,9). Therefore, the present study was aimed to-

- Evaluate the effectiveness of the training session regarding BMW management among staff nurses posted
- Observe the activities pertaining to BMW management which were being carried out at the health facility before and after the training session.

## MATERIAL & METHODS

**Study type and design:** A quasi- experimental study was conducted using pretest- posttest design and educational interventional.

**Study setting:** The study was conducted in a tertiary health care center of District Saharanpur, Uttar Pradesh

**Study population:** All the nursing staff including nurse-in-charge, officiating nurse-in-charge and staff nurse posted at the tertiary health care

***Study duration:*** Study was conducted from May 2022 to June 2022

***Sample size:*** All the nursing staff working in tertiary health care center were included following inclusion and exclusion criteria. According to the records a total of 187 nursing were eligible for the study. Out of these 68 workers who were not included, on enquiring it was found that 17 participants were on leave during that period, 23 were posted in night shift so they did not turn up for the morning training sessions, 12 gave incomplete information and left in between training while the reason for the remaining 16 participants was unknown.

***Inclusion criteria:*** All nursing staff both male and female working in all the shifts

***Exclusion criteria:*** All those who did not give consent to participate in the study

***Sampling technique:*** Convenience sampling technique

***Strategy for data collection:*** A list of all the nursing staff posted at the health facility was obtained by the Chief Medical Superintendent's (CMS) office. As per the list, 187 nursing staff were posted in the health facility at different posts including nurse-in-charge, officiating nurse-in-charge and staff nurse in different departments. A schedule was made and authorized by the principal for four days containing list of 45- 47 participants for each day. If any participant was unable to attend the training on the day he/she was posted due to their working hours, the participants were provided with the option for attending the training on other days. On each of the four days, after a formal introduction and sensitization regarding the topic, the pretest questionnaire was administered to the participants for twenty minutes. After collection of the questionnaires, the intervention was delivered which was followed by discussion and clarification of any doubts of the participants. The participants were asked for any suggestions to improve the management and handling of BMW at the facility. Once the session was complete, the posttest questionnaire was administered for twenty minutes to the participants. To observe the activities pertaining to BMW visits were made to the Out- Patient Department (OPD), immunization center, labour room, In Patient Department (IPD), pathology, emergency and Operation Theater (OT). These sites were chosen as their contribution to the BMW generated was significant. The activities were observed one week before and one week after the intervention. For OPD and IPD, random selection was done to choose the department. The OPD was observed for the surgery department while IPD was observed for medicine department. The person in-charge of the handling of BMW for the facility was contacted to gain access to the records and registers. Visit was made to the place of location of interim shade in order to entry the data regarding the same.

***Study tool:*** The study tool consisted of two parts: one for the assessment of knowledge of participants second for observation of the activities related to BMW at the facility. The study tool was prepared based on the guidelines of Bio- Medical Waste Management, as per BMWM Rules, 2016 and the latest amendment of 2018 (10). The study tool for the participants consisted of 24 questions and it was structured with two sections: socio-demographic parameters and knowledge on BMW management The questionnaire was prepared in English language and then it was translated into Hindi. In order to ensure that both the questionnaires were conceptually equivalent, forward translation and back translation were done. The knowledge of the participants was classified as poor (0%-50%), average (51%-75%) and good (>75%) based on the score percentage calculated using the answers to the 18 questions for knowledge of BMW during pretest.

To observe the activities related to BMW at the facility, the questionnaire had three sections: first section was used to assess the availability of BMW components at the seven sites. Second section was used to assess the availability and completeness of

records and registers while third was used to observe the completeness of interim shade.

Pilot study was conducted by administering the questionnaire to 10 participants- four post-graduate students of Community Medicine and six faculty of the Department of Community Medicine. A mean time of completion of questionnaire was calculated which came out to be twenty minutes. The sample data collected from the pilot study was not included in the final data sheet. Minor correction were made in terms of language as per the suggestions made during pilot study.

***Intervention:*** The educational intervention was in the form of research lecture which was delivered with the help of a PowerPoint presentation. The contents of the presentation were discussed by faculty members of the Department of Community before finalizing it. The final contents of the presentation were: history of BMW management rules, guidelines of BMW management as per the latest guidelines, type of BMW and the procedures of handling the BMW at different stages. Case scenarios were provided and hand on training was also given pertaining to the topic. The intervention was performed by three faculty members of the Department of Community Medicine, who were provided with the presentation a week prior to the beginning of the study.

***Data analysis:*** The data collected was checked for completeness and quality, then was entered in Microsoft Excel. Then it was analyzed using Statistical Package for Social Sciences (SPSS) version 24.0, IBM Inc. Chicago, USA software. The socio-demographic parameters were represented in form of proportions for categorical data and mean with standard deviation for continuous data. McNemar's test was used to determine if there was any difference in knowledge between the pretest and post-test groups. The knowledge of participants for each of the questions was represented in form of both proportion and mean ± standard deviation. Normality of the data was evaluated using skewness. If skewness was less than -1 and greater than 1, the distribution was considered to be highly skewed and non-parametric tests were used. The difference among the pre & post score was calculated using paired t test (mean difference) if the data was normally distributed and Wilcoxon Matched Pair test (median difference) if the data was skewed. Paired T test statistics was represented as "T" while Wilcoxon signed ranks tests was represented using "Z". A p values of <0.005 was considered as statistically significant. All other data were presented in form of percentage or mean ± standard deviation depending on the type of data.

***Ethical consideration:*** The study protocol was approved by the Institutional Ethics Committee of SMMH Medical College (IEC-22: 22.2.2022) where the study was conducted.

## RESULTS

A total of 119 people took part in the study among which majority were female (95.8%) and belonged to the age group of 31- 40 years (47.9%) (Table 1). Around 50% of the participants were graduate and 81.5% of them were posted at permanent position in the tertiary care facility. The results revealed that 16.8% of the participants had attended a training session pertaining to BMW management prior to this study.

**Table 1: Socio- demographic characteristics of the study participants (N=119)**

| Socio- demographic characters | | Frequency (%) |
|---|---|---|
| **Age (in completed years)** | 18- 30 | 36 (30.3) |
| | 31- 40 | 57 (47.9) |
| | 41- 50 | 25 (21.0) |
| | >50 | 1 (0.8) |
| **Gender** | Male | 5 (4.2) |
| | Female | 114 (95.8) |
| **Education** | Intermediate | 32 (26.9) |
| | Graduate | 61 (51.3) |
| | Post graduate | 26 (21.8) |
| **Caste** | Schedule Caste/ Tribe | 27 (22.7) |
| | Other Backward Class | 41(34.5) |
| | General | 51 (42.9) |
| **Religion** | Hindu | 96 (80.7) |
| | Muslim | 11 (9.2) |
| | Sikh | 2 (1.7) |
| | Christian | 10 (8.4) |
| **Type of employment** | Permanent | 97 (81.5) |
| | Contractual | 22 (18.5) |

The knowledge assessed through pretesting stated that 63% of the participants had an average knowledge about BMW rules while 18.5% each had poor and good knowledge. The training had a significant impact on the knowledge of the participants in terms of BMW management (Z=-6.963, p<0.01) as there was significant improvement in the mean score of post- test (14.601 ± 2.357) when compared with mean pre-test scores (9.661 ± 2.291). The mean pre-test score of the participants who had attended any prior training related to BMW management (16.8%) was 12.285 ± 2.556 while it was 11.900 ± 2.633 for the participants who did not attend any training (83.2%). There was no significant difference in the knowledge of both the group of participants during pre- test (t=0.612, p=0.944) thereby eliminating selection bias. Out of 18 questions, knowledge was significantly improved for nine of the questions related to BMW management (Table 2).

**Table 2: Impact of training on awareness of study participants regarding BMW Management (N=119)**

| Bio Medical Waste Management knowledge | Pre- test N=119 | Post-test N=119 | P* | Pre- test mean | Post-test mean | Z | P** |
|---|---|---|---|---|---|---|---|
| Guidelines by government of India for BMW management | 119(100.0) | 119(100.0) | 1.000 | 1 | 0.99 | 1.0 | 0.317 |
| Type of waste is generated by heath facility | 106(89.1) | 102(85.7) | 0.388 | 0.89 | 0.86 | 1.1 | 0.248 |
| Number of categories of BMW per BMW 2016 | 104(87.4) | 105(88.2) | 1.000 | 0.87 | 0.88 | 0.2 | 0.827 |
| Bin for soiled waste | 93(78.2) | 111(93.3) | <0.01 | 0.78 | 0.93 | 3.4 | <0.01 |
| Bin for expired or discarded medicines | 46(38.7) | 105(88.2) | <0.01 | 0.3 | 0.88 | 7.6 | <0.01 |
| Bin for microbiology, & clinical lab waste | 53(44.5) | 96(80.7) | <0.01 | 0.45 | 0.81 | 6.1 | <0.01 |
| Bin for contaminated (Recyclable) waste | 64(53.8) | 88(73.9) | <0.01 | 0.54 | 0.74 | 3.5 | <0.01 |
| Bins for metallic (waste sharps) waste | 91(76.5) | 100(84.0) | 0.150 | 0.76 | 0.84 | 1.6 | 0.106 |
| Bins for glass waste (intact & broken) | 83(69.7) | 103(86.6) | <0.01 | 0.7 | 0.87 | 3.3 | <0.01 |
| Type of plastic bags used for waste collection | 59(49.6) | 72(61.3) | 0.060 | 0.5 | 0.61 | 2.0 | <0.05 |
| How full are the bags when they are replaced | 73(61.3) | 101(84.9) | <0.01 | 0.61 | 0.85 | 4.1 | <0.01 |
| Where should the plastic bags be tied | 83(69.7) | 92(77.3) | 0.150 | 0.7 | 0.77 | 1.6 | 0.106 |
| What is the timing for collection of BMW | 36(30.3) | 27(22.7) | 0.243 | 0.3 | 0.23 | 1.3 | 0.189 |
| Is biomedical waste and general waste collected in same trolley | 65(54.6) | 72(60.5) | 0.349 | 0.55 | 0.61 | 1.1 | 0.274 |
| Symbol of bio- hazard | 101(84.9) | 105(88.2) | 0.541 | 0.85 | 0.88 | 0.8 | 0.414 |
| Which waste category is pre- treated with 10% chlorine | 48(40.3) | 77(64.7) | <0.01 | 0.4 | 0.65 | 4.0 | <0.01 |
| For how long can be BMW stored in a health facility | 11(9.2) | 33(27.7) | <0.01 | 0.09 | 0.28 | 4.2 | <0.01 |
| When is BMW segregated | 101(84.9) | 112(94.1) | <0.05 | 0.85 | 0.94 | 2.3 | <0.05 |

Among the required records and registers related to BMW, only few were available out of which one was not updated (Table 3). Although an interim shade for collection of BMW was available at the health facility but it did not full fill the criteria as per BMW rules and regulations. On inspection, Operation theatre fulfilled all the requirement in terms of BMW management whereas, immunization centre and IPD had poor availability of BMW items (Table 4). Improvement was observed after the training session in terms of availability of BMW management consumables, however it did not level as per the requirements due to the unavailability of the items in the stock. (Figure 1)

Figure 2 showed out of 119 study participants 89% were vaccinated for Hepatitis B, 94% for COVID vaccine and 68% for Tetanus vaccine.

**Table 3: Availability of items related to BMW management**

| BMW management items | Response |
|---|---|
| **Nodal officer-in-charge of biomedical waste management** | Available |
| **Biomedical waste management committee and team** | Available |
| **Training conducted by Biomedical waste management committee** | Not performed |
| **Safe and secured location for storage of segregated biomedical waste** | Available |
| **Separate enclosure for each bag colour** | Available |
| **Enclosure locked at the time of inspection** | No |
| **Provision of water supply near to the central waste storage** | Absent |
| **Enclosure locked at the time of inspection** | No |
| **Exhaust fan in the BMW interim collection shed** | Absent |
| **Provision of water supply near to the central waste storage** | Absent |
| **Biomedical waste collection records** | Available |
| **BMW generation station monthly scoring records** | Available |
| **Healthcare facility level training record** | Not available |
| **Annual Report** | Available and updated |
| **Consumables supply records** | Available but not updated |
| **Biomedical waste storage shed cleaning record** | Not available |
| **Reporting of Major Accidents and Remedial Action Taken** | Not performed |

**Table 4: Availability of BMW items in the hospital at selected locations before and after the training**

| BMW items | OPD | | Immunization centre | | Labour room | | IPD | | Pathology | | Emergency | | OT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| **Yellow bin** | ✓ | ✓ | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Yellow plastic bag on bin** | X | X | N/A | N/A | X | X | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Yellow bin containing infected waste** | X | ✓ | N/A | N/A | X | ✓ | X | X | X | X | X | X | ✓ | ✓ |
| **Red bin** | X | X | ✓ | ✓ | ✓ | ✓ | X | X | X | X | ✓ | ✓ | ✓ | ✓ |
| **Red plastic bag on bin** | N/A | N/A | ✓ | ✓ | ✓ | ✓ | N/A | N/A | N/A | N/A | ✓ | ✓ | ✓ | ✓ |
| **Red bin containing recyclable waste** | N/A | N/A | X | ✓ | X | ✓ | N/A | N/A | N/A | N/A | ✓ | ✓ | ✓ | ✓ |
| **Blue container** | ✓ | ✓ | X | ✓ | X | ✓ | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Blue container containing sharp glass waste** | X | X | N/A | ✓ | N/A | ✓ | N/A | ✓ | X | ✓ | ✓ | ✓ | ✓ | ✓ |
| **White translucent container** | X | ✓ | X | ✓ | ✓ | ✓ | X | ✓ | X | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Metallic sharp waste in white container** | N/A | ✓ | N/A | ✓ | ✓ | ✓ | N/A | ✓ | N/A | ✓ | ✓ | ✓ | ✓ | ✓ |
| **All containers kept together** | ✓ | ✓ | X | X | X | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Hub cutter** | ✓ | ✓ | ✓ | ✓ | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Posters indicating BMW segregation** | ✓ | ✓ | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

*OPD- Out Patient Department, IPD- In Patient Department, OT- Operation Theatre*

**Figure 1: -Availability of BMW items at all seven sites pre and post intervention**

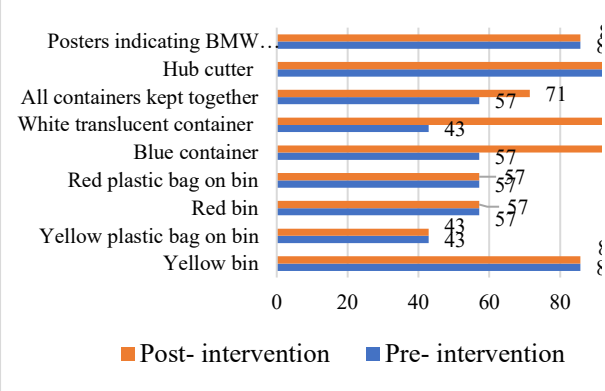
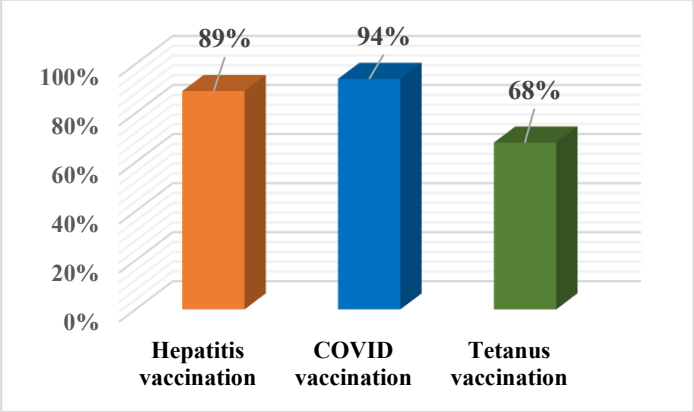



**Fig 2: Vaccination status of Study participants**




## DISCUSSION

For prevention of hospital borne infections along with the protection of environment and public health from health hazards caused by hospital waste, an appropriate BMW management guideline is absolutely essential. Recognizing the importance, Government of India laid down set of rules and regulation for BMW management in 1998 which were further modified in year 2003, 2016 and 2018. All medical, paramedical, and health-care professionals must fully understand BMW (M and H) rules, 2016 and the amendment made by the government from time to time. Implementation of guidelines along with close monitoring of its compliance is important in achieving the ultimate goals so is the social science approach which includes education motivation and change in mindset of all the health workers (11).

Numerous studies have examined the effectiveness of training programs aimed at improving the biological waste management skills of healthcare workers (12, 13). The study was conducted on Nursing Staff because they are the primary staff responsible for delivering medical care and are therefore major producers of biological waste. This section examines the findings of these studies and their implications for understanding the impact of training on healthcare professionals' awareness on BMW management.

Research revealed that the sociodemographic characteristics of the study participants were comparable to those of studies carried out in Bengaluru by Shivashankarappa et al (14). The majority of participants in the study received vaccinations against hepatitis B (89%), COVID-19 (94%), and tetanus (68%). Almost similar findings were observed by Shivashankarappa et al in Bengaluru (14).

It is essential that nurses comprehend colour coding since biomedical waste handlers sorted waste at the point of generation into specific colour containers. Among study participants in the present study 38%-78% had knowledge of colour coded bags which later enhanced with knowledge. Shivashankarappa et al in Bengaluru (14) showed that 93 % had sufficient colour coding expertise, which they later enhanced with instruction. Also, Similar results shown by Shaheen et al (15) and Imchen et al (16). This shows that training is a useful strategy that can raise awareness about the colour coding of biomedical waste.

Based on the pre- test findings, it was observed that only 18.5% of the participants had poor knowledge of BMW management guidelines. The findings were similar to the results of study conducted by Dalui A et al. where 18.2% of the healthcare workers had poor knowledge (17). The present study showed a remarkable improvement in the knowledge of participants. The post- test scores were considerably improved after the training session. In a similar vein, research by Hameed W et al (13), Gaikwad et al (18) and Rohilla R et al (19) revealed a substantial (P = 0.000) difference in practise and knowledge between pre- and post-knowledge.

Based on the observations made at seven sites in the medical college, there was a shortage of bins and bags except for hub cutter which was available at all the sites. Posters indicating segregation of BMW were displayed at 86% of the sites. Similar shortage was reported in other studies like that of Shrestha D et al. where yellow bags were available at 12.5% of the sites (20). A similar study conducted by Singh A et al., only 10% of the study sites had all four colour coded bags at the right place (21). They also observed shortage of yellow and red bags. At our facility 86% of the sites had displayed the BMW posters for wastage segregation. This observation was much higher when compared to results from study conducted by Verma L et al. where only 12.5%- 33.4% of the health care facilities were displaying BMW posters (22).

No significant improvement was observed in terms of availability of BMW items except for substitutes of blue and white containers which were made available as the same was discussed during the intervention.

The practises of the participants improved post intervention as on observation the BMW bins contained the waste which belonged to those coloured bins. This result was expected as other studies like Uddin MN et al. and Jyoti et al. depicted similar results stating that educational interventional helps in refining knowledge and enhancement in practices (23,24). Knowledge of BMW management is of equal importance to all the healthcare workers and not only to the staff nurses. Hence, the same study should be conducted for all the healthcare staff including the residents and interns.

The strength of the study was that the questionnaire and training was given in English and Hindi language both which was understandable for all.

## CONCLUSION

A well trained and motivated staff can provide greater level of protection for the fellow staff members, patients and the community. The knowledge and practices of healthcare workers in terms of BMW management and handling can have a serious impact on public health therefore time to time training sessions should be organized to improve and update the knowledge of healthcare staff. This also gives an opportunity to get feedback on the practical problems faced during real-time situations and discuss a solution for the same.

## RECOMMENDATION

Based on the results it will be prudent to organize educational intervention at regular intervals for all the levels of healthcare staff as the same is also required to be done per the BMW rules and regulations. The administration should ensure the availability of the BMW items as there availability will ensure a smooth working of the system for hospital waste handling and it also gives an opportunity to apply the knowledge of healthcare staff in practical. All the gaps which were observed as a result of this study was brought under the notice of the hospital administration for further action.

**Impact of training:** The present study had a great impact as the college authorities made it compulsory to have such kind of training sessions every year for all health care workers. Those 68-nursing staff who didn't attend training session, for them another 2-day plan has been made to train them. The Nodal officer-in-charge of BMW management was enquired and instructed to ensure the availability of BMW consumables regularly.

## LIMITATION OF THE STUDY

The Limitation of the study was that out of 187 nursing staff only 119 were trained for BMW management. Awareness was assessed only through the self-structured questionnaire.

## RELEVANCE OF THE STUDY

Because of the high case load, the healthcare staff is busy performing their duties. It is important that

the institutional authorities organize training and hands on sessions as the knowledge is directly proportional to the adherence to guideline protocols. Regular physical assessment of the premises is also important as it reflects the reality and the gaps can be assessed which thereby aid in improving the situation.

## AUTHORS CONTRIBUTION

All authors have contributed equally.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Nil


## CONFLICT OF INTEREST

There is not conflict of interest.


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## DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/AI assisted technologies in the writing process.

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