Original Research Article

AN INSIGHT INTO AWARENESS AND PRACTICE OF BIOMEDICAL WASTE MANAGEMENT AMONG HEALTH CARE PROVIDERS AT A TERTIARY CARE CENTRE

Chinthamani N Sowmya[1], Geetanjali T[2], Nagasrilatha Bathala[3], Khaja Mohiddin Shaik[1], Srilakshmi Venna[4], Sukumar Y[5]

[1]*Assistant Professor, Department of Microbiology, Government Medical College, Kadapa, Andhra Pradesh, India.*
[2]*Associate Professor, Department of Microbiology, Government Medical College, Kadapa, Andhra Pradesh, India.*
[3]*Professor & Head, Department of Microbiology, Government Medical College, Kadapa, Andhra Pradesh, India.*
[4]*Tutor, Department of Microbiology, Government Medical College, Kadapa, Andhra Pradesh, India.*
[5]*Post Graduate, Department of Microbiology, Government Medical College, Kadapa, Andhra Pradesh, India.*

ABSTRACT

Background: The Biomedical waste management rules, 2016(amended 2018) by Government of India mandates the proper segregation, disposal as per color coded method and safe handling practices. Despite these strict regulations there has been an inconsistent compliance to these practices across tertiary care centers contributed by factors like insufficient training, lack of supervision and high work load etc. **Aim:** To assess the awareness and practice of biomedical waste (BMW) management among healthcare providers at a tertiary care centre.
Materials and Methods: A cross-sectional observational study was conducted over six months among 200 healthcare providers, including nurses, interns and postgraduates. Knowledge was assessed using a structured questionnaire containing 12 questions covering essential BMW guidelines, whereas actual practices were evaluated using an observational checklist across various clinical and diagnostic departments.
Results: Overall awareness regarding BMW regulations was (95%), and all participants had heard about BMW guidelines. Knowledge regarding colour coding (96%), disposal of sharps l (96%), and risk of transmission of infection from waste was (97%); however, gaps existed in identifying the biohazard symbol (80.5%) and disposal of waste within 48-hour (72%). Interns and postgraduates demonstrated higher knowledge than nurses. Department-wise practice assessment showed substantial variability across all color-coded bins. Blood bank and laboratory departments exhibited consistently high compliance, while high-workload areas such as casualty, medicine, surgery, and pulmonary medicine demonstrated fluctuating adherence. An improvement in compliance was observed following training in July, followed by a gradual decline in subsequent months, indicating reduced retention of training impact.
Conclusion: This study highlights that although Health care providers demonstrated a basic level of awareness regarding biomedical waste management guidelines variability in adherence emphasizes on the need for more structured and continuous training approach. Strengthening interdepartmental coordination along with regular capacity building measures is essential to ensure a safe environment for both patients as well as health care workers.
Keywords: Biomedical waste, awareness, healthcare providers, infection control practices, compliance.

INTRODUCTION

Biomedical waste refers to any waste generated during the diagnosis, treatment or immunization of humans or animals or in related research activities.[1] Improper handling of this waste poses a risk of transmitting infections as well as cause long term damage to the environment.[2]

The Biomedical waste management rules,2016(amended 2018) by Government of India mandates the proper segregation, disposal as per color coded method and safe handling practices.[1] Despite these strict regulations there has been an inconsistent compliance to these practices across health care facilities.[3,4] At the root level the health care providers like nurses,doctors,interns,and postgraduate trainees are directly responsible for handling and disposal of biomedical waste as they are often the first point of contact in patient care and therefore play an important role in maintaining infection control standards.[5] However, in tertiary care centers with high volume of patient load there will be a discrepancy in implementation of the prescribed BMW protocols contributed by factors like insufficient training, lack of supervision and high work load etc.[6]

In the context of increasing public health challenges, antibiotic resistance, and the risk of hospital-acquired infections, strengthening biomedical waste management is not just a regulatory requirement—it is a fundamental component of quality healthcare delivery.[7,8]

The present study was undertaken to assess the awareness and practices related to biomedical waste (BMW) management among healthcare providers at a tertiary care centre. The study specifically evaluated the level of knowledge regarding biomedical waste management rules and guidelines and assessed adherence to recommended BMW handling and disposal practices across different clinical and diagnostic departments. In addition, the study aimed to identify gaps between knowledge and actual practices related to BMW handling, determine the need for targeted training programs for various categories of healthcare providers, and formulate recommendations to improve biomedical waste management compliance and strengthen overall infection control within the healthcare facility.

MATERIALS AND METHODS

This was an observational cross sectional study conducted to assess the awareness and practices related to biomedical waste across various departments including clinical as well as diagnostic departments at a tertiary care center, Andhra Pradesh for a duration of 6 months i.e. from July to December 2024.Data regarding the awareness of health care providers towards the biomedical waste management guidelines was collected using a structured questionnaire covering the key aspects of biomedical waste management guidelines, color coding, time of disposal etc, and the responses were recorded as yes or no. An observational checklist comprising of color-coded disposal, use of PPE, adherence to disinfection practices was used to evaluate the practices of biomedical waste across various departments.

RESULTS

A total of 200 health care providers categorized as nurses (34%),interns(44%)and post graduates (22%) participated in this study. The questionnaire to assess the knowledge comprised of 12 questions related to the key concepts of biomedical waste management.

Knowledge regarding Biomedical waste management:

All participants n=200 have heard about Biomedical waste management rules, and majority of health care providers across all categories are aware of the biomedical waste management regulations.

All the interns (100%) followed by post graduates (95%) knew different categories of biomedical waste. Overall (80%) correctly identified biohazard symbol with highest by postgraduates (95%) followed by interns (83%) and nurses (68%). All the interns had knowledge regarding the color- coding system for disposal of biomedical waste, but only 95% of post graduates and only 91% of nurses have knowledge. Overall 96%of the health care providers identified correct container for disposal of sharps, 97% were aware of the transmission risks associated with improper handling of biomedical waste and 93.5% of the participants had knowledge that BMW should be disinfected before disposal. Only 72% knew that BMW should be disposed within 48 hrs. All the postgraduates (100%) followed by interns (98%) acknowledged the necessity for PPE while handling BMW, but its only 84% among nurses. Almost all the participants (96%) knew the disposal methods regarding biomedical waste.

Table 1: Knowledge on Biomedical Waste Management Among Healthcare Providers

Question	Nurses Yes (n,%)	Interns Yes (n,%)	PGs Yes (n,%)	Total Yes (n,%)
Have you heard about BMW	68 (100%)	88 (100%)	44 (100%)	200 (100%)
Are you aware of BMW management regulations	62 (91%)	86 (98%)	42 (95%)	190 (95%)
Do you know different categories of BMW	62 (91%)	88 (100%)	42 (95%)	192 (96%)
Do you know the biohazard symbol	46 (68%)	73 (83%)	42 (95%)	161 (80.5%)

Do you know the colour coding of BMW	62 (91%)	88 (100%)	42(95%)	192 (96%)
Correct container for disposal of sharps	64 (94%)	84 (95%)	44 (100%)	192 (96%)
Can HIV, HBsAg, HCV transmit via BMW	62 (91%)	88 (100%)	44 (100%)	194 (97%)
BMW should be disinfected before disposal	57 (84%)	88 (100%)	42 (95%)	187 (93.5%)
BMW should be disposed within 48 hours	42 (62%)	66 (75%)	36 (81%)	144 (72%)
PPE necessary while handling BMW	57 (84%)	86 (98%)	44 (100%)	187 (93.5%)
Do you know BMW disposal methods	62 (91%)	86 (98%)	44 (100%)	192 (96%)

BIOMEDICAL WASTE MANAGEMENT PRACTICES:

Green Bin: The mean compliance across all the departments ranges from 60-80% with blood bank showing highest compliance of 100% in December, ENT maintained moderate adherence rate of 72%, pulmonary medicine demonstrated lower mean of approximately 65%,ICU showed stable adherence(70-76%),Pediatrics showed highest in July(83%),Gynecology also showed stable compliance rate(65-75%)Causality and surgery ,ART showed good compliance initially but a decline is noted towards December. Investigative departments and orthopedics showed good compliance range (67-83%) Injection room showed adherence of (50-84%) with best during October (84%).
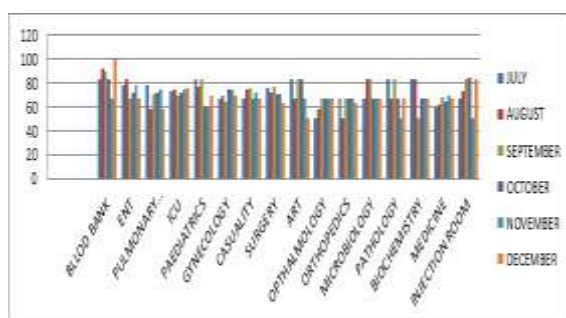

Figure 1: Bar diagram representing the BMW practices of green BIN

Yellow bin: Overall mean compliance ranged between 65-85 % with blood bank being the highest (100%).ENT, surgery, pulmonary medicine showed moderate compliance range (67-89%).ICU had consistent compliance (63-72%).Casuality, ART showed fluctuating compliance trends. Opthalmology and investigative departments maintained moderate compliance range. Medicine showed consistent compliance range.
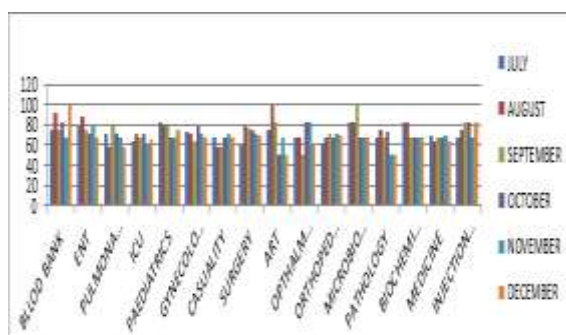

Figure 2: Bar Diagram Representing the BMW practices of yellow Bin

Red bin: The mean compliance across all departments ranged from 68-82% with blood bank being the highest. ENT, Surgery and Gynecology maintained moderate compliance range (72-75%).Pulmonary medicine and ICU showed consistent compliance range. Opthalmology and causality showed moderate compliance. Investigative departments also showed moderate to good compliance.
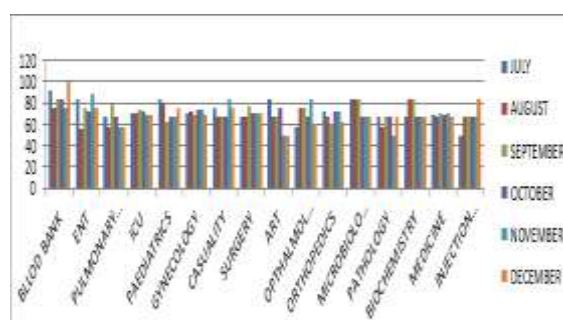

Figure 3: Bar diagram representing the BMW practices of red bin

Blue bin:
The overall compliance ranged between 70-88%, with blood bank showing excellent compliance.ICU, Paediatrics and Gynaecology maintained high compliance. Pulmonary medicine and ART showed high compliance in august which declined later. Orthopaedics, Microbiology, medicine maintained stable adherence rate. Injection room showed progressive improvement in compliance (67–83%) with best performance in November and December (83%).
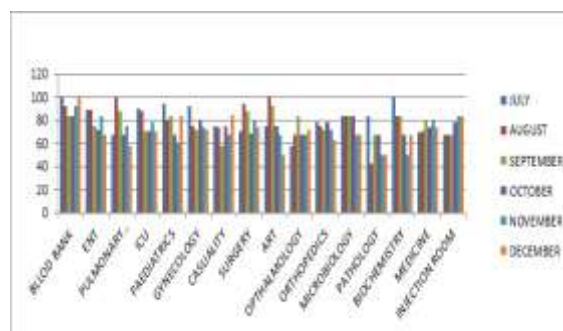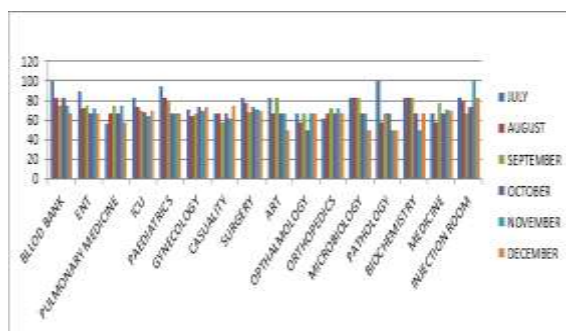

Figure 4: Bar diagram representing the BMW practices of blue bin

White bin:
The mean compliance ranged rom 65-85%. Blood bank and injection room showed excellent adherence rate. Paediatrics and surgery showed good

compliance. ENT and Gynaecology showed moderate compliance rate. Pathology department showed variable performance (50–100%) with highest compliance in July (100%).

Figure 5: Bar diagram representing the BMW practices of white puncture proof container

DISCUSSION

Biomedical waste management is a critical component of infection prevention and environmental safety in hospital setting. The present study explored about two components of Biomedical waste management, one is knowledge and other one is actual practices across various departments for a period of six months revealing significant insights into strengths and knowledge gaps in the current practice system. The findings of the present study revealed that although there was a satisfactory level of awareness regarding Biomedical waste management rules and guidelines among health care providers, in actual practice varied trends across different departments and waste categories exists.

All the participants in this study had heard about BMW rules and majority were aware of the regulations and color coding system, indicating that universal basic awareness about biomedical waste management rules among the health care providers. This findings were similar to studies Mathur et al. and Sharma et al. where awareness among healthcare personnel regarding BMW guidelines were high.[5,6] Only 80.5% knew about Biohazard symbol which is fundamental indicator, alarming significant risk in the frontline health care providers.[5] 96% of participants knew about the color coding system and 97% of the participants were aware that improper handling of biomedical waste can transmit infections like HIV, HBV, HCV remaining 3% were unaware indicating a serious threat to occupational safety and patient protection. Only 72% were aware that biomedical waste should be disposed within 48 hrs and 93.5% considered the use of PPE while handling biomedical waste, this may compromise personal safety.[6] Singh et al study also showed that health care workers lacked clarity on important aspects like symbol identification and time bound disposal of waste.[7] Among the participants interns and postgraduates possesses higher knowledge when compared to nurses, highlighting the influence of education level on awareness. These findings were

consistent with Ranjan et al. which reported that nurses exhibited lower level of knowledge compared to trained medical graduates.[3] Interns due to recent academic exposure showed high correct responses, post graduates also performed well, but nurses while experienced showed most variability, this may be due to lack of regular training to refresh their knowledge. This reinforces the need for regular refresher programs for nursing personnel being the ones who handle the BMW at the highest frequency.

An in depth department wise observational analysis revealed that although satisfactory level of knowledge exists there is a variability in adherence to BMW practices. This is similar to other studies done at tertiary care centres like Sahoo et al, Krishnamurthy et al, Pravin raj et al. although knowledge level is high compliance is lagging behinds.[9,10,11] Blood bank and investigative departments like microbiology consistently showed high adherence, whereas clinical departments showed low compliance towards the end of study period. This suggests that although knowledge exists its translation into daily practice is inconsistent. Departments with heavy patient load such as casuality, medicine, surgery showed varied compliance trends. Similar observations were reported from studies like Sharma et al. and Patil and Shekdar where clinical departments showed reduced compliance due to increased workload.[2,6] This indicates the challenge of maintaining constant adherence under high workload conditions. Dhole KS et al. study explored the barriers to BMW compliance like workload and monitoring deficits.[13] There is an increased adherence across all color categories in the month of August. This is likely due to training and induction programs conducted in the month of july. Post august there was a steady decline in most of the categories, with the lowest scores in the month of November. This suggests that the behavioral reinforcement from training programs diminishes over time. This finding is similar to studies by Patil et al and Ranjan et al, Shivasankarappa et al. who also reported that practice levels significantly improved following training and gradually declined later.[2,3,12]

Limitations: Despite the strengths of this study, certain limitations should be acknowledged. Being a single-centre study, the findings may have limited generalizability to other healthcare settings. Knowledge assessment was based on self-reported responses and may therefore be influenced by response bias. Furthermore, the six-month study duration may not adequately capture long-term trends in biomedical waste management practices or the sustained impact of training interventions.

CONCLUSION

This study achieved its aim of assessing awareness and practices related to biomedical waste management among healthcare providers at a tertiary care centre. Overall knowledge regarding biomedical

waste management rules and guidelines was satisfactory across all categories of healthcare providers; however, adherence to recommended handling and disposal practices varied across clinical and diagnostic departments. Notable gaps were identified between knowledge and actual practices, particularly in high-workload areas, indicating that awareness alone does not ensure compliance. The temporary improvement in practices following training, followed by a subsequent decline, highlights the need for targeted and periodic training programs. Strengthening institutional policies, continuous monitoring, and focused capacity-building measures are essential to improve compliance with biomedical waste management protocols and enhance overall infection control within the healthcare facility.

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