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RESEARCH ARTICLE

COVID 19 PANDEMIC: ASSESSMENT OF KNOWLEDGE AND ATTITUDES IN BIOMEDICAL WASTE MANAGEMENT AMONG HEALTH CARE PROFESSIONALS IN TAMIL NADU

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ABSTRACT

Coronavirus, which was started provincially at Wuhan of China, has become a worldwide pandemic by affecting individuals of almost all the world. The developing pandemic of COVID-19 disease requires social distancing and individual cleanliness measures to secure general wellbeing. The aim of the present study is to evaluate the knowledge, attitude, practice and awareness of biomedical waste management in this pandemic situation among healthcare workers and medical students across Tamil Nadu.

A cross sectional questionnaire survey was prepared to evaluate the knowledge regarding waste management and waste handling techniques. The survey found that most of the hospitals (50%) are using plastic containers for waste collection. Almost 79.7% of the respondents said they follow colour coding while disposing waste. When asked about exact category only few gave correct answers. Nearly 72.8% answered that they collect the Covid patient's wastes separately. As coronavirus is a contagious disease, each healthcare worker should be trained in safe handling of wastes. From this survey, it is clear that training about safe handling of waste is needed among workers. This survey will help government and healthcare providers to handle this Covid pandemic successfully and more effectively.

KEYWORDS

Biomedical, Waste Management, awareness, health hazards, COVID 19, Pandemic management

INTRODUCTION

The data from Central Pollution Control Board (CPCB), India indicates 28,468.85 tonnes of bio-medical waste during COVID-19 for the last six months between June to November.[1] India is the second most populous country in the world after China. [2-3] Biomedical Waste is the waste produced during diagnosis, treatment or immunization of human or animal research activities. The waste management framework consists of characterisation, quantification, separation, storage, transfer and treatment methods. India has a strict rule on onsite segregation of biomedical waste for storing, transporting and disposing as essential standards of good biomedical waste management. This practice depends on the idea of 3R's

reduce, recycle and reuse. The best Biomedical Waste Management aims at avoiding the generation of waste or recovering as much as possible rather than disposing.[4] A huge amount of biomedical waste generally arises from the isolation wards, quarantine centres and hospitals. New categories of biomedical waste has emerged after COVID-19 outbreaks.[5]

Biomedical waste differs from the municipal waste as it creates more health hazards. Biomedical waste management rules were enacted in the year 2016 and amended in the 2018. They were provided by Ministry of environment, forest and climate change (MoEF) to implement the handling activities occurring in biomedical waste management. Due to the inconsistent knowledge in biomedical waste, India has faced severe crisis during COVID-19. They are in total 198 approved biomedical waste disposal facilities in the country and 28 are under construction. [6] Biomedical waste includes general waste, pathological waste, radioactive, chemical, and potentially infectious waste, sharps (includes needles, scalpel blades), pharmaceuticals and pressurized containers are the eight categories of medical waste categorized by world health organization.[7]

For segregation, the waste can be categorised into ten types. For easy segregation, later it was changed to four categories of yellow, red, white, and blue. The yellow indicates infected waste, whereas red category is marked as non-infected and recyclable. The sharps and tiny metallic items fall in the white category and lastly blue denotes the waste material that consists of glass. They are mainly five methods available for the treatment of medical wastes. They include chemical, treatment, mechanical, irradiation and biological process.[8] It is estimated that only 10-25% of biomedical waste are harmful and the remaining 75%-95% is harmless waste.[9] The hazardous waste is further classified into infectious waste and other hazardous waste. The infectious waste contains non sharps, sharps plastic disposable and liquid wastes while other hazardous wastes contain radioactive wastes, discarded glass, pressurized containers, chemical wastes, cytotoxic waste and incinerators ash.[5] Segregated waste was kept in open ventilated area and stored waste was transported to the biomedical disposal facilities.[10]

The hazardous biomedical wastes can result in different types of infections like respiratory, skin, upper and lower abdominal infections, as well as acquired immunodeficiency syndrome (AIDS), hepatitis, Congo-Crimean, anthrax, brucellosis and tuberculosis.[11] For effective biomedical waste management source segregation is important in most of the healthcare establishment's segregations of medical waste was not done properly.[12] Improper disposal of infected face masks can make a significant risk for increasing COVID-19. [13] Most hospitals in India generate about one to two kg per bed per day except the tertiary care hospitals like AIIMS, Sher-I-Kashmir Institute of Medical Science (SKIMS) which produce increased amounts of waste. [14] After COVID-19 the waste generated increased significantly. The number of used facemasks and medical waste is increasing daily with the increase in number of COVID-19 cases. [15] In recent times, Delhi and Mumbai are most affected by corona virus in India. More than 40 sanitation workers have tested positive for the infection in Delhi and whereas in Mumbai 15 have lost their lives, 10 workers and 2 security monitors at the city's landfills, Kanjurmarg, have been contaminated with COVID-19 and recovered. [16] It is evident that private hospitals are producing more healthcare waste (Red and Yellow category of waste) than public hospitals in the given context. However, in blue category public hospitals are generating more waste than private ones. [17] Awareness programmes should not only be the objective for the doctors, nurses, paramedics; but also, the waste handlers. Proper training and demonstration of handling wastes should be given to waste handlers. [18] Literally, awareness about disposal of biomedical waste is very low among the lower age group people followed by male workers, supporting staff and lab-technicians. On the other hand, the doctors have good knowledge about rules and regulation regarding biomedical waste rules. Only few healthcare providers like medical students, health care professionals know the categorization of Biomedical Waste. [19] Teaching staff are also having more awareness in waste handling than non-teaching staff and other workers.[20] In this COVID-19 pandemic situation incineration is the best way to dispose of waste but, we should not forget the associated environmental problems [21] this causes. As indicated by the current circumstance, the pandemic is likely to extend past the year 2025. [22]

Effective biomedical waste management helps to reduce the environmental problems and safeguards public and healthcare workers from getting infected. Hence this present study aims to understand the knowledge, attitude and practice of biomedical waste management during this pandemic among medical students and healthcare workers across Tamil Nadu.

MATERIAL AND METHODS

In this study sampling technique was used. This method was taken because in this pandemic, movement was severely restricted in India. It is not possible to take the questionnaire survey through direct contact with people. The study was cross sectional, accidental sampling and non-probability sampling method were carried out. For the initial pilot study, the sampling methods were seen to be very effective and positive in time saving and cost effective. A prevalence study was taken from April 1st to 20th, 2021. We targeted people like doctors, medical students and faculty, nurses, health care professionals and some public people to know about their awareness level of corona virus. The semi structured questionnaire was prepared in concise form and reasonable English in Google form. The questionaries data were uploaded through Google Forms by distributing the link electronically. The question was structured and created for the people's knowledge on characteristics related to the handling and disposal of COVID-19 wastes and their consequences, identification of waste categories, hospital policies and awareness level on the COVID 19 virus. We disseminated the survey by social media, emails and mobile based networks like WhatsApp, Telegram. The participants showed the overwhelming responses where they passed to their friends all over Tamil Nadu. The questions were designed by standard guidelines and protocols as per WHO guidelines at the time. [23]

In total, 30 questions were included with 15 multiple choices and the remaining 15 were in YES/NO format. A total of 30 questionnaires were designed and distributed to medical college and hospitals treating COVID-19 patients across Tamil Nadu. We have received about 257 responses. Out of 257 responses, 39.69 %(n=102) students, 27.63%(n=71) nurse followed by doctors and faculty were 18.68 %(n=48) and 14 %(n=36) as described in Table 1.

TABLE 1: DEMOGRAPHIC INFORMATION OF RESPONDENTS

VARIABLES	PARTICIPANT (N)	PARTICIPANT PERCENTAGE (%)
Doctors	48	18.68%
Nurses	71	27.63%
Faculty	36	14%
Students	102	39.69%

RESULTS

The study presents the key findings from the total 257 respondents we divided the questions into four headings. The type of waste, ideas and waste generated during COVID 19 was shown in Figure 1, Figure 2 and Figure 3. The results of the survey were shown in the form of tables and charts, simultaneously the inference from the question has been discussed.

Table 2 is an extract of data from the survey and shows the awareness in the management of waste by the respondents

TABLE 2 AWARENESS ABOUT WASTE MANAGEMENT

QUESTIONS	PARTICIPANTS(N)	PARTICIPANTS IN PERCENTAGE
1.Do you follow the guidelines suggested by WHO for waste management?		
Yes	193	75%
No	64	25%

2.After COVID 19 there is massive increase in Biomedical waste production.		
Agree	241	93.8%
Disagree	16	6.2%
3.Whether COVID 19 infected waste is mixed with non-infected waste in your institution/hospital?		
Yes	201	78.2%
No	28	10.9%
May be	28	10.9%
4.How long do you store waste before treatment/disposal?		
Less than 24 hours		
More than 24 hours	109	42.2%
48 hours	60	23.4%
More than 48 hours	48	18.8%
	40	15.6%
5.Types of containers used for waste collection		
Plastic containers	129	50%
Metal containers	56	21.9%
Biohazard bags	72	28.1%
Sharp bins	0	0%
6.Whether anybody affected by COVID19 while handling wastes?		
Yes	44	17.2%
No	169	65.6%
May be	44	17.2%
7.Do you aware of biomedical waste rules and regulations followed in India?		
Yes	104	40.6%
No	44	17.2%
Know little bit	109	42.2%
8.Do you have separate bins for collecting COVID patient wastes?		
Yes	177	68.8%
No	80	31.2%
9.Could staffs be trained regarding collection of COVID patient's wastes?		
Yes	161	62.5%
No	44	17.2%
May be	52	20.3%
10.Improper waste management cause various health hazards		
True	229	89.1%
False	28	10.9%
11.Is it necessary to improve the waste management technique during COVID19 pandemic?		
Yes	205	79.7%
No	32	12.5%
May be	20	7.8%

12.Do you follow color coding while disposing wastes?		
Yes	205	79.7%
No	24	9.4%
Never noticed	28	10.9%
13.Which disposal technique is followed by your hospital/institution?		
Taken to Municipal landfill	109	42.2%
Buried at hospital ground	44	17.2%
Incineration	104	40.6%
14.Is there any biomedical waste disposal policy in your hospital/Institution?		
Yes	185	71.8%
No	36	14.1%
Maybe	36	14.1%
15.Whether maintaining Biomedical waste record is mandatory in your hospital/clinic?		
Yes	181	70.3%
No	76	29.7%
16.What type of waste you often see during COVID-19 pandemic?		
Masks	213	82.8%
Needles	20	7.8%
Gloves	20	7.8%
Bandages	4	1.6%
17.How long is the disposal site from your hospital/institution?		
Nearer	112	43.8%
Far apart	145	56.2%
18.What type of laboratory facilities do you have?		
Clinical/biomedical	175	68%
R&D	40	15.6%
Animal	42	16.4%
19.Which color bin is used to dispose glassware and metallic body implants?		
Blue bins	100	39.1%
White bins	72	28.1%
Yellow bins	32	12.5%
Don't know	53	20.3%
20.Pathalogical wastes are disposed in?		
Blue bins	44	17.2%
Red bins	41	15.6%
Yellow bins	100	39.1%
Don't know	72	28.1%
21.Contaminated wastes(recyclable) are disposed in?		
Blue bins	36	14%
Red bins	81	31.3%
Yellow bins	72	28.1%
Don't know	68	26.6%

22.Did you notice any charts regarding waste disposal displayed near dust bins?		
Yes	161	62.5%
No	96	37.5%
23.Types of waste generated during COVID-19 are		
Infectious	90	35%
Non-infectious	36	14%
Pathological	39	15%
Radioactive	13	5%
Chemical	28	11%
Pharmaceutical	51	20%
24.What ideas do you follow in waste management?		
Plan	72	28.1%
3R rule	64	25%
Committee	72	28.1%
Records	49	18.8%
25.Is there any future precaution to manage waste planned by your institution?		
Yes	193	75%
No	64	25%
26.Which of this method is followed by your institution for medical waste treatment?		
Thermal	56	21.9%
Biological	93	36%
Irradiation	28	10.9%
Mechanical	28	10.9%
None of the above	52	20.3%
27.Waste segregation at the source has high risk to waste handlers		
Agree	216	84%
Disagree	41	16%
28.Used masks (including 3-layer masks, etc.) are disposed in		
Blue bags	48	18.8%
Red bags	20	7.8%
Yellow bags	169	65.6%
Don't know	20	7.8%
29.Do you have sufficient bins in your hospital/institution?		
Yes	211	82%
No	46	18%
30.What is the rating given by you to your hospital/institution in waste management?		
1-3	20	8%
4-7	62	24%
8-10	175	68%

FIGURE 1: IDEAS FOLLOWED IN WASTE MANAGEMENT AND PERCENTAGE

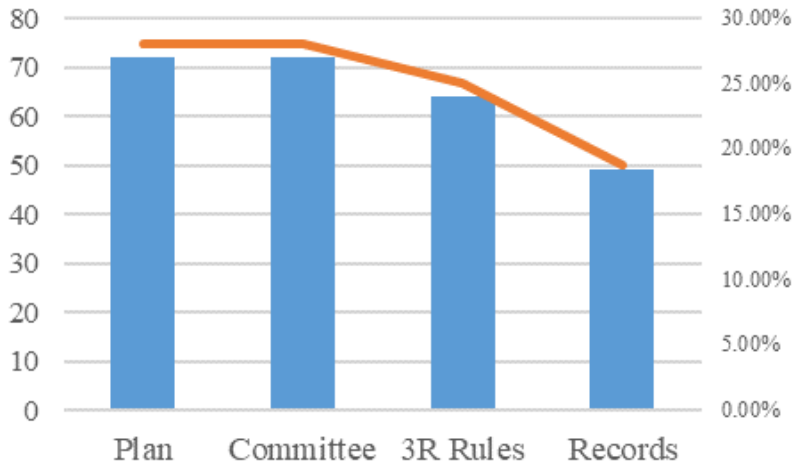


FIGURE 2: TYPE OF WASTE GENERATED DURING COVID 19 PANDEMIC

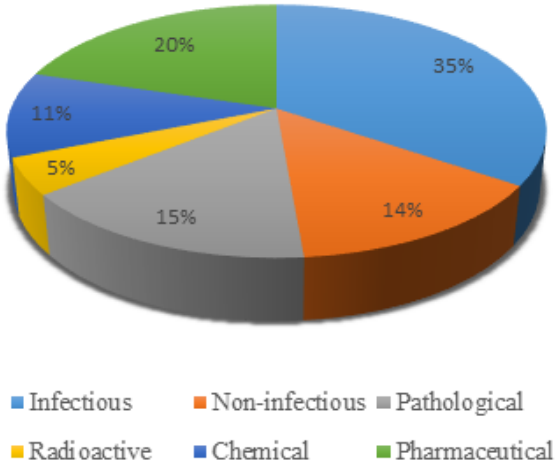
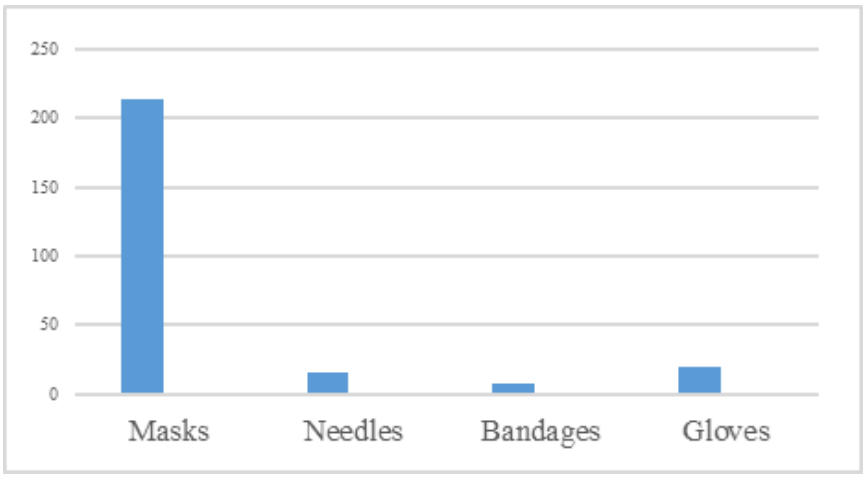


FIGURE 3: TYPE OF WASTE OFTEN SEE DURING COVID 19 PANDEMIC



RESULTS

The waste management procedures in the different hospitals and institutions revealed that 25% of the facilities didn't follow all the guidelines suggested by world health organisation and 75% of the facilities are following all the rules and regulations. A 'bitter truth' is biomedical waste

production is increasing daily with the increase in number of COVID cases. In our survey about 93.8% of the respondents agreed that there is a massive increase in biomedical waste generation after COVID-19. Most importantly COVID-19 infected wastes should be collected safely and separately. Almost 89.1% of the respondents aware that improper waste management cause various health hazards. From the survey it was found that 78.2% of the respondents answered COVID-19 infected waste is mixed with other common wastes in their hospital. and 10.9% of the respondents answered they collect covid patient's wastes separately.

It was also found that 28.1% of the facilities had management plans for handling wastes while 28.1% of the facilities had a separate management committee to deal the wastes, 25% of the facilities followed the 3Rs rule (Reduce, Reuse, Recycle) of waste management and 18.8% of the facilities are maintaining daily records of waste generation. 70.3% of the respondents answered maintaining biomedical waste records are mandatory in their hospital and also found that 71.8% of respondents have separate biomedical waste disposal policy in their institution/hospital. Almost 35% considered most of the wastes are infectious, 20% considered most of the wastes produced are pharmaceutical wastes. Nearly 14% of the respondents considered as non-infectious and 15% considered as pathological wastes. Very few respondents considered most of the wastes produced are radioactive wastes. This study also reveals that time of storage before disposal, some of facilities were storing wastes less than 24 hours. On the other hand, 18.8% of the facilities were having storage time of 48 hours; meanwhile, 15.6% of the facilities we're storing wastes more than 48 hours. It is found that nearly 50% of the facilities are using plastic containers for the collection of wastes and 28.1% of the respondents were using biohazard bags. Only few responded are using metal containers and 82% of them answered they have sufficient bins in their hospital/institution. Nearly 65.6% said that nobody in their hospital or institution affected by COVID-19 while handling waste.17.2% were not aware of such things and 17.2% said some of the healthcare workers are affected by COVID-19 while handling wastes of COVID infected patients. This shows awareness about personal protective equipment is still needed. When asked about the necessity to improve waste management plan, almost 79.7% of the respondents answered there is a need to improve waste management technique during the COVID-19 pandemic. 12.5% of respondents answered there is no need and 7.8% of respondents answered it may be needed. It was found that 40.6% of hospitals followed incineration techniques for final disposal. Meanwhile,17.2% of hospitals buried the wastes on hospitals ground. In addition to this, 42.2% took the wastes to municipal landfills. For the treatment of waste 36% of them following biological method. Almost 62.5% answered that the staff are trained regarding waste collection and 17.2% of the respondents said no for the above question. About 20.3% of the respondents don't know whether training is provided or not. When asked about guideline charts displayed near dustbins, 62.5% answered they have noticed and 37.5% answered they never noticed such charts. The segregation results showed that 68.8% of the facilities have separate colour coded bins for collecting COVID patient wastes. The bins used for collection of COVID-19 wastes should be labelled with COVID-19 on it. Almost 56.2% of the respondents answered the have disposal site at longer distance. When asked about laboratory facilities 68% of them have clinical/biomedical laboratory, 15.6% of them have R&D laboratory, 16.4% of them have facilities for animal laboratory in their hospital.

One of the most important method in biomedical waste management is source segregation. Waste segregation at the source has high risk to waste handlers and 84% of the respondents also agreed it. Almost 79.7% of the respondents answered that they follow colour coding while disposing wastes and 9.4% agreed they didn't follow colour coding and nearly 10.9% of the respondents were not aware of colour coding. For the question "How do you dispose used masks?", 65.6% answered correctly that yellow bags are used. When asked about specific category most of the respondents answered wrongly. For the question "which colour bin is used to dispose glassware and metallic body implants?" only 39.1% answered correctly and when asked about pathological wastes and contaminated recyclable wastes only 39.1% and 31.3% answered correctly. These results clearly show they have lack of knowledge.

Almost 75% of them answered their institution had future precautionary plans to avoid complication in waste management. From the survey nearly 82.8% of the respondents considered the use of facemask increased tremendously after COVID-19. Along with facemasks the use of personal protective equipment and testing kid also increased.

DISCUSSION

The huge amount of biomedical waste is generated from the isolation wards, emergency clinics and the home quarantine since the outbreak of Novel Corona virus. Based on the survey, the usage of facemask, testing kits, individual protective equipment and nitrile gloves are the main reason for piling up of biomedical waste. [24] A serious and timely collection, treatment, disposal of COVID patient's waste is the major problems by all medical care workers. Based on the survey, 82.8% considered that at the time of COVID-19 the generation of facemasks increased rapidly.
Proper collection and disposal of biomedical waste is crucial for environment safety and may also give a better solution to bio security risk. In this study, it is found that nearly 40.6% of the facilities are using incineration technique for final disposal of infectious waste which is similar to the study conducted by Mohamed et al where they reported around 40% of the hospitals in Bahrain followed incineration as final treatment of infectious waste.[25]Meanwhile Another study conducted at Karachi Pakistan showed 70% of the facilities are following incineration technique.[26] A study by Francis among the nurses in Christian Mission Hospitals at Madurai, Tamilnadu showed that 77% of the nurses had adequate knowledge and 23% of the nurses had moderate adequate knowledge about waste management and none of them were not aware of medical waste management.[27]

However, in this study, 62.5% of the participant's answered staff were trained, which is better than findings from earlier studies from India [28] and even from Ethiopia.[29] On the other hand, a study in Nigerian settings had better results (81%).[30]

This study reveals that about 35% of the respondents considered all the healthcare wastes are mostly infectious. The previous study conducted by Sood et al at three dental colleges in Delhi reveals that 60% of respondents considered all the wastes are hazardous wastes. [31] Similarly, in a study conducted by Aradhya et al in Himachal Pradesh also showed 88.3% of the respondents considered all the waste are hazardous. [32] But the fact is only 10-15% of the wastes are hazardous.

It is found that about 79.7% said they are following colour coding while disposing wastes. But when asked about exact categories only 39.1% could tell which colour container is used for collecting glassware & metallic body. Similarly, very few could tell correct answers for the questions which colour bins are used to dispose infectious and non-infectious wastes. Our study is similar to a study conducted in a tertiary care hospital, Kanchipuram by Mohan Kumar, that also reported only 34.2% answered correct and the remaining did not answer.[33] But our results are contradicted the result of Kanchi et al in that 86% of the respondents had knowledge of colour coding.[34] However, a study done by Deo et also found lack of knowledge among the medical staff (20%).[35] But a study in Davangere city, Karnataka showed 27.2% were not aware of colour coding. [36]

When coming to record maintenance, 70.3% considered maintaining records are mandatory. This is similar to a study done by Kanchi et al, who reported 72%. But Mohan Kumar reported 94.8% considered record maintenance is mandatory. [37] About 89.1% considered improper waste management cause various health hazards.
When asked about separation of COVID patients wastes 68.8% of the participants answered they had separate bins for collection. Almost 78.2% answered one should not mix COVID-19 infected waste with non-infectious waste. Regarding waste management, 79.7% of the respondents felt improvement is needed to manage wastes during COVID-19 pandemic.

To lessen the volume of PPE and to prevent shortage, it's reuse has been exhorted with legitimate safety measure. [38] N95 masks can be reused for 3–4 times by a similar individual whenever put away in paper packs and kept far from others. [39] The Central Pollution Control Board (CPCB) has made an application called 'COVID19 BWM' for everyday reports on COVID19 waste management and follow-up.[40]

CONCLUSION

This study showed that creating more awareness among healthcare workers for proper handling, treatment and disposal of medical waste generated from COVID patients is necessary. Creating potential strategies to overcome difficulties while handling and treatment of waste during COVID-19 pandemic may reduce the waste generation and minimize environmental problems. Another important factor from this study is that most of the clinics should follow WHO guidelines on healthcare waste management, during this current pandemic situation, many of institutes followed disposal method like safe pit for COVID waste, and

incineration was used as a final treatment method by most of the hospitals. Using double layered bags, mandatory labelling and colour coded bins for the management of waste generated during the diagnostics and treatment of suspected and confirmed COVID-19 patients are the guidelines issued by the Central Pollution Control Board (CPCB).

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