



Knowledge and Practice of Dental Waste Management among Undergraduate Dental Students and Interns in College of Dentistry, Taibah University, Saudi Arabia

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Authors' contributions

This work was carried out in collaboration between both authors. The first author LAO designed the study, performed the statistical analysis, wrote the protocol, compiled the first draft of the manuscript and managed the analyses of the study as well as the literature search. The second author SS reviewed the protocol and edited the final draft of manuscript. Both the authors have read and approved the final manuscript.

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ABSTRACT

Objective: The objective of this study was to assess the awareness and practices of dental waste management among dental students at College of Dentistry, Taibah University, Madinah Saudi Arabia.

Methodology: An observational analytical cross-sectional study was conducted at College of dentistry, Taibah University, which targeted all male and female dental students within clinical years (third, fourth and fifth) and interns using an anonymous self-administered online questionnaire.

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Results: Amongst the total respondents, 15.1% (11) were male and 84.9% (62) were female. Significantly, 8 (11%) dental students stated that they were not aware of the different categories of biomedical waste generated at dental clinics.

Furthermore, 35 (47.9%) students reported that they dispose extracted teeth in yellow containers. While 6 (8.2%) dispose them in common bins. When asked about the colour coding followed for different biomedical waste, 31 (42.5%) dental students said they were not aware about it. On the other hand, 58 (79%) of them segregate different waste according to the laws related to biomedical waste management. Approximately, 5 (6.8%) dental students correctly answered that used needles and syringes fall under Category 4 (sharp waste), whereas only 3 (4.1%) of them informed that they dispose such needles in common bins after use.

Conclusion: The majority of the dental students answered questions pertaining to dental waste management incorrectly and followed wrong practices to dispose different waste. Moreover, a substantial percentage of them were not aware of the different colour codes adhered to for biomedical waste. Therefore, this research work denotes an urgent need to implement educational programs and develop stricter laws regarding this vital issue.

Keywords: Knowledge; practice; dental waste; students; Saudi Arabia.

1. BACKGROUND

Waste management is one of the key ecological challenges faced by the modern world. Waste is a direct consequence of human activity and the quantity of waste generated is often an indicator of the economic strength and development of a community [1]. Dentistry is a health care discipline that aims to maintain and enhance oral health as a part of humans' overall health and well-being, using different materials and equipment. Dental waste is a component of health care waste. Health care waste, as defined by the World Health Organization (WHO), includes all waste generated by health care establishments, research facilities and laboratories. Moreover, it includes the waste originating from "minor" or "scattered" sources such as those produced in the course of health care administration undertaken at home (dialysis, insulin injections, among others) [2]. According to WHO fact sheets, about 85% of the total amount of waste generated by health care activities includes general, non-hazardous waste. The remaining 15% is considered to be hazardous materials that are either infectious, toxic or radioactive. Hazardous health care waste materials are classified into infectious waste, pathological waste, sharps, pharmaceutical waste, genotoxic waste, chemical waste, waste with high content of heavy metals, pressurised containers and radioactive waste [3]. Despite the fact that dental clinics are considered as a minor source of health care waste [4], dental clinics and offices primarily generate infectious waste, sharps and wastes with high heavy-metal content [3], which are all of high concern globally. The main concern pertaining to infectious hospital

waste is the transmission the of human immunodeficiency virus and hepatitis B or C viruses. In this regard, sharps such as syringes and needles have the highest disease transmission potential [5]. On the other hand, there is hazardous heavy metal waste whose impact has been of much concern in recent years [6].

Dental waste is classified into two categories: liquid dental waste and solid dental waste, which are further categorised into two main groups: non-risk dental waste and risk dental waste. To elaborate, the latter includes infectious waste and hazardous waste. The infectious waste contains blood saturated materials and pathologic tissues such as extracted teeth. Conversely, hazardous waste comprises metals that are toxic and long lasting within the environment, which do not undergo degradation. It consists of silver, lead, mercury, X-rays and cleaning solutions [5].

A major concern in the dental field is the management and disposal of mercury, which has been used as an amalgam and a direct restorative material for more than 15 decades. Amalgam particles can be released into dental offices' wastewater and/or in solid waste and subsequently released into the environment, resulting in harmful environmental pollution [7]. In addition to harming the environment, improper disposal of amalgam and other dental waste can cause harm to dentists, waste handlers or the people who come in direct contact with them [8].

In order to minimise the aforementioned adverse effects, proper waste handling should be followed in dental offices, ensuring strict adherence to international regulations in this regard. From this starting point, several studies were conducted to evaluate and assess the awareness and practices regarding dental waste management in different countries. This is very important to measure its knowledge and effective application among different dental practitioners, in order to fill the gaps and improve their behaviour until healthy dental and outer environments are achieved.

This study assessed knowledge and practice of dental waste management among dental students of Taibah University, Saudi Arabia.

2. MATERIALS AND METHODS

2.1 Design of the Methods

2.1.1 Study area

The study area of this research was College of Dentistry, Taibah University, Al-Madinah Al-Munawwarah, Kingdom of Saudi Arabia.

2.1.2 Study design

An observational analytical cross-sectional study carried out in April, 2016.

2.1.3 Study population

The study population comprised all male and female dental students within clinical years (third, fourth and fifth) and interns.

2.1.3.1 Inclusion criteria

Third, fourth, fifth year dental students and/or dental interns at College of Dentistry, Taibah University, had been included in this study.

2.1.4 Sample size

This study was a whole population based study included all male and female dental students within clinical years and interns of College of Dentistry, Taibah University. It had a sample of 202 participants (167 undergraduate students, 36 post-graduate students, including males and females).

2.1.5 Study tool

An anonymous online self-administered closed structured questionnaire with two sections was used for the data collection:

1. Section 1: Questions regarding the awareness and knowledge of dental waste management, including colour coding disposal system;
2. Section 2: concerning the practice of dental waste management by students at the dental office, Taibah University.

2.2 Recruitment Methods

An online questionnaire sent electronically to all students in their clinical years as well as interns at College of Dentistry, Taibah University.

2.3 Statistical Analysis Plan

Data were collected from the online questionnaires filled by the participants, which will be coded and entered using Microsoft Excel Software. Subsequently, the data had been transferred to the Statistical Package for Social Sciences (SPSS) version 22.0 to conduct relevant analysis. In the beginning, simple descriptive analysis to ascertain sample characteristics in form of means and standard deviations was performed. Following this process, inferential statistics were applied using, for instance, chi-square test when comparing males and females.

P-value of 0.05 was considered as the significance level controlling alpha error.

2.4 Ethical Considerations

Ethical clearance for the study was sought and obtained from the Ethics Committee of Taibah University. Informed consent was obtained from the participants and all information collected were treated confidential.

3. RESULTS

The response rate was 75.74% (153/202). Out of those who responded, 38.6% (59) were male and 61.4% (94) were female.

The number of respondents who were third-year students was 61 (39.7%), those in fourth year was 33 (21.9%), and those in

fifth year was 36 (23.3%). Furthermore, the number of dental interns who participated in this study was 23.

(including the comparison between different academic levels using chi-square test) has been presented in Tables 1 and 2, respectively.

Summary of the data regarding the knowledge and practice of dental waste management

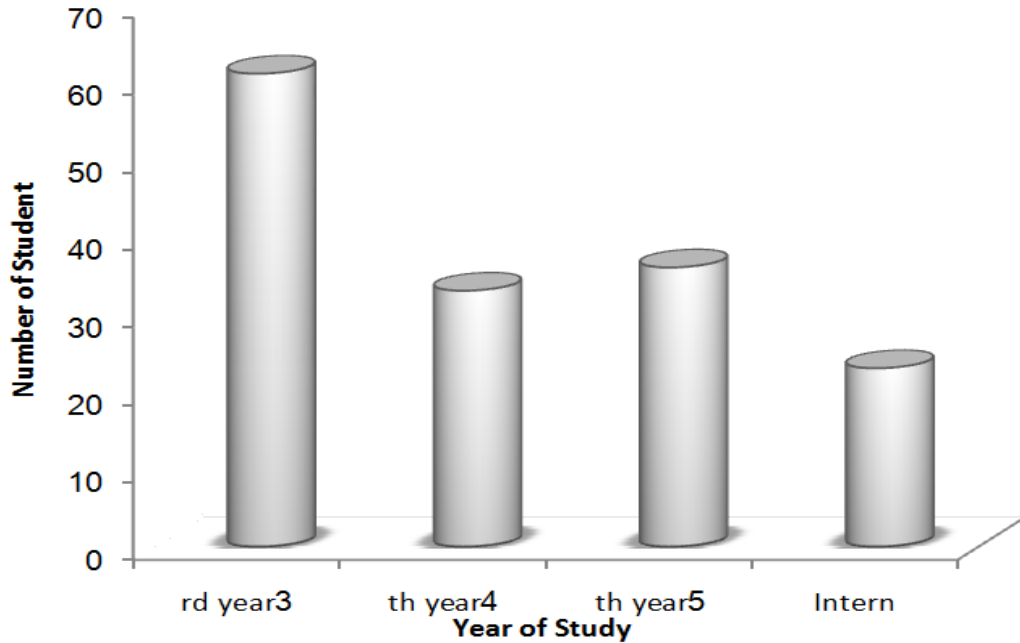


Fig. 1. Number of respondents from different dental grades

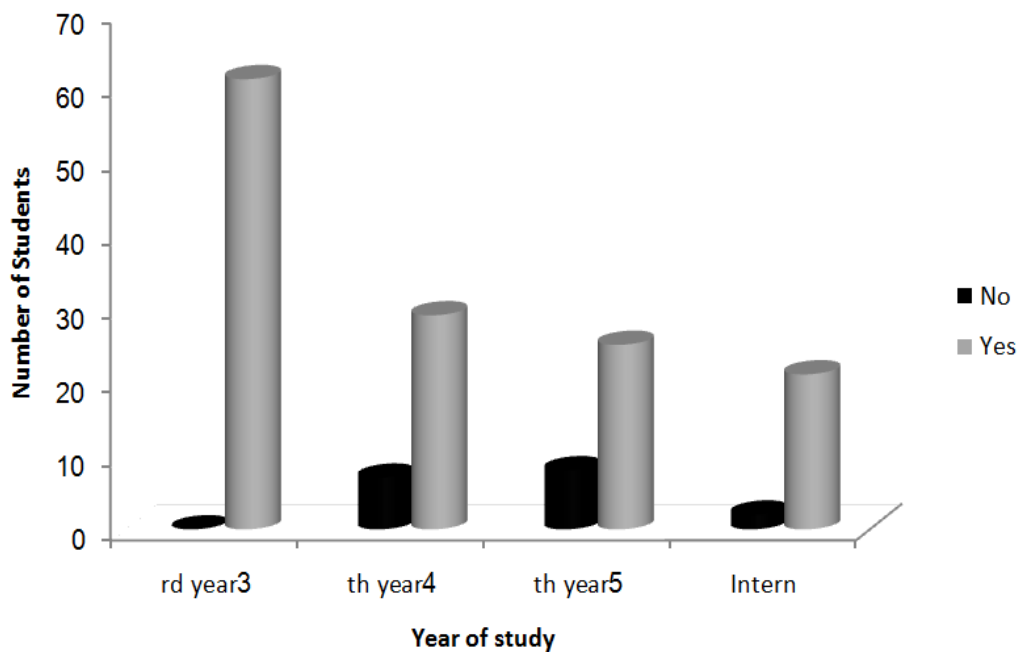


Fig. 2. Distribution of answers among different academic levels

Table 1. Summary of data regarding knowledge of dental waste management (Opposite to each answer is the percentage of students who chose that answer respectively, as well as the distribution of the percentage of the correct answer among different dental grade`s students)

Section 1: Awareness of dental waste management		3rd year	4th year	5th year	Dental intern	P-value [≤5]
Question	Percent					
Are you aware about different categories of biomedical waste generated at dental clinic?						
Yes	89%	100%	81.25%	76.5%	90.91%	0.061
No	11%					
Are you aware about variocolourlor coding for different types of biomedical wastes?						
Yes	57.5%	82.8%	43.75%	29.4%	54.5%	.002
No	42.5%					
Human anatomical wastes should be disposed in						
Yellow container	27.4%	27.6%	31.25%	23.5%	27.3%	0.970
Red container	12.3%					
Blue/white container	13.7%					
Black container	13.7%					
Don't know	32.9%					
Sharps should be disposed in						
Yellow container	89.0%					
Red container	8.2%					
Blue/white container	0%					
Black container	1.4%					
Don't know	1.4%					
Outdated or expired medicines fall in which category?						
Chemical waste	46.6%					
Cytotoxic waste	17.8%	24.1%	12.5%	11.8%	18.2%	0.676
Biotechnological waste	4.1%					
Don't know	31.5%					
Used impression material and cotton fall in which category						
Soild waste	8.2%	13.8%	6.3%	0%	9.1%	0.442
Infected waste	74.0%					
Soiled waste	5.5%					
Don't know	12.3%					
Extracted tooth falls in which category?						
Infected	95.9%	96.6%	87.5%	100%	100%	0.252
Chemical	1.4%					
Don't know	2.7%					
Used needles and syringes fall in which category?						
Category 1	17.8%					
Category 2	1.4%					
Category 4	6.8%	3.4%	6.25%	0%	27.3%	0.030
Don't know	74.0%					

Table 2. Summary of data regarding practice of dental waste management

Section 2: Practice of dental waste management	3rd	4th	5th	Dental intern	P-value	
Question	Percent	year	year	year	intern	
Do you segregate different types of wastes in your clinic?						
Yes	79.5%	93.1%	56.3%	76.5%	81.8%	0.033
No	20.5%					
How do you dispose infected needles?						
Dispose it in common bin	4.1%					
Break the needle and dispose	9.6%					
Needle burner	4.1%	0%	6.25%	5.9%	9.1%	0.521
Dispose it in puncture proof bags	68.5%					
Don't know	13.7%					
How do you dispose developer and fixer?						
Direct in wash basin	5.5%					
Dilute it and dispose	17.8%	3.44%	25%	29.4%	27.3%	0.076
Add new and reuse	4.1%					
Others	4.1%					
Don't know	68.5%					
How do you dispose X-ray film lead foils and X-ray films?						
Dispose it in common bin	11.0%					
Store separately and then to be disposed in secured landfills by experts	24.7%	20.7%	25%	17.6%	45.5%	0.354
Bury it	2.7%					
Don't know	61.6%					
How do you dispose outdated or expired medicines?						
Dispose it in common bin	13.7%					
Store separately and dispose	15.1%					
Bury it	2.7%					
Dispose it in secured landfills	17.8%	24.1%	25%	5.9%	9.1%	0.310
Don't know	50.7%					
How do you dispose extracted tooth?						
Dispose it in common bin	8.2%					
Yellow container	47.9%	48.3%	43.8%	47.1%	54.5%	0.958
Red container	17.8%					
Blue/ white container	6.8%					
Black container	19.2%					
How do you store excess silver amalgam?						
Dispose it in common bin	12.3%					
Store it in air tight container with water	52.1%	65.5%	31.3%	58.8%	36.4%	0.099
Store it in a fixer	4.1%					
Don't know	15.1%					
Don't use	16.4%					
How do you dispose orthodontic wires and brackets?						
Dispose it in common bin	6.8%					
Deform and dispose	16.4%	6.9%	0%	35.3%	36.4%	0.005
Sell to certified buyers	4.1%					
Don't use	28.8%					
Don't know	43.8%					

Apparently, 17 (11%) dental students reported that they were not aware about the different categories of biomedical waste generated at dental clinics. Percentages and frequencies of answers regarding awareness about different categories of biomedical waste generated at dental clinics have been described in Table 1. Moreover, distribution of answers among different academic levels has been presented in Fig. 2. Data distribution in all these figures is based on frequency.

Table 3. Awareness about different categories of biomedical waste generated at dental clinics

	Frequency	Percent
Yes	136	89%
No	17	11%
Total	153	100%

Out of 153 dental students, only 27 (17.8%) were aware of the fact that expired or outdated medicines come under the cytotoxic waste category (drugs category).

When questioned about the category of impression material and cotton, only 12 (8.2%) participants answered correctly, stating that it falls under the category of soiled waste.

With regard to the questions concerning the category of an extracted tooth, 147 (95.9%)

participants answered correctly, stating that it comes under the category of infected waste.

About 10 (6.8%) dental students correctly answered that used needles and syringes fall under Category 4 (sharp waste).

Furthermore, 65 (42.5%) dental students stated that they were not aware of the colour coding followed to dispose such waste. Percentages and frequencies of answers regarding awareness of various colour codes for different types of biomedical waste have been presented in Table 4.

Table 4. Awareness about various colour codes for different types of biomedical waste

	Frequency	Percent
Yes	88	57.5%
No	65	42.5%
Total	153	100%

Approximately, 42 (27.4%) dental students reported that they were aware of the yellow colour-coded container that should be used for the disposal of human anatomical waste. When asked about the colour coding for disposing sharps, all 153 participants (100%) stated that they were not aware that a blue/white container is the correct colour code in this regard.

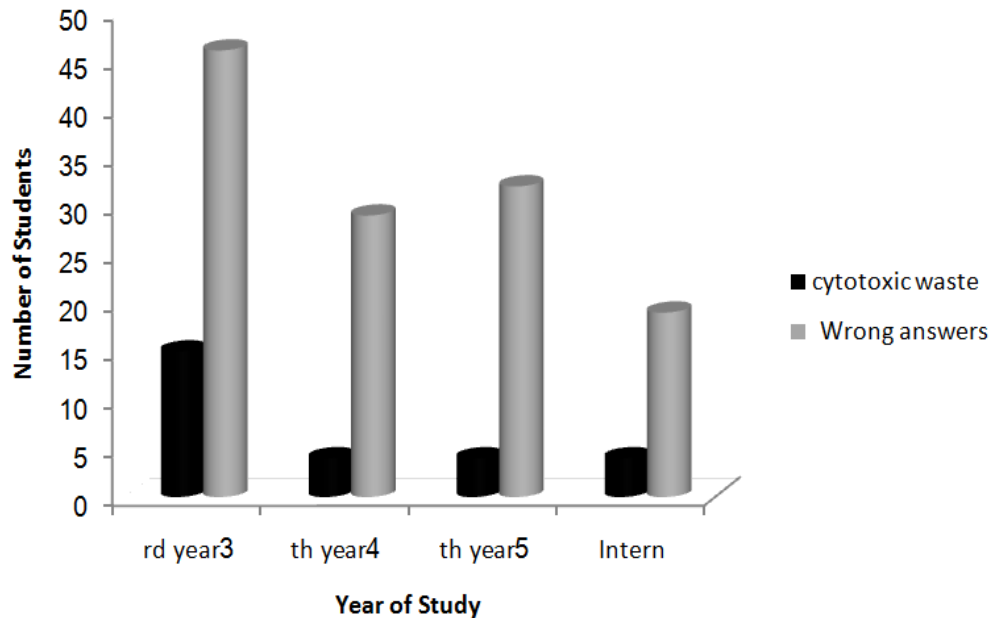


Fig. 3. Distribution of answers regarding the knowledge of expired medicine disposal among different academic levels

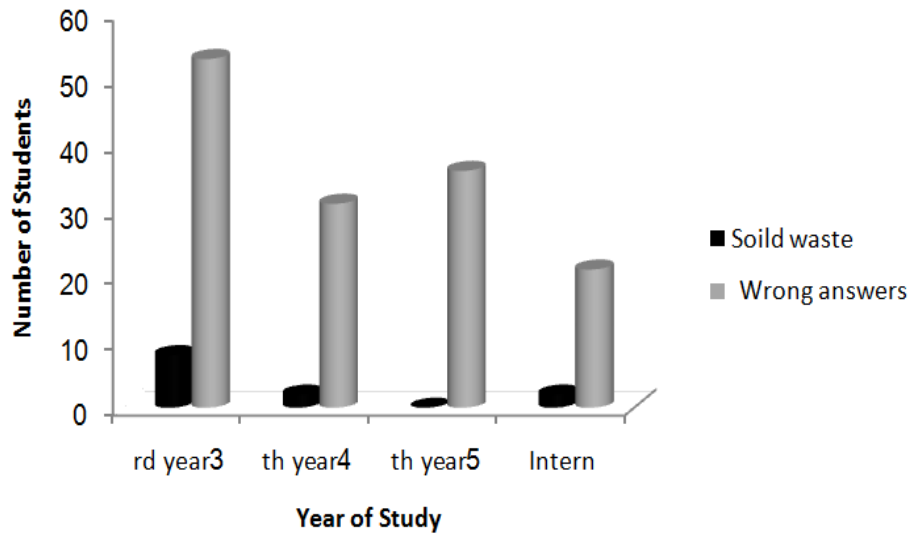


Fig. 4. Distribution of answers regarding the knowledge of impression material and cotton disposal among different academic levels

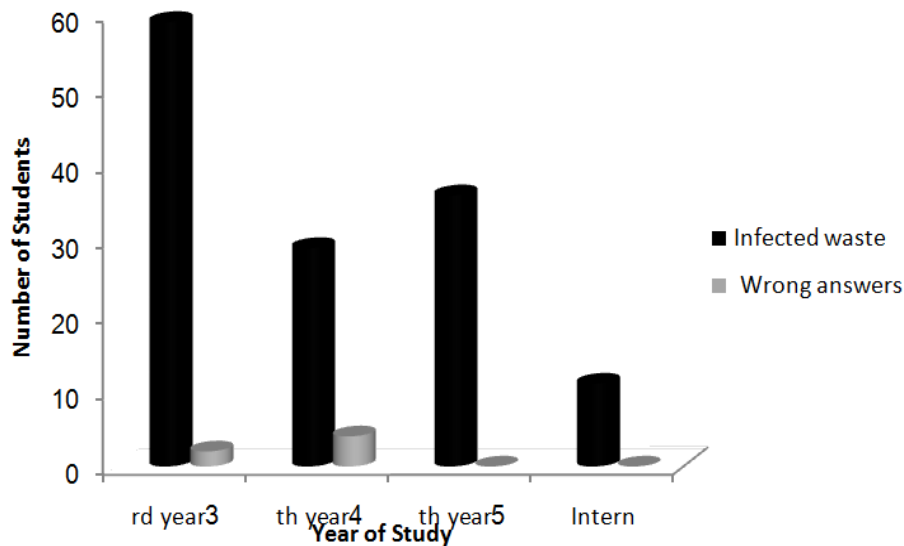


Fig. 5. Distribution of answers regarding the knowledge of extracted teeth disposal among different academic levels

Furthermore, 121 (79%) dental students segregate different wastes according to the laws related to biomedical waste management.

It is noteworthy that only six (4.1%) dental students reported that they dispose used needles in the common bin, whereas 105 (68.5%) dispose them in puncture-proof bags.

In addition, 27 (17.8%) participants stated that they dilute developers and fixers first and then dispose them.

Moreover, 38 (24.7%) dental students correctly store lead foils and X-ray films separately and safely dispose them later.

Outdated or expired medicines were stored separately and then disposed by 23 (15.1%) participants, whereas 27 (17.8%) of them dispose them in secured landfills.

Significantly, 73 (47.9%) dental students dispose extracted teeth in yellow containers, while 12 (8.2%) dispose them in common bins.

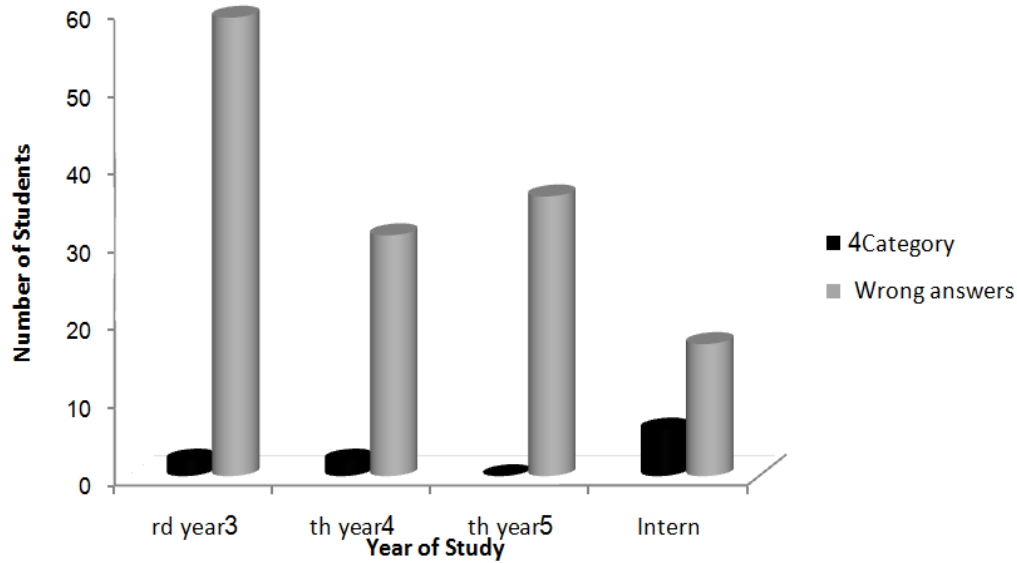


Fig. 6. Distribution of answers regarding the knowledge of used needles and syringes disposal among different academic levels

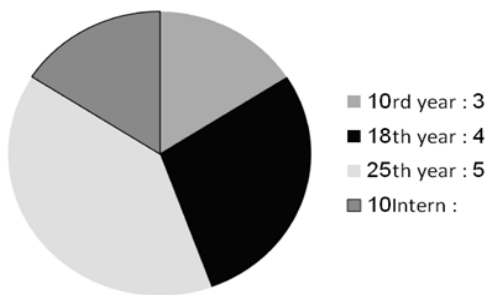


Fig. 7. Distribution of answers regarding awareness of various colour codes for different types of biomedical waste among different academic levels. This figure represents the unawareness percentage of each level

About 80 (52.1%) dental students store excess silver amalgam in airtight containers with water. On the other hand, 19 (12.3%) of them dispose it in a common bin.

About 67 (43.8%) dental students did not know the ideal method to dispose orthodontic wires and brackets, whereas 25 (16.4%) participants reported that they deformed them first and then disposed them.

4. DISCUSSION

This study was conducted to assess knowledge and practice of dental waste management

among undergraduate dental students and interns at College of Dentistry, Taibah University. Owing to the shortage of responses from male participants, the intended comparison between male and female students could not be accomplished in this study at present.

Utilising chi-square test on each question, to compare the knowledge and practice regarding dental waste management among different academic levels, reveals that there is no significant difference between third-, fourth- and fifth-year dental students and interns regarding the said issue.

However, the results of this study identify certain significant individual differences shown as highlighted P-values in Tables 1 and 2. These observations reveal that 27.3% of dental interns correctly know that used needles and syringes fall under Category 4, which is determined to be quite high compared to the percentage of other academic levels in this regard. On the other hand, third-year dental students seem to have the best knowledge regarding the colour coding followed for different types of biomedical waste. It is important to note that third-year dental students and interns surpass the other academic levels with regard to the percentage of segregation of different kinds of dental waste at the clinic. The disposal method followed for orthodontic wires and brackets was also noticed to be significantly varied among different academic levels.

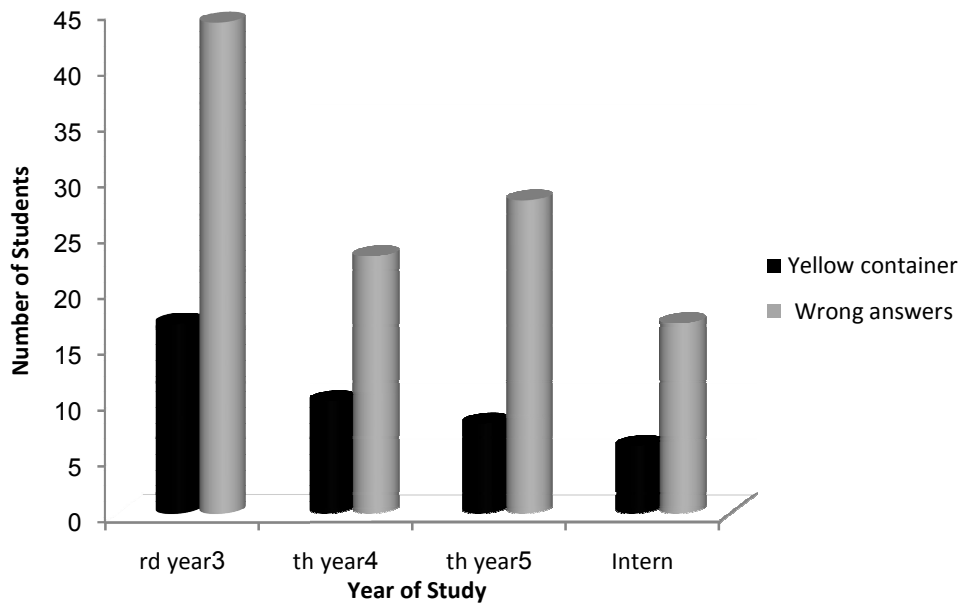


Fig. 8. Distribution of answers regarding the knowledge of the colour coding followed for human anatomical waste among different academic levels

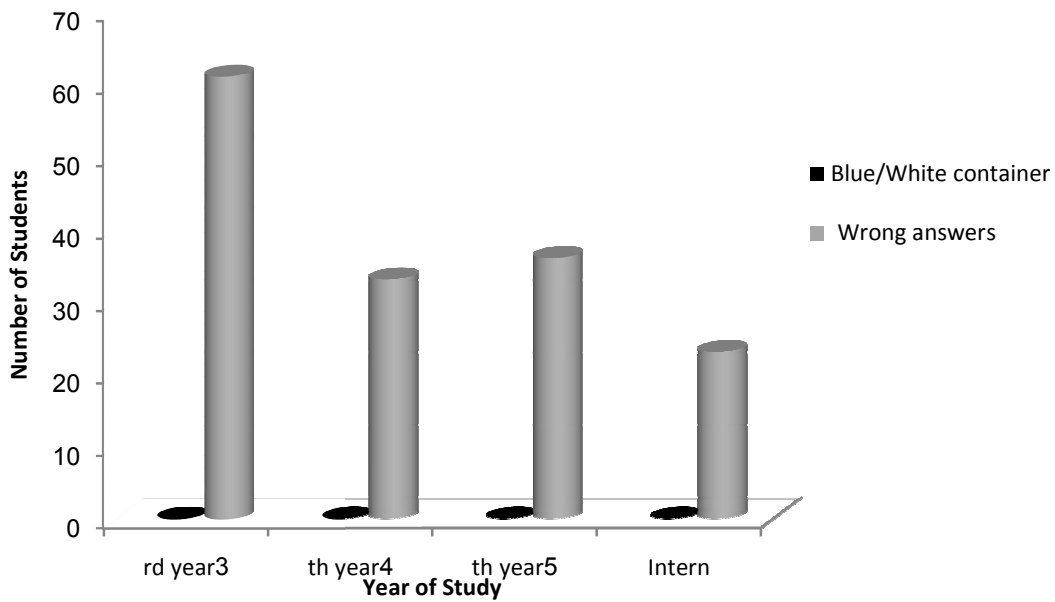


Fig. 9. Distribution of answers regarding the knowledge of the colour coding followed for sharp waste among different academic levels

In general, considering the entire already recruited population and all the questions, no disparity was observed statistically between the students studying in different academic levels at

College of Dentistry, Taibah University, in this study. The present results state that all levels depict nearly equal low knowledge and poor practice regarding dental waste management.

Our study screened the actual knowledge and performance of dental students with respect to dental health care waste management. Consequently, it provides valuable insight on the ideal practices for the aforementioned waste

management and addresses the corresponding need for improvements to train and educate dentists, especially in such a productive area of education as the dental college of Taibah University, Saudi Arabia.

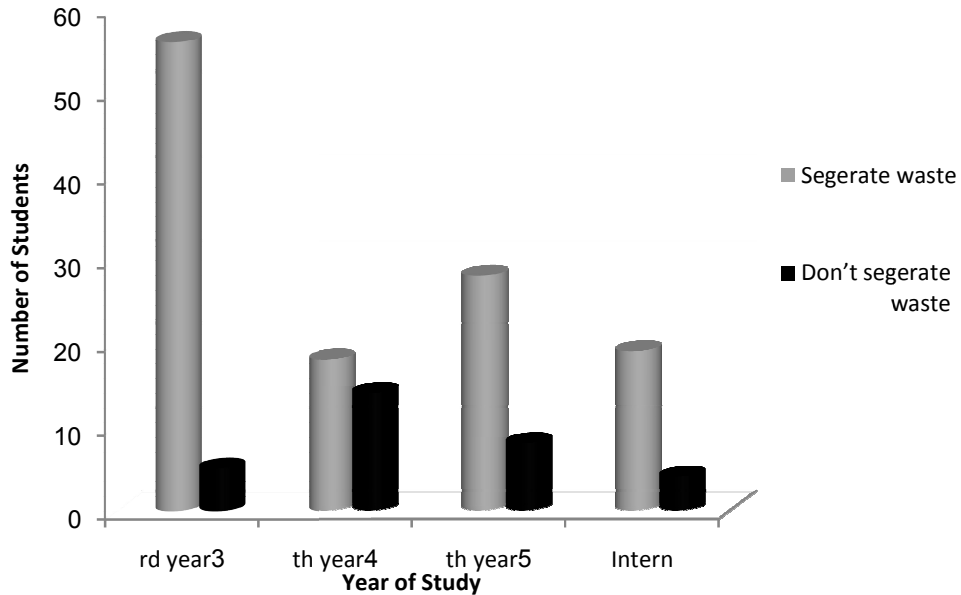


Fig. 10. Distribution of answers regarding segregation of different wastes according to the rules of biomedical waste management among different academic levels

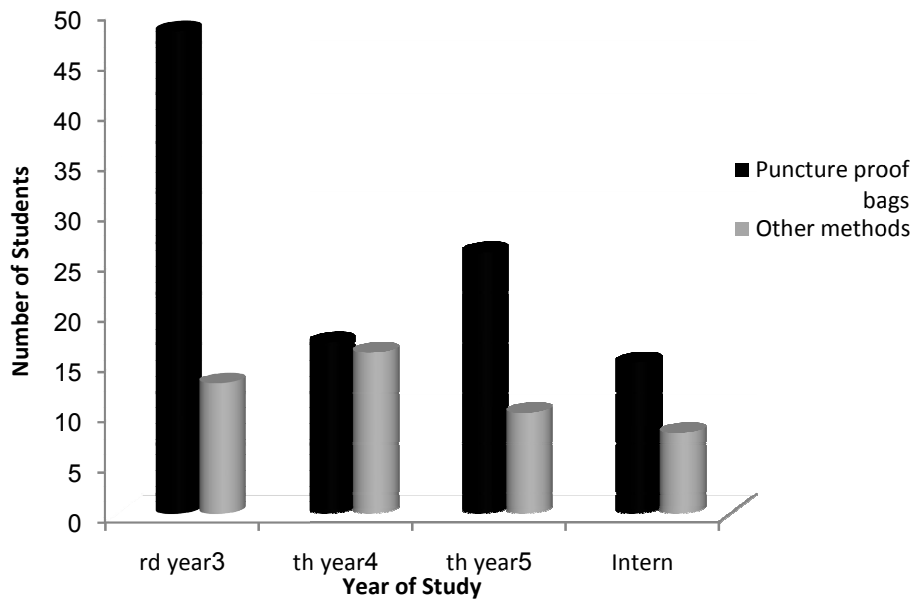


Fig. 11. Distribution of answers regarding needle disposal practice among different academic levels

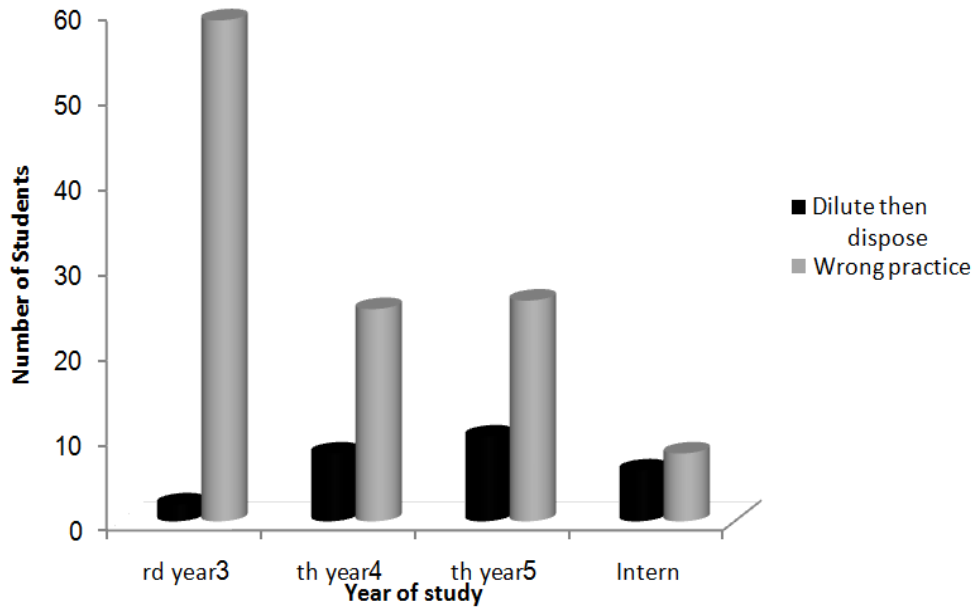


Fig. 12. Distribution of answers regarding fixer and developer disposal practice among different academic levels

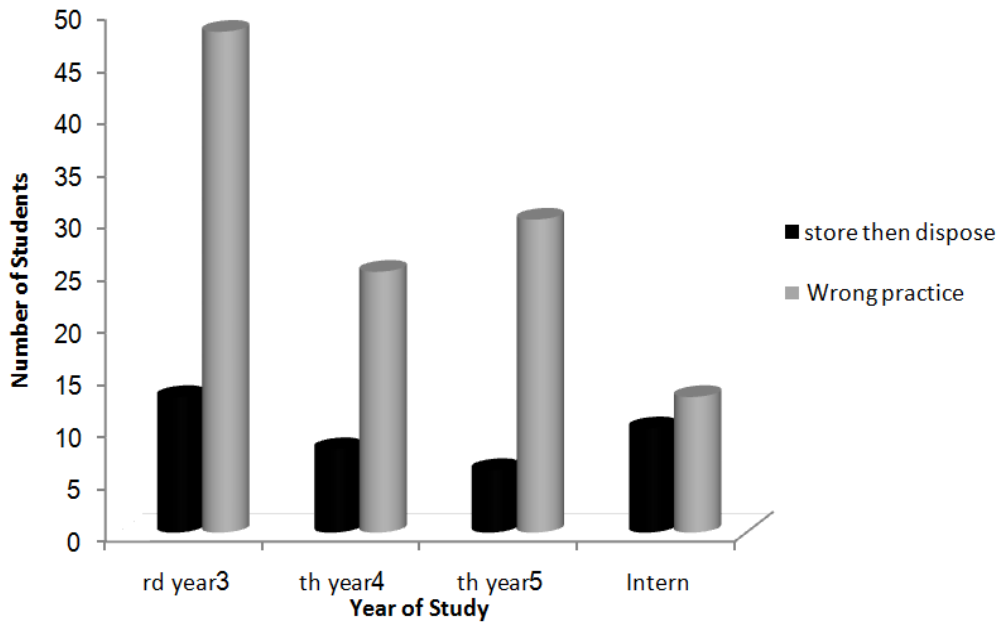


Fig. 13. Distribution of answers regarding practices concerning lead foil and X-ray film disposal among different academic levels

Studies were conducted in numerous countries to measure the awareness regarding dental waste management of dental practitioners belonging to different categories, including dental students, laboratory technicians, assistants and dentists.

Special concern regarding this field has been noticed in India, where plenty of similar studies have been published over the years.

Unfortunately, the authors could not find many similar studies that have been published in Saudi

Arabia to compare against. However, a study was conducted on Abha city in Saudi Arabia to measure the awareness, attitude, practice and facilities prevalent among the different categories of dental laboratories Haralur et al. 2015, which has been published in several journals. Despite that the aforementioned study targeted different type of population which were dental technicians, it still discuss the same issue which is dental waste management, considering that the dental

laboratories waste differ than the dental clinic waste but they share some types of waste such as the biomedical waste. Haralur et al. [9] concluded that there was considerable variation in knowledge and disposal of biomedical waste among dental technicians evaluated, which is completely different than this study's outcome that states no disparity was observed statistically between the students.

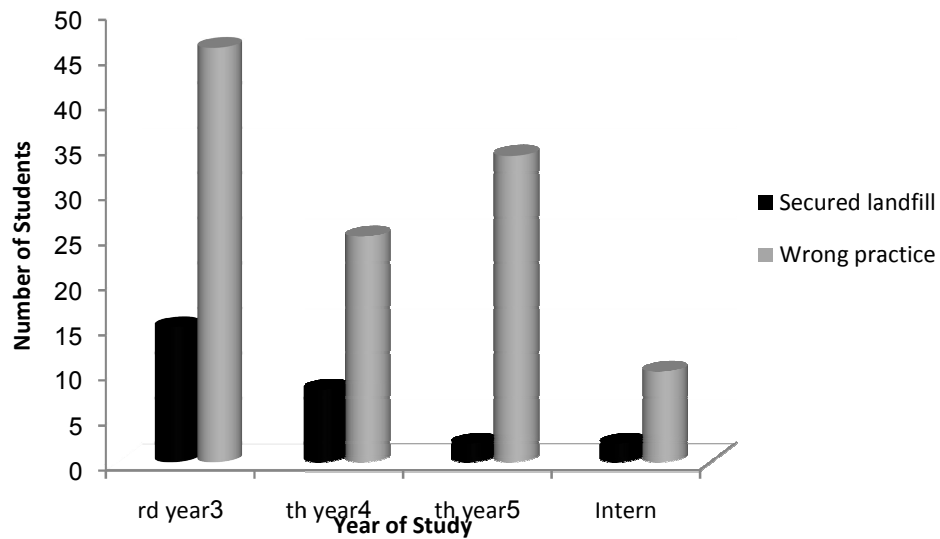


Fig. 14. Distribution of answers regarding practices of expired medicine disposal among different academic levels

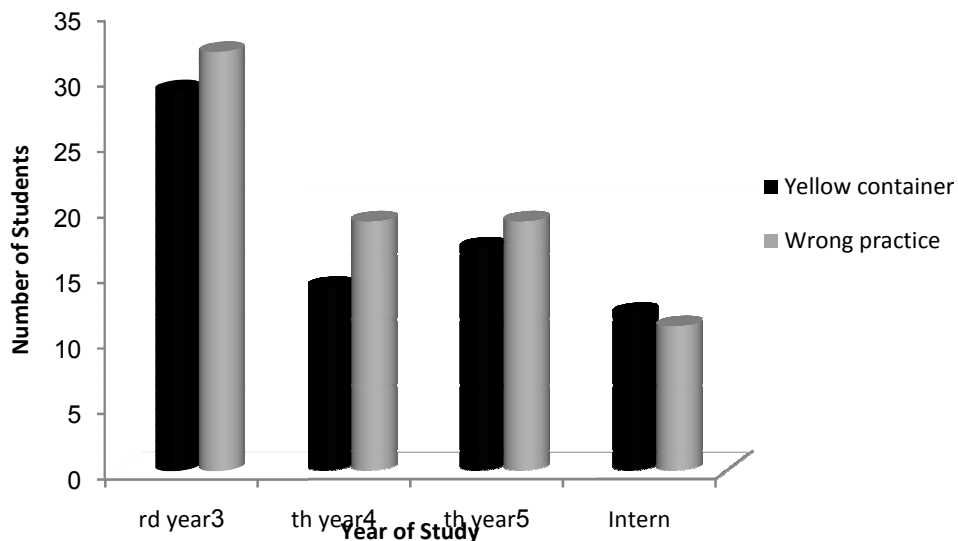


Fig. 15. Distribution of answers regarding practices of extracted teeth disposal among different academic levels

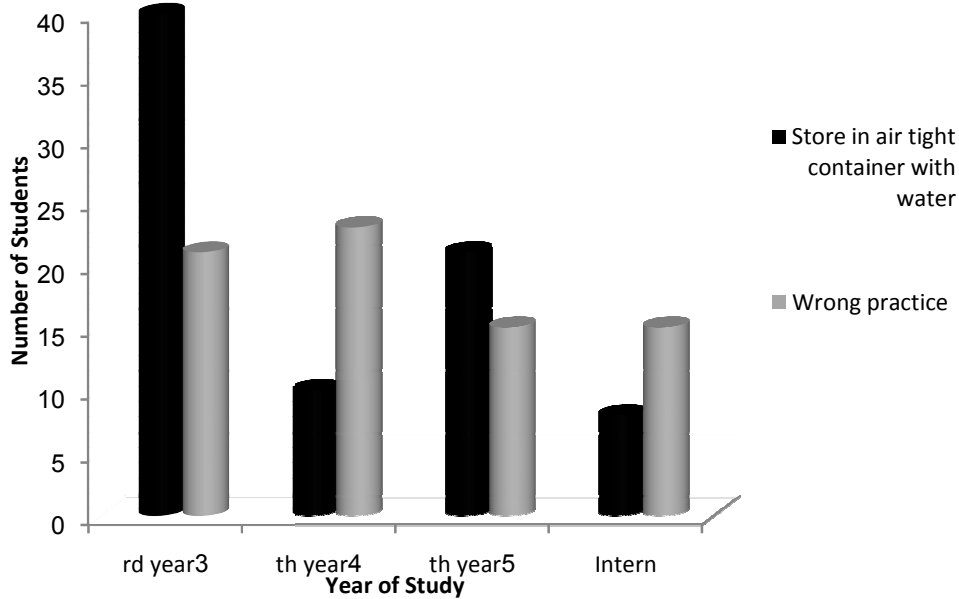


Fig. 16. Distribution of answers regarding practices of excess silver amalgam disposal among different academic levels

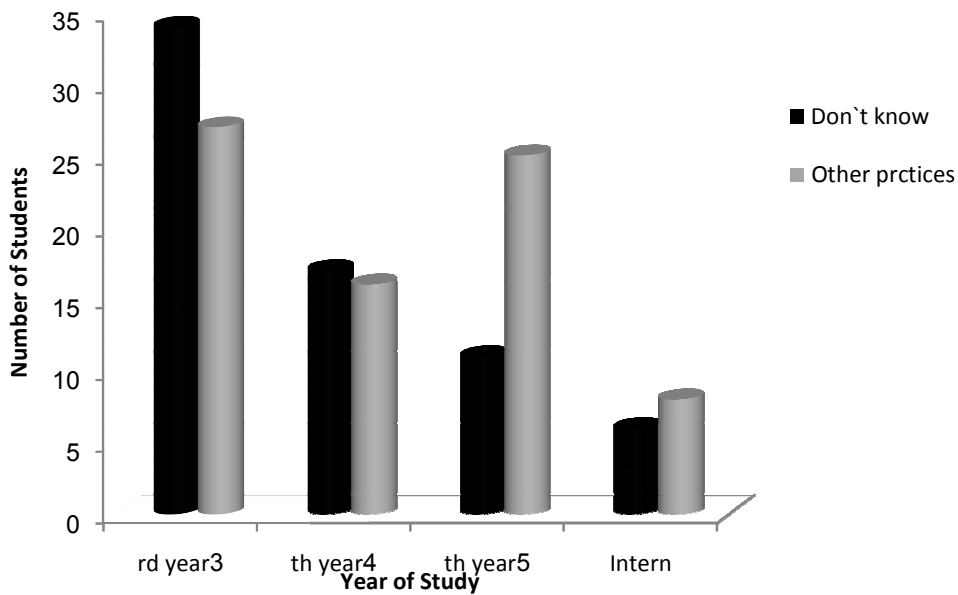


Fig. 17. Distribution of answers regarding practices of orthodontic wires and brackets disposal among different academic levels

In the present study, 11% dental students stated that they were not aware of the different categories of dental waste, which was quite similar to the conclusions drawn by Bansal, Gupta & Vashisth [5] on three Indian cities, wherein 14% dental practitioners reported

that they were not aware of the different categories.

Furthermore, 42.5% of the students stated they were not aware of the colour coding followed for different biomedical waste, which was

determined to be too high in comparison to the percentages observed in the study conducted by Bansal et al. [5].

Unfortunately, although 89% of the dental students reported that they were aware of the different dental waste categories, the majority of them could not answer the subsequent questions correctly, such as the colour coding of biomedical waste.

In our study, 20.5% of the students stated they do not segregate different waste generated in their clinic, which is quite less compared to percentage noted in Sudhakar and Chandrashekar [10]. The aforementioned study showed that a considerable percentage of dental practitioners disposed dental waste without segregating them, which actually subjects garbage collectors to a high risk of contracting any waste-related infection.

Moreover, 4.1% of the students in our study disposed infected needles in common bins. In the study conducted by Charania and Ingle [11] in India, 33.2% of the participants disposed needles in common bins, which shows a marked difference between practitioners' practice in Madinah, Saudi Arabia, and those in Chennai, India. However, in the present study, only 6.8% of the dental students answered correctly by stating that needles fall under Category 4, and the majority of them thought that needles should be disposed in yellow containers, while 0% knew that a blue/white container is the suitable option for disposing them. In contrast, in Charania and Ingle [11], 27.2% of the participants knew that needles fall under Category 4, and 26.4% correctly stated they should be disposed in blue/white containers, which reveals better knowledge despite worse practice. Furthermore, the ideal method to dispose infected needles is to use needle destroyers (burners), which are unfortunately unavailable at the dental college of Taibah University. Accordingly, the majority of the participants (68.5%) disposed needles in puncture-proof bags, which is not the correct method.

Approximately, 17.8% of the participants diluted and then disposed developers and fixers, while 50.8% of them diluted them prior to disposal in Charania and Ingle [11]. In addition, similar percentages were noted in a study conducted by Al-Khatib & Darwish [4] on two cities in Palestine.

Silver is not a component of developers, hence it can be diluted and filled into a conduit. In

contrast, fixer solutions contain silver. Thus, if it is filled into a conduit, it will increase the metal load in the pipes, which is incompatible with the mandates of environmental protection laws. Developed countries offer silver recovery units to reclaim silver. The ideal solution in this regard is to store it separately and subsequently send it to certified buyers, so that they can extract the silver component from it.

It was observed that 24.7% of the dental students in this study stored lead foils and X-ray films and then disposed them in secured landfills. However, in a study conducted by Sudhir et al. [12], 22% of them disposed them directly into common bins, which can alter the proper functioning of a human body's neurological system.

In this study, only 17.8% of the dental students were aware of the fact that expired medicines fall under the category of cytotoxic waste. Again, surprisingly, 17.8% of them disposed them ideally in secured landfills. On the other hand, 13.7% disposed such outdated medicines in common bins, which is less than the half compared to the 32% of dental practitioners documented in [5] who follow the same practice. However, both these percentages are still quite less in contrast to the 68% noted in [11].

With regard to the question pertaining to extracted teeth, 95.9% correctly stated that it falls under the category of infected waste. In addition, 47.9% followed the correct disposal method for extracted teeth, which should be disposed in yellow containers, whereas only 8.2% disposed them in common bins. This percentage is quite low compared to the findings of a study conducted by Al-Khatib & Darwish [4], wherein participants reported that extracted teeth were disposed in common bins in all the clinics.

In this study, about 52.1% of the dental students disposed excess silver amalgam in airtight containers, which is quite high in contrast to the observations of a study conducted by Bansal et al. [5]. Nevertheless, only 12.3% of them disposed excess silver amalgam in common bins, which is quite low in comparison to the 35.2% of dentists who did so as documented by Sudhakar and Chandrashekar [10].

In our study, only 6.8% of the participants disposed orthodontic wires and brackets directly in common bins. To elaborate, 16.4% of them first deformed them and then disposed them, while 43.8% stated that they do not know the

correct way to dispose orthodontic wires and brackets, which should be disposed in blue colour-coded bags as they are considered to be sharp waste according to OSHA (Occupational Safety and Health Administration). The sharp ends of orthodontic wires can penetrate one's skin, causing considerable contamination of blood.

5. CONCLUSION

Considerable deficiency has been observed regarding the knowledge of and practices followed for dental waste management by the dental students at College of Dentistry, Taibah University, Madinah, Saudi Arabia. Even if they were able to answer a few questions correctly, they failed to practice the same methods in their clinic.

6. RECOMMENDATIONS

A few recommendations for future course of action could be implemented by effective collaboration of Ministry of Health, Ministry of Education and Ministry of Municipal and Rural Affairs in Saudi Arabia as follows:

- Develop education and training programs regarding dental waste management;
- Enforce stricter rules and protocols for the organisation of dental waste management processes;
- Apply systematic penalties on dental waste management poor practice;
- Make recent equipment and resources required to dispose specific waste readily available (e.g., needle burners and different coloured bins).

CONSENT

Informed consent was obtained from the participants and all information collected were treated confidential.

ETHICAL APPROVAL

Ethical clearance for the study was sought and obtained from the Ethics Committee of Taibah University.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kucar SD, Butuci J, Kufrin J. Waste management in the Republic of Croatia--current status. *Arhiv za higijenu rada i toksikologiju*. 2006;57(3):263-6.
2. Prüss-Üstün A, Giroult E, Rushbrook P. Safe management of waste from health-care activities. Geneva, Switzerland: World Health Organization; 1999.
3. World Health Organization. Health-Care Waste; 2016. Available:<http://www.who.int/mediacentre/factsheets/fs253/en/>
4. Al-Khatib IA, Darwish R. Assessment of waste amalgam management in dental clinics in Ramallah and al-Bireh cities in Palestine. *International Journal of Environmental Health Research*. 2004;14(3):179-83.
5. Bansal M, Vashisth S, Gupta N. Knowledge, awareness and practices of dental care waste management among private dental practitioners in Tricity (Chandigarh, Panchkula and Mohali). *Journal of International Society of Preventive & Community Dentistry*. 2013;3(2):72.
6. Muhamedagic B, Muhamedagic L, Masic I. Dental office waste--public health and ecological risk. *Materia Socio-medica*. 2009; 21(1):35.
7. Singh RD, Jurel SK, Tripathi S, Agrawal KK, Kumari R. Mercury and other biomedical waste management practices among dental practitioners in India. *BioMed Research International*; 2014.
8. Mackert Jr JR, Berglund A. Mercury exposure from dental amalgam fillings: Absorbed dose and the potential for adverse

- health effects. *Critical Reviews in Oral Biology & Medicine*. 1997;8(4):410-36.
9. Haralur SB, Al-Qahtani AS, Al-Qarni MM, Al-Homrany RM, Aboalkhair AE, Madalakote SS. The dental solid waste management in different categories of dental laboratories in Abha City, Saudi Arabia. *The Open Dentistry Journal*. 2015;9:449.
 10. Sudhakar V, Chandrashekar J. Dental health care waste disposal among private dental practices in Bangalore City, India. *International Dental Journal*. 2008;58(1):51-4.
 11. Charania ZK, Ingle NA. Awareness and practices of dental care waste management among dental practitioners in Chennai city. *Journal of Contemporary Dentistry*. 2011; 1(1):15.
 12. Sudhir KM, Chandu GN, Prashant GM, Nagendra J, Shafiulla M, Reddy VS. Awareness and practices about dental health care waste management among dentists of Davanagere City, Karnataka. *Journal of Indian Association of Public Health Dentistry*. 2006;4(8):44.

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