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Original Research Article

A step towards sustainability in current dental practice: a cross sectional study

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ABSTRACT

Background: Preservation of planet should be of utmost importance. All practicing dentists collectively produce an amount of waste which can turn out to be extremely harmful to the environment. Biomedical waste management and eco-friendly approach in dental practice should be leveraged for a better future. Aim was to assess the changing trends regarding biomedical waste management and eco-friendly approach in regular practice among dentists of Ahmedabad.
Methods: A questionnaire-based study consisting of 17 questions was conducted among practicing dentists of Ahmedabad city. A total of 301 dentists voluntarily participated in the study.
Results: Most of the practicing dentists (98.7%) were aware about the biomedical waste management categories and 90.4% were known to the colour coding system used for waste segregation and disposal. A standard method of mercury waste management and sharps disposal was practiced by 53.7% and 88.4% of total participants respectively. Most of the participants were using disposable suction tips (91.6%) and disposable syringes (98.9%). However, 71.6% and 28.4% participants were using autoclavable patient drape, head cap and mask.
Conclusions: Comparison based on experience revealed that dentists with lesser experience are more prone to having eco-friendly choices. Comparison based on qualification revealed that paediatric dentists were having the least eco-friendly approach in regular practice compared to other groups. Concept of eco-friendly dentistry was familiar to majority of the dentists but, use of various eco-friendly alternatives were not preferred equally by all dentists.

Keywords: Biomedical waste, Eco-friendly dentistry, Green dentistry

INTRODUCTION

This land is all we have as humans. Humans are the greatest risk to their own race due to the waste they produce. Protecting our environment is one of the main agenda. On an individual level, each person disposes minimal amount of waste, but when compiled, it creates an amount of waste that leads to environmental hazard. In recent years, the necessity of sustainability has been increasingly recognized in various healthcare sectors. Various aspects of dental practice can leave a significant carbon footprint.[1] The first carbon footprint for dentistry was calculated in Fife, Scotland in 2011.[2] "Eco-friendly" and "Green" are terms that have been widely used recently to denote sustainability and energy efficiency. The term "eco-friendly dentistry" was introduced by Dr. Malden Kralj, founder of Ora Dental Studio, America's first green dental group.[3] The combination of better health and the environment leads to environmentally friendly dentistry, which provides an opportunity to further reduce the degradation of our planet. There are four "R's" (reduce, reuse, recycle and rethink) to consider when dealing with waste.[4]

In many countries, medical waste management is not properly carried out due to lack of operational standards.[5] All dentists use different materials to give their patients the best possible treatment. These materials, along with their use, necessarily generate waste. All waste in a general dental office should be sorted according to a

universal color-coding system and disposed of accordingly. "Environmental audit" should be taken into account to reduce waste and make effective choices in patient treatment.[6] All the toxic waste generated in a dental clinic eventually leads to the pollution of water sources and landfills. Newer techniques are more focused on reducing waste in the dental clinic and providing better treatment outcomes. The current study was aimed at evaluating the knowledge and attitudes of practicing dentists of Ahmedabad city regarding the use of sustainable options in their routine practice.

METHODS

A cross sectional study was conducted among practicing dentists of Ahmedabad city and they were chosen by random selection method. A pre-designed questionnaire form was circulated among the dentists of Ahmedabad. As the questionnaire was self-designed, the content validity was established by a panel of health science faculty at Ahmedabad Dental College and Hospital. Questionnaire was pilot tested by circulating it among 10 practicing dentists of Ahmedabad city and they were told to provide feedback. The questionnaire consisted of three sections: demographic data; biomedical waste management; perception of practicing dentists regarding sustainable choices in regular practice.

Questionnaire circulation was done from 1st January 2023 to 30th January 2023. 325 dentists were personally contacted and asked to read the cover letter explaining the purpose of the survey. 301 dentists participated in the study voluntarily. Respondents were informed that their identity will not be revealed on the questionnaire as well as to the principle investigator. If the person voluntarily consented to participate, the administrator waited and collected the questionnaire after it was completed. For inclusion, subjects had to be dentists, 24-65 years of age, working in private dental offices and willing to complete the questionnaire. The filled questionnaires were obtained and result formulation was done.

RESULTS

A total of 301 dentists consented to participate in the study. Among the total participating dentists, 30.6% were BDS (general dental practitioners), 16.8% were practicing Paediatric dentists and 52.6% were MDS of branches other than paediatric dentistry. Most of the participating dentists (73.7%) were having less than 5 years of experience. 12.6% and 13.7% participants were having respectively 5-10 years of experience and more than 10 years of experience.

Table 1: Results gained on the basis of qualification.

Options	Qualification N (%)			Total (%)
	MDS (pediatric dentist)	MDS (otherbranches)	BDS	
Q1. Are you aware about different categories of biomedical waste management? **				
Yes	50 (100)	154 (97.5)	93 (100)	297 (98.7)
No	0 (0)	4 (2.5)	0 (0)	4 (1.3)
Not certain	0 (0)	0 (0)	0 (0)	0 (0)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q2. Are you aware about colour coding employed in biomedical waste management?**				
Yes	50 (100)	155 (98.1)	93 (100)	298 (99)
No	0 (0)	3 (1.9)	0 (0)	3 (1)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q3. If yes, do you use the colour coding system at your clinic/workplace for wastedisposal? *				
Yes	47 (94)	131 (84.5)	89 (95.7)	257 (89.6)
No	3 (6)	24 (15.5)	4 (4.3)	31 (10.4)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q4. Who manages the disposal of biomedical waste at your clinic/workplace/hospital?**				
Assistant/attender at the clinic	43 (86)	135 (85.4)	83 (89.2)	261 (86.7)
Self	7 (14)	23 (14.6)	10 (10.8)	40 (13.3)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q5. How often is the biomedical waste collected from your clinic by the professionalagency? **				
Once a week	19 (38)	66 (41.8)	39 (41.9)	124 (41.2)
Twice a week	13 (26)	56 (35.4)	35 (37.6)	104 (34.6)
Thrice a week	18 (36)	36 (22.8)	19 (20.4)	73 (24.3)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q6. Do you have separate system for mercury containing waste management? *				
No	24 (48)	87 (55.1)	28 (39.1)	139 (46.1)
Yes (amalgamseparator)	26 (52)	71 (44.9)	65 (69.9)	162 (53.8)

Continued.

Options	Qualification N (%)			Total (%)
	MDS (pediatric dentist)	MDS (otherbranches)	BDS	
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q7. Do you have a separate system for lead containing waste management? **				
No	31 (62)	91 (57.6)	44 (47.3)	166 (55.1)
Yes	19 (38)	67 (42.4)	49 (52.7)	135 (44.9)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q8. Do you use a sharps container for sharp waste disposal? **				
Yes	41 (82)	138 (87.3)	87 (93.5)	266 (88.4)
No	9 (18)	20 (12.7)	6 (6.5)	35 (11.6)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q9. Do you believe in the concept of sustainable/eco friendly dentistry? *				
Yes	47 (94)	158 (100)	93 (100)	298 (99)
No	3 (6)	0 (0)	0 (0)	3 (1)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q10. Which of the following patient apron do you use at your clinic? *				
Reusable	28 (56)	127 (80.4)	61 (65.6)	216 (71.8)
Disposable	22 (44)	31 (19.6)	32 (34.4)	85 (28.2)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q11. Which of the following suction tip do you use? *				
Disposable	47 (94)	137 (86.7)	90 (96.8)	274 (91)
Autoclavable	3(6)	21 (13.3)	3 (3.2)	27 (9)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q12. Which of the following water cups do you use at your clinic? *				
Biodegradablepaper cups	25 (50)	98 (62)	67 (72)	190 (63.1)
Plastic cups	25 (50)	60 (38)	26 (28)	111 (36.9)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q13. Which of the following syringe do you use? *				
Disposable	47 (94)	158 (100)	93 (100)	298 (99)
Autoclavableglass syringe	3 (6)	0 (0)	0 (0)	3 (1)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q14. Which of the following method of obtaining radiograph do you use? *				
OPG	44 (88)	123 (77.8)	87 (93.5)	154 (84.4)
IOPA	6 (12)	35 (22.2)	6 (6.5)	47 (15.6)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q15. Which of the following impression taking technique do you use? *				
Autoclavable sstrays	34 (68)	92 (58.2)	41 (44.1)	167 (55.5)
Disposableplastic trays	9 (18)	53 (33.5)	36 (38.7)	98 (32.6)
Digital scanimpression	7 (14)	13 (8.2)	16 (17.2)	36 (12)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q16. Which of the following headcap and mask do you use? **				
Disposable	38 (76)	109 (69)	66 (71)	213 (70.8)
Reusable cloth	12 (24)	49 (31)	27 (29)	88 (29.2)
Total	50 (100)	158 (100)	93 (100)	301 (100)
Q.17 Which of the following systems do you follow to maintain patient records at theclinic? **				
Digital case files	16 (32)	43 (27.2)	18 (19.4)	77 (25.6)
Digital case files	6 (12)	28 (17.7)	22 (23.7)	56 (18.6)
Both	28 (56)	87 (55.1)	53 (57)	168 (55.8)
Total	50 (100)	158 (100)	93 (100)	301 (100)

Almost all the BDS participants (95.7%) were using colour coding system at their clinic/workplace for waste disposal than other participants. Similarly, greater number of BDS participants (69.9%) were having separate system for mercury containing waste management compared to other participants which was statistically significant. Almost all of the BDS and MDS (other branches) participants (100%) believed in the concept of sustainable/eco friendly dentistry than other participants.

Table 2: Results gained on the basis of years of experience.

Options	Years of experience N (%)			Total (%)
	< 5 years	5 to 10 years	> 10 years	
Q1. Are you aware about different categories of biomedical waste management? *				
Yes	221 (100)	38 (100)	38 (90.5)	297 (98.7)
No	0 (0)	0 (0)	4 (9.5)	4 (1.3)
Not certain	0 (0)	0 (0)	0 (0)	0 (0)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q2. Are you aware about colour coding employed in biomedical waste management?**				
Yes	218 (98.6)	38 (100)	42 (100)	298 (99)
No	3 (1.4)	0 (0)	0 (0)	3 (1)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q3. If yes, do you use the colour coding system at your clinic/workplace for wastedisposal? *				
Yes	200 (90.5)	25 (71.4)	42 (100)	257 (89.6)
No	21 (9.5)	10 (28.6)	0 (0)	31 (10.4)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q4. Who manages the disposal of biomedical waste at your clinic/workplace/hospital?*				
Assistant/attender at theclinic	187 (84.6)	32 (84.2)	42 (100)	261 (86.7)
Self	34 (15.4)	6 (15.8)	0 (0)	40 (13.3)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q5. How often is the biomedical waste collected from your clinic by the professionalagency? **				
Once a week	104 (47.1)	10 (26.3)	10 (23.8)	124 (41.2)
Twice a week	63 (28.5)	19 (50)	22 (52.4)	104 (34.6)
Thrice a week	54 (24.4)	9 (23.7)	10 (23.8)	73 (24.3)
Total	221 (100)	38 (100)	42(100)	301 (100)
Q6. Do you have separate system for mercury containing waste management? *				
No	80 (36.2)	26 (68.4)	33 (78.6)	139 (46.1)
Yes (amalgamseparator)	141 (63.8)	12 (31.6)	9 (21.4)	162 (53.8)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q7. Do you have a separate system for lead containing waste management? **				
No	115 (52)	22 (57.9)	29 (69)	166 (55.1)
Yes	106 (48)	16 (42.1)	13 (31)	135 (44.9)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q8. Do you use a sharps container for sharp waste disposal? *				
Yes	205 (92.8)	25 (65.8)	36 (85.7)	266 (88.4)
No	16 (7.2)	13 (34.2)	6 (14.3)	35 (11.6)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q9. Do you believe in the concept of Sustainable/Eco friendly dentistry? **				
Yes	218 (98.6)	38 (100)	42 (100)	298 (99)
No	3 (1.4)	0 (0)	0 (0)	3 (1)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q10. Which of the following patient apron do you use at your clinic? **				
Reusable	152 (68.8)	32 (84.2)	32 (76.2)	216 (71.8)
Disposable	69 (31.2)	6 (15.8)	10 (23.8)	85 (28.2)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q11. Which of the following suction tip do you use? *				
Disposable	208 (94.1)	28 (73.7)	38 (90.5)	274 (91)
Autoclavable	13 (5.9)	10 (26.3)	4 (9.5)	27 (9)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q12. Which of the following water cups do you use at your clinic? *				
Biodegradablepaper cups	136 (61.5)	19 (50)	35 (83.3)	190 (63.1)
Plastic cups	85 (38.5)	19 (50)	7 (16.7)	111 (36.9)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q13. Which of the following Syringe do you use? **				

Continued.

Options	Years of experience N (%)			Total (%)
	< 5 years	5 to 10 years	> 10 years	
Disposable	218 (98.6)	38 (100)	42 (100)	298 (99)
Autoclavableglass syringe	3 (1.4)	0 (0)	0 (0)	3 (1)
Total	221 (100)	38 (100)	42 (100)	301(100)
Q14. Which of the following method of obtaining radiograph do you use? **				
OPG	188 (85.1)	31 (81.6)	35 (83.3)	254 (84.4)
IOPA	33 (14.9)	7 (18.4)	7 (16.7)	47 (15.6)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q15. Which o the following impression taking technique do you use? *				
Autoclavable sstrays	119 (53.8)	16 (42.1)	32 (76.1)	167 (55.5)
Disposableplastic trays	75 (33.9)	16 (42.1)	7 (16.7)	98 (32.6)
Digital scanimpression	27 (12.2)	6 (15.8)	3 (7.1)	36 (12)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q16. Which of the following head cap and mask do you use? *				
Disposable	165 (74.7)	29 (76.3)	19 (45.2)	213 (70.8)
Reusable Cloth	56 (25.3)	9 (23.7)	23 (54.8)	88 (29.2)
Total	221 (100)	38 (100)	42 (100)	301 (100)
Q17. Which of the following systems do you follow to maintain patient records at the clinic? *				
Physical casefiles	43 (19.5)	20(52.6)	14 (33.3)	77 (25.6)
Digital case files	53 (24)	0 (0)	3 (7.1)	56 (18.6)
Both	125 (56.6)	18 (47.4)	25 (59.5)	168 (55.8)
Total	221 (100)	38 (100)	42 (100)	301 (100)

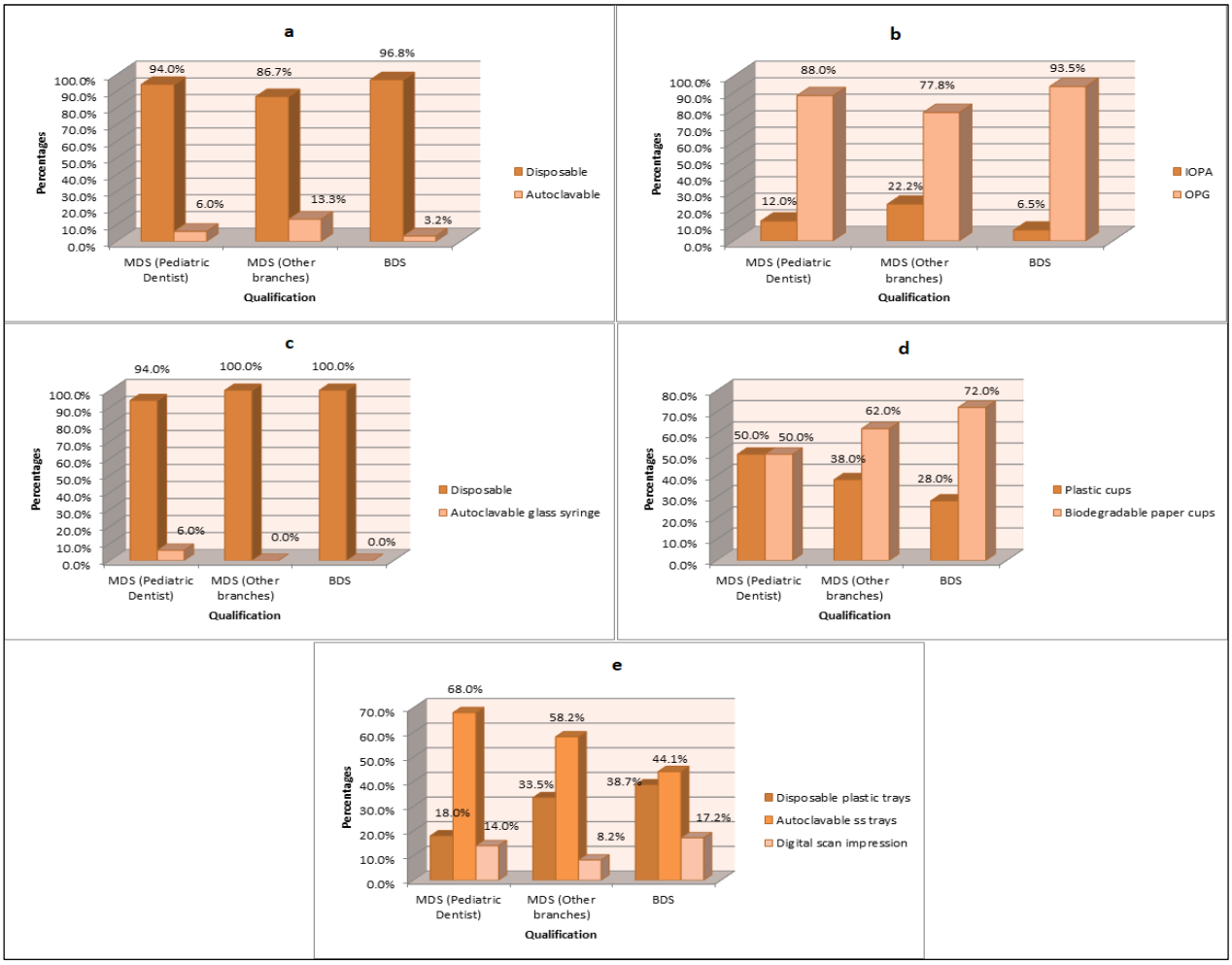

Figure 1: Graphical representation of significant results of questions from table 1.

Predominantly MDS (paediatric dentist) participants (44%) were using disposable patient apron at their clinic than the other participants [Figure 1(a)].

Majorly all the BDS participants (93.5%) were using OPG compared to the other participants [Figure 1(b)].

Almost all of the BDS and MDS (other branches) participants (100%) were using disposable syringe whereas only 6% of MDS (Paediatric dentist) chose to use glass syringe [Figure 1(c)].

Greater number of MDS (paediatric dentist) participants (94%) were using disposable suction tip and half of the MDS (paediatric dentist) were using plastic cups than other participants [Figure 1(d)].

It was observed that 94% of MDS (paediatric dentist) participants were using autoclavable trays for impression compared to the other participants. Whereas, a few practitioners (12%) started using digital impressions [Figure 1(e)].

Among all participants, the participants with more than 10 years' experience (100%) were using the colour coding system at their clinic/workplace for waste disposal and were giving responsibility to assistant/attender at the clinic to manage the disposal of biomedical waste than other participants compared to other participants.

It is evident that the participants with more than 10 years' experience (83.3%) were using plastic water cup than other participants. 63.8% of the participants with less than 5 years' experience were having separate system for mercury containing waste management. 92.8% of the dentists with less than 5 years' experience were using a sharps container for sharp waste disposal compared to the other participants. These results were statistically significant results.

Maximum participants with less than 5 years' experience (94.1%) were using disposable suction tip than other participants. Statistically, significant difference was present among various study participants [Figure 2(a)].

With respect to patients' documentation, the participants with less than 5 years' experience (24%) were using digital case file systems to maintain patient records at the clinic than other participants [Figure 2(b)].

Half of the participants with more than 10 years' experience (54.8%) were using head cap and mask made from reusable cloth compared to practitioners with 5-10 years' of experience (23.7%) and practitioners with less than 5 years' experience (25.3%). The result was statistically significant [Figure 2(c)].

Large number of participants (76.1%) with more than 10 years' of experience were using autoclavable stainless steel trays compared to participants with less than 5 years' of experience (53.8%) and participants with 5-10 years' of experience (42.1%). These results were statistically significant [Figure 2(d)].

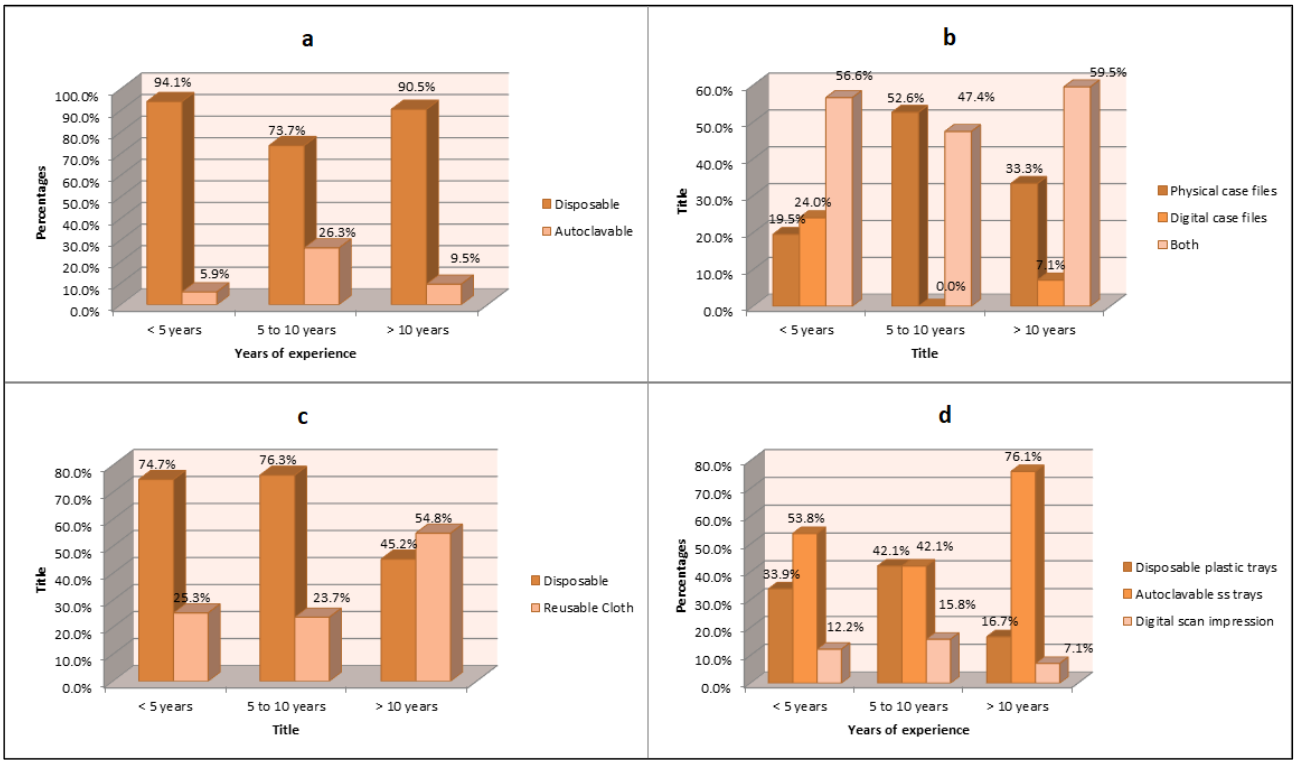

Figure 2: Graphical representation of results of questions from Table 2.

DISCUSSION

The study was done to assess knowledge and use of eco-friendly options in regular practice as well as to assess the situation of biomedical waste management. This study also assessed the changing trends regarding using eco-friendly options in regular practice among dentists of Ahmedabad city. Assessing the changing trends is necessary to provide a better pathway towards green dentistry. It can lead practicing dentists towards using autoclavable instruments for treatments as well as incorporating digitization in maintaining patient records. This study concluded in a key point that 99% of practicing dentists of Ahmedabad city believed and understood the concept of green dentistry which is significantly higher than shown in the study done by Chandrasekhar et al in 2020, where 64.4% respondents were aware.[7]

A study done by Grose et al in 2016 concluded that the staff was concerned regarding the amount of waste generated but recognized that this was in response to strict infection control guidelines.[8] It can be compared to the results gained by current study as most of the dentists preferred using disposable instruments compared to autoclavable owing to infection control guidelines. According to a study done by Danaei et al in 2014, only 60% of centres used standard method for sharps disposal in clinics in Shiraz, which is lesser than the gained results (88.4%) of the current study.[9] Studies done by Pallavi et al, Chopra et al and Al Shatrat et al have shown use of digital patient record system in 52.9%, 78.7%, 49% respectively.[7,10,11] These results are similar to the current study where 55.8% of dentists use both the computer based as well as the physical filing system. However, results of the study done by Nagarale et al in 2022 concluded that 80% of dentists maintained digital records which was significantly higher compared to the results gained by current study.[12] Among the participating dentists, 84.2% utilize digital radiography, a notably higher percentage compared to the research conducted by Chandrashekhar et al (51.7%) and Sen et al (40.3%).[7,13] Use of reusable suction tips was done by only 8.4% of dental practitioners participating in the current study. This was in accordance with the study done by Chandrashekhar et al (9.2%) and by Al Shatrat et al (8.7%).[7] 53.7% of dentists used proper amalgam waste management systems which was contradictory to results of the study done by Al Shatrat et al (18%).[11] Use of stainless steel cups instead of disposable paper or plastic cups are recommended by various guidelines.[4] If using a disposable cup is a must, use of biodegradable disposable paper cups should be done.[4] 63.2% of total participants used biodegradable paper cups.

Biomedical waste management is also an important factor for maintaining an eco-friendly dental practice. According to a study done by Ingle et al in 2003 and Sudhir et al in 2006, 14.8% and 11.1% of the dentists were not aware about the different categories of bio-medical waste produced in their clinic which is significantly higher than the results obtained by the current study (1.3%).[14,15] 90.4% of the participants of current study were aware about the colour coding system of bio-degradable waste which was higher than results of the study done by Ingle et al (72%).[14] In a study done by Treasure et al, 40% of participating dental practitioners destroyed the needle before disposing the injection.[16] Another study by Ingle et al curated results that 24.4% participants used a proper sharps disposal which was significantly lower than the results gained by the current study (88.4%).[14]

The study also compared biomedical waste management and eco-friendly choices of dentists based on their experience and qualification. Paediatric dentists were the only participants who were using autoclavable glass syringe and stainless steel impression trays in their regular practice. While comparing the responses based on their years of experience, the outcome stated that majority of the newly practicing dentists were having more eco-friendly choices in terms of use of digitisation in dental clinic. The results also concluded that dentists with less than 5 years of experience exhibited proper methods for sharps and mercury waste disposal as compared to more experienced dentists. However, use of autoclavable cloth head cap and mask were followed more by the dentists who have had more than 10 years of experience.

Validity and reliability of such surveys can be influenced by the design, content of questions, analysis and response rates.

CONCLUSION

The current study concludes that the knowledge regarding proper biomedical waste management and sustainable options in regular dental practice is satisfactory among dentists of Ahmedabad. Though incorporating and implementing eco-friendly options or strategies in general dental practice is not as easy as one might think considering the cost effectivity and infection control protocols. Specific organizations for biomedical waste collection are available in their place but half of the dentists voted that waste collection is only done once every week which appeared insufficient. Knowledge regarding biomedical waste management and eco-friendly dentistry can be adapted by including them in regular curriculum.

Safe and efficient management of waste is a legal necessity and a social responsibility of all medical professionals. Green dentistry is a high-tech approach that reduces risk and environmental impact of dental practice and includes a safe model for dentistry that supports and sustains overall wellness. As health professionals, we should care about supporting not only the patients' health and well-being, but also of the environment.

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