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RESEARCH ARTICLE

ASSESSING STERILIZATION AND INFECTION CONTROL PRACTICES: THE CASE OF PRIVATE DENTAL PRACTITIONERS IN EAST DELHI REGION

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ABSTRACT

Background: Biosafety is a concern in all health sector services. Confronted with a high biological riskboth for patients and professionals in dentalcare and due to the constant development of new technologies, information, equipment, material and behavioral attitudes in this area.
Aim: The aim of this study was to assess sterilization and infection control practices that are followed by private dental practitioners in East Delhi region.
Methodology: A descriptive, cross-sectional survey was conducted to assess the attitude towards and sterilization practices among the private dental practitioners in East Delhi, India. A structured proforma was used for the collection of the information by the investigator.
Results: A large proportion (68.0%) of the private dental practitioners carried out the pre-cleaning of the instruments before sterilization. Autoclave (66.0%) was the principle method of sterilization of the instruments among the private dental practitioners followed by Chemiclave (18.0%). Most (46.0%) of the private dental practitioners utilized the sterilized instruments within 1 week of sterilization. Autoclave was used more by the dental practitioners with more than 10 years of experience (35.7%) for sterilization of burs. Most (40.0%) of the private dental practitioners were not sterilizing endodontic files in their office. Most (52.0% and 66.0% respectively) of the private dental practitioners sterilized paper points and guttapercha respectively in their office.
Conclusion: To achieve sterilization, it is necessary to adhere strictly to procedures for instrument cleaning and wrapping and to follow carefully the sterilizer manufacturer's operating and maintenance instructions.

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INTRODUCTION

Biosafety is a concern in all health sector services. Confronted with a high biological risk both for patients and professionals in dental care and due to the constant development of new technologies, information, equipment, material and behavioral attitudes in this area, [15,33,21] health Organizations such as the Center for Disease Control (CDC), the American Dental Association (ADA), the National Sanitary Department (ANVISA) and the Ministry of Health (MOH) among others, have developed guidelines to prevent, minimize or eliminate any threat to life or health during treatment. This includes all instruments and equipment used, regardless of the confirmed or presumed diagnosis, being infectious or not.[9,11] The dental clinic is an environment where disease transmission occurs easily.[41] Prevention of cross infection in the dental clinic is therefore a crucial aspect of dental practice, and dental clinic workers must adopt certain basic routines while practicing. Dental health care professionals (DHCPs) are at risk of infections caused by various microorganisms such as Mycobacterium tuberculosis, hepatitis B and hepatitis C viruses, staphylococci, streptococci, herpes simplex virus types 1, human immunodeficiency virus (HIV), mumps, influenza, and rubella.[16,38] The environment in dentistry practices and clinics is far from ideal.[23]However, the adoption of infection control measures is an effective way to reduce occupational risk and the transmission of pathogens, mainly through saliva, blood, air or water. These measures essentially include (I) cleaning, disinfection and sterilization; (II) the use of personal equipment protection;(III) immunization; (IV) prevention and correct handling in occupational accidents which involve exposure to blood and bodily fluids; and (V) antisepsis.[5,11,30]

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Disinfection and sterilization are essential for ensuring that medical and surgical instruments do not transmit infectious pathogens to patients. Because sterilization of all patient-care items is not necessary, health-care policies must identify, primarily on the basis of the items' intended use, whether cleaning, disinfection, or sterilization is indicated.[23,39,42,47]
The American Dental Association recommends that all instruments, burs, mirrors, bands, and other devices used in intraoral treatments be sterilized by one of these four methods: Steam autoclaves, Dry heat ovens, Unsaturated chemical vapor sterilizers, and Ethylene oxide gas sterilizers. There four types of sterilization can be easily controlled and their effectiveness verified during use in the dental office.[2,13,14] However, the factors that affect the efficacy of both disinfection and sterilization include prior cleaning of the object; organic and inorganic load present; type and level of microbial contamination; concentration of and exposure time to the germicide; physical nature of the object (e.g., crevices, hinges, and lumens); presence of biofilms; temperature and pH of the disinfection process; and in some cases, relative humidity of the sterilization process (e.g., ethylene oxide). Since the occurrence of most sterilization problems is unpredictable, it is necessary to routinely monitor equipment performance. Physical observations and internal and external chemical monitors can provide immediate results. Unfortunately, such methods can measure only one parameter, such as temperature or the presence of a specific gas. They cannot assess all of the physical factors that must work in concert so that sterilization can be achieved. The main guarantee of sterilization is the successful killing of a bacterial endospore sample.[1, 14,31] Multiple studies in many countries have documented lack of compliance with established guidelines for disinfection and sterilization.[23,39,42,47] Failure to comply with scientifically-based guidelines has led to numerous outbreaks.[12,20,25,26,39,44,45] Therefore, the present study was conducted to assess the attitude and practices of the private dental practitioners in India towards the sterilization of the instruments and equipments and suggest suitable recommendations in the light of the current scenario.

MATERIALS AND METHODS

A descriptive, cross-sectional survey was conducted to assess the attitude towards and sterilization practices among the private dental practitioners in East Delhi, India. A structured proforma was used for the collection of the information by the investigator.

Ethical clearance: The permission to carry out the study was obtained from the Institutional Committee of the Santosh Dental College, Ghaziabad. Written informed consent was obtained from all participants. The present research was conducted in full accordance with the World Medical Association Declaration of Helsinki.

Study proforma: The proforma included information such as demographic factors, including gender, age, and year of study. As, there was no standard proforma available, aproforma was framed with the help of experts in the field. The questions assessed the attitude and practices regarding the sterilization of the instruments and equipments among the private dental practitioners. The proforma kept the study group in mind, and questions were linked to the sterilization practices. A self-administrated proforma consisting of fourteen close-ended items was used for data collection.

Study sample: The study population consisted of private dental practitioners in East Delhi. A total of 300dentists were delivered the survey questionnaire, of which 200 completed the whole questionnaire. The over-all response rate among there spondents was 70%.

Statistical Analysis: The data were tabulated and entered into Microsoft excel 2010 and analysed using the SPSS software 16.0. The descriptive analysis of the responses was carried out and the results were expressed in the form off requencies and percentages. The chi-square test was used for comparison of the categorical variables.

RESULTS

All the private dental practitioners in the present study were concerned about the risk of cross-infection to themselves and their assistants. Majority (62.0%) of the dental practitioners did not sterilize their instruments themselves in their office and were sterilized by their assistants only. Majority (68.0%) of the dental assistants did not have any formal training in the sterilization and infection control practices and were trained in practice only. However, there was no difference in these practices among the dental practitioners with less than 10 years and more than 10 years of practice. (**Table 1**) A large proportion (68.0%) of the private dental practitioners carried out the pre-cleaning of the instruments before sterilization. Mostly, the pre-cleaning of the instruments was carried out either by washing with soap and water (29.4%) or washing with water only (23.5%) with 47.1%using an ultrasonic cleaner for the pre-cleaning of the instruments. There was not any significant difference in the pre-cleaning of the instruments as per the practice years. (**Table 2**) Surgical cloth (42.0%) was used most frequently by the private practitioners for the packaging of the instruments before sterilization. The private dental practitioners with experience more than 10 years were using both Plastic Pouches and Surgical cloth (50.0%) whereas the practitioners with less than 10 years of practice were using only surgical cloth (46.4%). There was a statistically significant ($p<0.05$) difference in the method of packaging of the instruments before keeping them for sterilization among the private dental practitioners. (**Table 3**) Autoclave (66.0%) was the principle method of sterilization of the instruments among the private dental practitioners followed by Chemiclave (18.0%).

There was a statistically significant ($p<0.05$) difference among the private dental practitioners in sterilization practices for the sterilization of the instruments. Autoclave (72.7%) and Dry heat (9.1%) followed significantly more frequently by the private dental practitioners with more than 10 years of practice. Boiling (14.3%) and Chemiclave (25.0%) were used significantly more by the private dental practitioners with less than 10 years of practice. (**Table 3**) Most (46.0%) of the private dental practitioners utilized the sterilized instruments within 1 week of sterilization.

Table 1. Attitude towards the sterilization among the private dental practitioners

	Response	Experience			
		Less than 10 years	More than 10 years	Total	p-value
Question 1: Are you concerned about the risk of cross-infection to yourselves and your dental assistants	Yes	56	44	100	
		100.0%	100.0%	100.0%	1.000#
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 2: Do you sterilize the instruments personally in your office	Yes	24	14	38	
		42.9%	31.8%	38.0%	0.259#
	No	32	30	62	
		57.1%	68.2%	62.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 3: Did your staff receive any formal training in the sterilization and infection control practices	Yes	18	14	32	
		32.1%	31.8%	32.0%	
	No	38	30	68	0.972#
		67.9%	68.2%	68.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	

Chi-square test
#Non-significant difference (p-value>0.05)

Table 2. Practice of Pre-cleaning of instruments among the private dental practitioners

	Response	**Experience**			
		Less than 10 years	More than 10 years	Total	p-value
Question 4: Do you preclean your instruments before sterilization?	Yes	40	28	68	
		71.4%	63.6%	68.0%	
	No	16	16	32	0.407#
		28.6%	36.4%	32.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 5: How the pre-cleaning is carried out?	Ultrasonic	20	12	32	0.703#
		50.0%	42.9%	47.1%	
	Washing with soap and water	12	8	20	
		30.0%	28.6%	29.4%	
	Washing with water only	8	8	16	
		20.0%	28.6%	23.5%	
	Total	40	28	68	
		100.0%	100.0%	100.0%	

Chi-square test
#Non-significant difference (p-value>0.05)

Table 3. Sterilization practices for the instruments among the private dental practitioners

	Response	**Experience**			
		Less than 10 years	More than 10 years	Total	p-value
Question 6: How do you wrap/ pack your instruments before keeping them for sterilization	Plastic Pouches	16	6	22	
		28.6%	13.6%	22.0%	
	Surgical Cloth	26	16	42	
		46.4%	36.4%	42.0%	
	Plastic Pouches, Surgical cloth	14	22	36	0.025*
		25.0%	50.0%	36.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 7: What is the preferred method for sterilization in your office?	Autoclave	34	32	66	
		60.7%	72.7%	66.0%	
	Boiling	8	4	12	
		14.3%	9.1%	12.0%	
	Chemiclave	14	4	18	
		25.0%	9.1%	18.0%	0.022*
	Dry heat	0	4	4	
		.0%	9.1%	4.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 8: Preferred time of use of sterilized, wrapped or packed instruments	1 week	22	24	46	
		39.3%	54.5%	46.0%	
	4 weeks	12	8	20	
		21.4%	18.2%	20.0%	
	6 weeks	14	4	18	
		25.0%	9.1%	18.0%	
	12 weeks	0	4	4	0.033*
		.0%	9.1%	4.0%	
	More than 12 weeks	8	4	12	
		14.3%	9.1%	12.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	

Chi-square test
* Significant difference (p-value≤0.05)

Table 4. Sterilization practices of the burs and handpiece among the private dental practitioners

	Response	Experience		Total	
		Less than 10 years	More than 10 years		p-value
Question 9: How do use sterilize burs in your clinic	Autoclave	20	8	28	
		35.7%	18.2%	28.0%	
	Chemical vapour	2	2	4	
		3.6%	4.5%	4.0%	
	Dip it in surgical spirit	6	10	16	
		10.7%	22.7%	16.0%	
	Dry heat	6	2	8	0.293#
		10.7%	4.5%	8.0%	
	Glass bead sterilizer	6	6	12	
		10.7%	13.6%	12.0%	
	No	16	16	18	
		28.6%	36.4%	18.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 10: How do you sterilize handpieces between patients?	Autoclave	6	16	22	0.001***
		10.7%	36.4%	22.0%	
	Autoclave, Chemicalve	14	8	22	
		25.0%	18.2%	22.0%	
	Run it in a disinfectant solution	2	6	8	
		3.6%	13.6%	8.0%	
	Wipe it with surgical spirit	24	6	30	
		42.9%	13.6%	30.0%	
	No	10	8	18	
		17.9%	18.2%	18.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	

Chi-square test
*** Very Highly Significant difference (p-value≤0.05)

Table 5. Sterilization of endodontic files, paper points and guttapercha among study population

	Response	Experience		Total	
		Less than 10 years	More than 10 years		p-value
Question 11: How do you sterilize endodontic files in your office?	Autoclave	8	2	10	
		14.3%	4.5%	10.0%	
	Chemiclave	6	4	10	
		10.7%	9.1%	10.0%	
	Dip in a disinfectant solution	12	10	22	
		21.4%	22.7%	22.0%	
	Glass bead sterilizer	8	10	18	0.101#
		14.3%	22.7%	18.0%	
	Don't sterilize	22	18	40	
		46.5%	40.9%	40.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 12: Do you sterilize the paper points before use in your clinic	No	32	20	52	
		57.1%	45.5%	52.0%	
	Yes	24	24	48	0.246#
		42.9%	54.5%	48.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 13: Do you sterilize Guttapercha points before use in your clinic	No	20	14	34	
		35.7%	31.8%	34.0%	
	Yes	36	30	66	0.683#
		64.3%	68.2%	66.0%	
	Total	56	44	100	
		100.0%	100.0%	100.0%	
Question 14: How do you sterilize Guttapercha points before use in your clinic	Ethyl alcohol	6	14	20	
		16.7%	46.7%	30.3%	
	Glass bead sterilizer	4	2	6	
		11.1%	6.7%	9.1%	
	Gluteraldehyde	12	2	14	
		33.3%	6.7%	21.2%	0.024*
	Gluteraldehyde, Ethyl alcohol	4	2	6	
		11.1%	6.7%	9.1%	
	Sodium hypochlorite	10	10	20	
		27.8%	33.3%	30.3%	
	Total	36	30	66	
		100.0%	100.0%	100.0%	

Chi-square test
#Non-Significant difference (p-value>0.05)
* Significant difference (p-value≤0.05)

The private dental practitioners with experience more than 10 years used the sterilized instruments in 1 week only (54.5%) whereas dental practitioners with experience less than 10 years used the sterilized instruments in 6 weeks (25.0%) and more than 12 weeks (14.3%). There was a significant difference ($p<0.05$) in the time of use of sterilized instruments among dental practitioners with more and less than 10 years of experience. (**Table 3**) Autoclave was used more by the dental practitioners with more than 10 years of experience (35.7%) for sterilization of burs but as such there was no significant difference ($p>0.05$) in the sterilization of burs by the private dental practitioners with different levels of experience. Most of the dental practitioners with more than 10 years of experience were using Autoclave for sterilization of the handpiece whereas the dental practitioners with less than 10 years of experience were wiping it with surgical spirit before use. There was a significant ($p<0.05$) difference in the method of sterilization of the handpiece. (**Table 4**)

Most (40.0%) of the private dental practitioners were not sterilizing endodontic files in their office. Most (52.0% and 66.0% respectively) of the private dental practitioners sterilized paper points and guttaperchare spectively in their office. As such, there was no difference in the sterilization practices for the endodontic files, paper points and guttapercha among the dental practitioners with less and more than 10 years of experience. Gluteraldehyde was used significantly ($p<0.05$) more frequently by the private dental practitioners with less than 10 years of experience (21.4%) whereas Ethyl alcohol significantly ($p<0.05$) more frequently by the private dental practitioners with more than 10 years of experience (31.8%). (**Table 5**)

DISCUSSION

Due to the nature of their profession, dentists and dental assistants should not forget the risk of treating patients with probability of infectious diseases. Dentists, dental assistants and patients may be exposed to pathogenic microorganisms localized in oral cavity and respiratory tract including cytomegalovirus (CMV), HBV, HCV, herpes simplex virus(HSV) type 1 and 2, HIV, Mycobacterium tuberculosis, staphylococci, streptococci and other viruses and bacteria.[6]These microorganisms could be transmitted to the dental healthcare professionals by direct contact with a patient's saliva, blood, skin, and oral secretions, or by indirect contact through injuries caused by sharp contaminated instruments, or by droplet infection from aerosols or spatter.[6,10,43]

All the private dental practitioners in the present study were concerned about the risk of cross-infection to themselves and their assistants. This was much higher than the study by Yüzbasioglu *et al*,[46] in which, 74.10% of the dentists expressed concern about the risk of cross-infection to themselves and their dental assistants. The role of the dental assistant is vital to the process of infection control and sterilization; however, the adherence of this particular group to these guidelines is inadequate because they receive less formal training than provided for dentists.[3]Any infection control training the dental assistants receive is provided by the dentists who employ dental assistants.

Formal training and certification is equally necessary for the dental surgery assistants as for the other members of the dental team to ensure a sound knowledge understanding of all aspects of infection control in the dental setting. The training of the dental assistants is less rigorous in United Kingdom but however, it is more rigorous in unites states.[16] Prior disinfection is characterized by soaking the instruments contaminated by organic material in chemical disinfectant solutions, before cleaning, in order to reduce risks of pathogen exposures to the professional. However, research shows that this practice is not based on scientific evidence, as the organic material can interfere in the antimicrobial activity of disinfectants.[17,34,35] A large proportion (68.0%) of the private dental practitioners carried out the pre-cleaning of the instruments before sterilization mostly, either by washing with soap and water (29.4%) or washing with water only (23.5%) with 47.1%used an ultrasonic cleaner. The study by Bellissimo-Rodrigues *et al*[4] reported that75.0% of private and 93.5% of public dentists reportedan adequate procedure ($p=0.047$), which means they were cleaned soon after being used or at the end of the day, after being immersed in non-antimicrobial liquidsoap.[7,11,40] Alternatively, others allowed the dirty instruments to dry or submerged the devices in germicides, such as glutaraldehyde, bleach, hydrogen peroxide, ammonium quaternary compounds or formaldehyde. Use of germicides before cleaning is not recommended because disinfection is not achieved in the presence oforganic material and may even promote adhesion of organic substances to the device, compromising subsequent cleaning. Additionally, it may pose hazards to health-care workers.[7,11] The private dental practitioners with experience more than 10 years were using both Plastic Pouches and Surgical cloth (50.0%) whereas the practitioners with less than 10 years of practice were using only surgical cloth (46.4%). Private dentists in our study were not found to be having adequate packing practice for packaging of the instruments. Packing devices prior to sterilisation is also relevant to achieve and maintain sterilization until the device is tobe used.[7,8,11]The study by Bellissimo-Rodrigues *et al*[4] reported that the adequate packing for dry heat sterilization was accomplished by 33.3% of private but none of the public dentists ($p<0.001$). For autoclave sterilization, adequate packing was accomplished by only 20.8% of private dentists and none of the public ones ($p=1.000$).

In the present study, Autoclave (66.0%) was the principle method of sterilization of the instruments among the private dental practitioners followed by Chemiclave (18.0%). Autoclave (72.7%) and Dry heat (9.1%) followed significantly ($p<0.05$) more frequently by the private dental practitioners with more than 10 years of practice. Boiling (14.3%) and Chemiclave (25.0%) were used significantly ($p<0.05$) more by the private dental practitioners with less than 10 years of practice. Asymptomatic patients, whether carriers of infectious diseases or not, are assisted by dental surgeons every day, making sterilization processes and validation of paramount importance. In the study by Matsuda *et al*,[22] autoclave(moist-heat by steam), oven (dry-heat sterilizer), chemical solutions and alcohol were analyzed as methods of "sterilization" with autoclave being the preferred method of sterilization.

Autoclave is considered the preferred method due to its safety, quickness and its lethal effect of pressurized steam on all microorganisms.[5,9,17] Nonetheless, recent studies have shown that 12% to 33% of these devices present defects that are easily detectable with periodical monitoring of the cycles and the simultaneous use of different sterilization indicators.[32] Findings by Monarca *et al*[28] show 68.60% of autoclave users with 27.40% referring no use of indicators. Similar results were observed in the study by Matsuda *et al*,[22] where 69.38% of participants used autoclave and33.80% of these did not use indicators. Daily use or atleast weekly us of indicators, as well as the combined use of different indicators, were ignored by 81.75% and83.21%, respectively. The free use of material and/or instruments with no certification of correct sterilization is a large concern in respect to biosafety. The literature describes the oven as a secure method for sterilization, but it is less appropriate than the autoclave, mainly as it permits the interruption of process, by the heterogeneity of penetration and heat distribution inside the chamber, by the absence of a precision thermostat to effectively control temperature and because it requires prolonged exposure to high temperatures.[36] Due to these issues, sterilization in a dry-heat sterilizer which seemed to be the practice of approximately 10%of the participants in our research is currently recommended just for metal blades, points, cutting or drill instruments sensitive to oxidization by steam.[37]Chemical solutions are also referred to as sterilizers provided their concentration and length of exposure. [5]They are also considered toxic and irritant, with limited action and effectiveness. Therefore they are restricted to thermo sensitive material and are used as a last resource for sterilization, on scientific grounds.[17] A large proportion (30.0%) of the private dental practitioners were sterilizing their handpieces by wiping them with the surgical spirit followed by Autoclave (22.0%) and a combination of Autoclave and Chemicalve (22.0%). In the study by Bellissimo-Rodrigues *et al*,[4] 80% of dentists preferred to clean hand pieces by wiping them with disinfectants, but only 17.8% of them stated that they preferred autoclave for sterilize handpieces. However, it is known live blood cells and bacterial and viralparticles can survive inside handpieces even after thoroughdisinfection.[19] Many authors have emphasized the hazard of cross-infection by the use of dental instruments.[27] Some of these authors showed that 94% of dentists in Kuwait used autoclave to sterilize handpieces.[29]Kurdy and Fontaine[18] showed that 30%of dentists in Saudi Arabia had sterilized hand pieces with autoclave and 90% of them autoclaved their instruments at the end the day. Al-Rabeah and Mohamed[3] stated that 37.90% of dentists autoclaved handpieces. According to Miller,[27] the mostcommon reason for not sterilizing hand pieces is the fear of damage to the equipment.

Conclusion

The sterilization process is a combination of a variety of procedures, which include both human and material factors. It would have been interesting if this study had determined the critical importance of one or two practice or personal elements. However, the inability to establish such identifications only reinforces the known complexity of the sterilization process. To achieve sterilization, it is necessary to adhere strictly to procedures for instrument cleaning and wrapping and to follow carefully the sterilizer manufacturer's operating and maintenance instructions.

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