

Awareness and Pragmatic Use of Respirators among Dental Healthcare Professionals during COVID-19 Pandemic: A Cross-sectional Study

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ABSTRACT

Aim: This cross-sectional study intends to assess dental healthcare professionals' (DHCPs) knowledge and awareness of the proper use and reuse of respirators.

Materials and methods: A hospital-based cross-sectional survey was conducted using a self-administered questionnaire adapted from the Centers for Disease Control and Prevention (CDC) guidelines regarding the use of respirators with the primary objective of cognizance regarding fit testing, use, reuse, and reprocessing. A total of 478 dental professionals, including 192 postgraduate (PG) students, 176 interns, and 110 teaching faculty, participated in the survey. Data were analyzed using descriptive statistics.

Results: A cumulative assessment revealed that 56.9% of dental professionals signed in to use level III masks and 29.3% for N95/KN95 respirators. Amongst those individuals using respirators, only 2.9% have got fit testing done. 92.1% ($n = 440$) were clueless about the various fit testing methods. 75.7% of DHCPs chose rotation base reuse of respirators rather than extended use of respirators.

Conclusion: Clear evidence of incognizance among dental professionals regarding respirator use may put the health care professional at risk of infection. The incorporation of respirator training in infection prevention and control programs should be a prerequisite for preventing cross-infection.

Clinical significance: There is a definite need for regular training and educational programs among DHCPs on various infection control protocols with the incorporation of respirator training and the terms of use of the respirator.

Keywords: Awareness, Coronavirus disease 2019, Dentists, Health personnel, Masks, N95 respirators.

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INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) has been proven to be the greatest threat to global health in recent times. COVID-19 is a contagious disease that spreads primarily through respiratory droplets ranging from 5 to 10 μm in diameter. The typical transmission mode is *via* discharge from the mouth or nose when an infected person coughs or sneezes. Various healthcare organizations, including the World Health Organization (WHO), the CDC, and other national health bodies, have launched effective awareness campaigns all over. These programs have resulted in the universal use of face masks to combat or prevent the disease's spread.^{1,2} While the world is still waiting for the availability and success of vaccines, there is still a vast need to prevent the spread of the disease through the use of face masks among the general public. This use of a face mask is of greater importance to healthcare professionals. The use of respiratory protective masks has become common among the various essential health care providers, including dentists.³⁻⁵ Different types of masks are available in the market, including cloth masks, surgical masks, N95/KN95/filtering facepiece 2/filtering facepiece respirators, or equivalent and higher-level masks. However, there are significant price disparities between different mask/respirator choices. These cost disparities also may play a significant role in the formulation of mask/respirator guidelines for healthcare workers (HCWs). According to the various healthcare bodies use of N95 or comparable masks is recommended for health professionals, including dentists, and is widely available in the market.^{3,4} However, the proper protocol for use and disinfection needs

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more consideration. Improper use of these respirators can reduce their effectiveness and put healthcare professionals at greater risk for cross-infection. Personal attitudes toward the use of respiratory barriers are significantly influenced by awareness of the importance of respiratory barriers in preventing respiratory disease transmission, knowledge of the general differences between the different types of respirators and masks used in the COVID-19 pandemic, and the type of filter used in these masks. Therefore, this cross-sectional study intends to assess dental professionals' knowledge and awareness of the proper use and reuse of respirators.

MATERIALS AND METHODS

Study Setting

The survey was conducted in a dental teaching hospital in Andhra Pradesh, India. The approval for conducting the survey was obtained from the institutional research and ethical committee. The duration of conducting the survey was from October 2020 to January 2021.

Study Design

The study was a cross-sectional questionnaire-based analysis that included DHCPs, that is, Teaching faculty, PG students, and interns who were working in the dental setup during the pandemic period.

Study Tool/Questionnaire

The survey included nine questions that examined healthcare personnel's knowledge and awareness of the various forms of face masks. The self-administered questionnaire included standardized, pre-coded, and validated questions from frequently asked questions as per the CDC and WHO interim guidelines. The items were related to knowledge and use of different types of masks, the most common motive or rationality for the use or nonuse of a respirator, fit testing of the respirators, the expected difficulties faced during the use of respirators, and knowledge about the extended use, reuse, and reprocessing of the respirators (Fig. 1).

After the removal of ambiguous and unsuitable questions, the questionnaire validation was done. The content validity of the questionnaire was done by six independent dental professionals who were trained in infection control practices, and the questionnaire was revised as suggested. Later, the questionnaire was distributed to 40 randomly selected dental health professionals as a pilot trial to determine the sample size.

Sample Size and Data Collection

Convenient sampling was done for data collection. The sample size was calculated based on a pilot study and denial equation with a significance level set at 0.05 (∞) and power set at 0.80 (1 β). The required sample size obtained was 456. However, considering the 20% dropout ratio, the survey form was sent to 640 respondents.

Based on convenient sampling, the participants comprised teaching faculty, PGs, and interns from five teaching institutes. Potential participants were informed of the following: the objective of the survey, no known hazards of participation, data confidentiality, and the overall participation eligibility requirement. The electronic/Google survey form was prepared and distributed to about 640 potential responders, with an online informed consent form on the first page. After affirmative consent, the responders were directed to the questionnaire. The subjects were divided into various groups based on their qualification (Teaching faculty, PG students, and interns). The questionnaire consisted of nine multiple-choice questions, of which respondents must check one single most appropriate item.

Statistical Analysis

Data were tabulated in excel, and descriptive statistics were performed using Statistical Package for Social Sciences 20 software. Data was described in terms of frequency (n) and percentage (%).

RESULTS

Response Rate

A total of 478 dental professionals, including 192 PG students, 176 interns, and 110 teaching faculty, responded with a response rate of 74.6%.

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Designation: Faculty/ Intern/ Post-graduate

1. What type of masks do you use during your dental practice?
 - a. Level I masks
 - b. Level II masks
 - c. Level III masks/ Surgical masks
 - d. N95/KN95 respirators
 - e. Others
2. Reasons for not using a respirator (For non-respirator users)
 - a. Not part of our protocol
 - b. Exposure was minimal
 - c. Shortage /Unavailability of respirators
 - d. Not economical
 - e. Feel uncomfortable using respirator
3. Are your respirators fit tested? (For Respirator users)
 - a. Yes
 - b. No
 - c. No idea about fit testing
4. Are you aware of the various fit testing methods?
 - a. Yes
 - b. No
5. Can N-95 respirators with fitted exhalation valves be used in dental clinical settings
 - a. Yes
 - b. No
 - c. No idea
6. What is the most common problem encountered during use of masks?
 - a. Difficulty in breathing
 - b. Tiredness
 - c. Fogging of goggles/face shield
 - d. No problem
7. In case of a crisis/shortage of respirator which of the following do you prefer?
 - a. Extended use of respirator
 - b. Re-use of respirator (repeat donning and doffing of respirator)
8. In case you prefer extended use what precautions should be taken without causing potential adverse effects?
 - a. Alternating between masks
 - b. Heat drying in direct sunlight
 - c. UV sterilization
 - d. Not aware
9. Can a respirator be disinfected?
 - a. Yes
 - b. No

Fig. 1: Self-administered questionnaire on the use of respirators by DHCPs

Use of Respirators among PG Students

Our study was embodied with 192 PGs, out of which 67.7% reported the use of level III masks or surgical masks during their practice, whereas 20.8% ($n = 20$) appeared to use N95/KN95 respirators. However, only 1% of them reported their respirators fit testing. Awareness about fit testing methods is inferior, as 92.7% of them were not aware of it. It has been assumed by 69.8% of the responders that N95 respirators with fitted exhalation valves can be used in dental clinical settings (Table 1).

The most common problem encountered while performing clinical cases using a respirator was difficulty breathing, as displayed by 56.3%. Reuse of respirators, i.e., repeated donning and doffing of respirators, was preferred by 62.5% during a crisis/shortage of respirators. In case of extended use, heat drying in direct sunlight was opted for by 75% of PG students and alternating between masks by 18.8%.

Use of Respirators among Faculty

A total of 110 faculty members were included in our survey. It was noticed that 47.3% chose to use N95/KN95 respirators during their dental practice. Minimal exposure to patient management was considered a common reason for not using a respirator 43.6%. It was revealed that 69.2% of faculty did not get their respirators fit tested. It is vital to be recognized that 78.2% were unaware of the various fit testing methods for respirators.

According to 43.6% of our faculty members, difficulty in breathing was mentioned as the most common problem encountered while performing clinical cases using respirators. During the crisis/shortage of respirators, reuse of respirators (repeat donning and doffing of respirator) was considered appropriate for most of the faculty, i.e., by 89.1%. 45.5% of faculty preferred alternating between masks as a precaution while extending the use of respirators. Regarding the reprocessing and disinfection of respirators, 87.3% perceived that they could be disinfected.

Table 1: Frequency and percentage of responses among DHCPs with various qualifications

Question no.	Options	PG students		Faculty		Interns	
		n	%	n	%	n	%
Q1	Level I mask	0	0	0	0	0	0
	Level II masks	14	7.3	0	0	32	18.2
	Level III masks/surgical masks	130	67.7	46	41.8	96	54.5
	N95/KN95 respirators	40	20.8	52	47.3	48	27.3
	Others	8	4.2	12	10.9	0	0
Q2	Not part of our protocol	20	10.4	0	0	112	63.6
	Exposure was minimal	16	8.3	48	43.6	0	0
	Shortage/unavailability of respirators	56	29.2	38	34.5	42	23.9
	Not economical	70	36.5	24	21.8	22	12.5
	Feel uncomfortable using a respirator	30	15.6	0	0	0	0
Q3	Yes	2	1.0	2	1.8	128	72.7
	No	24	12.5	36	32.7	8	4.5
	No idea about fit testing	14	7.3	14	12.7	40	22.7
Q4	Yes	10	5.2	24	21.8	0	0
	No	178	92.7	86	78.2	176	100.0
	No idea	4	2.1	0	0		
Q5	Yes	134	69.8	76	69.1	116	65.9
	No	50	26.0	26	23.6	48	27.3
	No idea	8	4.2	8	7.3	12	6.8
Q6	Difficulty in breathing	108	56.3	48	43.6	80	45.5
	Tiredness	24	12.5	22	20.0	16	9.1
	Fogging of the goggles/face shield	60	31.3	40	36.4	80	45.5
	No problems encountered	0	0	0	0	0	0
Q7	Extended use of a respirator	72	37.5	12	10.9	32	18.2
	Reuse of respirator	120	62.5	98	89.1	144	81.8
Q8	Alternating between masks	36	18.8	50	45.5	80	45.5
	Heat drying in direct sunlight	144	75.0	24	21.8	96	54.5
	UV sterilization	12	6.3	36	32.7	0	0
	Not aware	0	0	0	0	0	0
Q9	Yes	116	60.4	96	87.3	128	72.7
	No	76	39.6	14	12.7	48	27.3

Table 2: Cumulative frequencies and percentages of responses among all the DHCPs

Question no.	Options	n	%
Q1	Level I mask	0	0
	Level II masks	46	9.6
	Level III masks/surgical masks	272	56.9
	N95/KN95 respirators	140	29.3
	Others	20	4.2
Q2	Not part of our protocol	132	27.6
	Exposure was minimal	64	13.4
	Shortage/unavailability of respirators	136	28.5
	Not economical	116	24.3
Q3	Feel uncomfortable using a respirator	30	6.3
	Yes	4	2.9
	No	68	48.6
	No idea about fit testing	68	48.6
Q4	Yes	34	7.1
	No	440	92.1
	No idea	4	0.8
Q5	Yes	326	68.2
	No	124	25.9
	No idea	28	5.9
Q6	Difficulty in breathing	236	49.4
	Tiredness	62	13.0
	Fogging of the goggles/face shield	180	37.7
	No problems encountered	0	0
Q7	Extended use of a respirator	116	24.3
	Reuse of respirator	362	75.7
Q8	Alternating between masks	166	34.7
	Heat drying in direct sunlight	264	55.2
	UV sterilization	48	10.0
	Not aware	0	0
Q9	Yes	340	71.1
	No	138	28.9

Use of Respirators among Interns

Our study comprehended responses of 176 interns, out of which 54.5% preferred level III masks or surgical masks and 27.3% preferred N95/KN95 respirators during their practice. Considering those students who preferred N95/KN95 masks, respirators fit was not tested for 83.3% of them. Whereas 63.6% did not consider respirators as a part of their protocol. It is quite alarming to note that none of the interns was aware of the fit testing for respirators. The opinion of 65.9% was that N95 respirators with fitted exhalation valves could be used in dental clinical settings. There was an equal percentage of interns (45.5%) who presumed difficulty breathing and fogging the goggles/ face shield as common problems faced with respirators during treatment procedures.

At times of crisis, 81.8% of interns considered the reuse of respirators to be a better option. 54.5% selected heat drying in direct sunlight, and 45.5% chose to alternate between masks as a precaution for extended use of respirators. According to 72.7% of interns, respirators need disinfection.

Cumulative Assessment

In total, 478 DHCPs responded, out of which 56.9% signed in to use level III masks. Amongst those individuals using respirators, only 2.9% got their respirators fit tested. A majority of our members, that is, 92.1% ($n = 440$), were clueless about the various fit testing methods. N95 respirators with fitted exhalation valves were perceived as safe to be used in clinical settings by 68.2%. The standard issue encountered while using respirators during treatment procedures was difficulty breathing, as pointed out by 49.4%. At times of shortage, 75.7% chose to reuse the respirators rather than extend the use of respirators. If extended use of respirators had to be performed, the precaution, which was considered 55.2%, heated drying in direct sunlight. Cumulatively 71.1% of our individuals agreed that respirators need disinfection (Table 2).

DISCUSSION

Among the 478 DHCPs, only 29.3% were wearing N95 or an equivalent respirator. Though people worldwide are using different types of face masks, including cloth masks, surgical masks, and respirators, for the general public, CDC recommends using simple cloth masks, whereas for people looking after someone who has COVID-19 and those having symptoms such as coughing and sneezing WHO recommends the use of surgical masks.^{2,6} For healthcare professionals in hospital settings treating COVID-19 patients and those dealing with aerosol-generating procedures, the use of a respirator is recommended.^{1,3} The use of a surgical mask during dental treatment can be recommended for non-aerosol-generating procedures recommended by the CDC.^{3,7} However, as most of the dental procedures are aerosol generating and performing the same without a respirator can put the dentist at the highest risk for cross-infection.^{8,9}

In the current survey, it was observed that the most common reasons for the nonuse of a respirator are economic concerns and reduced comfort during the same. It was observed a higher demand for N95 masks has a greater impact on the cost of the respirators. Earlier systematic reviews have reported that there are insufficient well-conducted cost-effectiveness studies on the use of alternative mask/respirator options.^{10,11} Considering the vast difference in the costs between masks and respirators, a comprehensive economic evaluation and analysis of the cost-benefit ratio may be the need of the hour. Based on these analyses, healthcare bodies and facilities should provide clear guidance and regulations on the appropriate use of different types of masks for various dental procedures.

During these times, a trend favors N95 respirators; however, there is no apparent awareness of the proper use of respirators. In our study, we have observed that only 2.9% of the responders got their respirators fit tested; most importantly, around half of the responders are ignorant of fit testing. Fit testing of respirators is a must for all respirators whenever a healthcare worker starts wearing it initially or should be done once annually or when the person changes to a different size, style, model, or make of respirator.^{12,13} The edges of these respirators are designed to form a seal around the nose and mouth. As reported by health and safety bodies, every time a respirator is worn, a seal check must be done to check that the respirator is appropriately sealing onto the face.¹⁴ Among the participants, 92.1% of dental professionals are not aware of fit testing methods. Though quantitative fit testing methods are more time-consuming and complicated, qualitative methods can be of great help in regular dental settings.^{15,16}

The most common problems encountered by all the responders during respirators' use are difficulty in breathing and fogging of the goggles or face shields. Fogging of the goggles is usually caused due to a lack of proper seal on the mask's upper nose component. Hussainy Haj A et al. reported in their studies that fogging can be prevented by checking for proper seal either by positive pressure or negative pressure technique every time the operator wears a mask or respirator, by double masking, or by putting the visor shield 5–6 cm away from the operator's face.^{17,18}

Though N95 respirators are designed as disposable and intended for disposal after the management of each patient, it was observed that most of the responders in the current study preferred extended use or reuse of the masks, which can affect the filtration capacity of the masks. This could be due to the economic concerns and unavailability of masks' which makes disposal of the respirator after each use highly impractical. According to CDC guidelines, extended use of the masks between the patients for up to 8 hours provided the respirators are covered with a face shield to prevent soiling.¹⁹ Reuse of respirators is preferred by a few organizations, keeping in mind that the virus remains inactive after 72 hours^{19,20}; therefore, rotation basis reuses to a maximum of 5 times only if the fit of the respirator is proper and not disturbed by mechanical forces.²⁰ Though the Food and Drug Administration's currently approved methods for emergency reprocessing of the respirators are hydrogen peroxide, ultraviolet (UV) light, and dry heat, when done under proper conditions without any mechanical damage, only 10% of the participants reported UV sterilization as a method of processing the used respirators.²⁰

Strengths and Limitations

To the best of our knowledge, this is the only study that was done to assess the awareness and knowledge about the use and reuse of respirators among DHCPs. This survey depicts the growing need for the adoption of strategies to improve awareness among DHCPs. However, there are a few limitations associated with any self-reporting questionnaires, such as accuracy and personal bias. Longitudinal studies emphasizing the importance of proper use and methods to improve the same would be beneficial in maintaining the health of the personnel and preventing cross infections.

CONCLUSION

Irrespective of the qualification of the DHCPs, overall awareness about respirator use amongst the HCWs is below par. As the world embraces the COVID-19 pandemic, there is a definite need for regular training, and educational programs among DHCPs on various infection control protocols with the incorporation of respirator training and the facilities should dictate the terms of use of the respirator. The questionnaire offers to be a potential tool for the development of educational tools and programs to offer guidance to dental health professionals regarding the use of respirators.

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