



COVID-19 Pandemic: The Implication for the Practice of Restorative Dentistry in Nigeria

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Abstract

Objective: To assess the implication of COVID-19 pandemic on the practice of restorative dentistry in Nigeria.

Materials and Methods: A cross-sectional study regarding the impact of COVID-19 on restorative dental practice was carried out among dentists across different cadres working in either private or public practice. Data was obtained using an online survey questionnaire regarding the infection control practice, availability and use of personal protective equipment, practice modifications to combat COVID-19 outbreak and the impact of COVID-19. Data was analysed using the chi-square test and p-value <0.05 was considered statistically significant.

Results: Amongst 137 dentists that participated in the study, majority of respondents were males (58.4%), a greater proportion (49.6%) were in the age range 35-44 years and 78.1% worked in public hospitals. A significantly higher number of male respondents ($p=0.019$) and public dental workers ($p=0.036$) immediately changed their mode of dental service delivery following the COVID-19 outbreak. Majority of respondents (60.6%) carried out restorative dental procedures despite the pandemic; most of these procedures being emergency dental treatment and non-aerosol generating dental procedures. About half of respondents had respiratory masks (51.8%) and isolation gowns (54.0%) available. Majority reported that the pandemic had decreased patient flow (88.3%), increased treatment fee (53.3%) and had an impact on the income generated (92%). Only 20.4% of respondents had problems with their staff; the problems being emotional problems, work abandonment and demand of salary increase. The pandemic has had a negative impact on most respondents (74.5%) and only 31.4% respondents were optimally prepared to render dental services.

Conclusion: COVID-19 pandemic has changed the mode of restorative dental practice in Nigeria; resulting in a psychological impact on dentists and a financial burden on dental practice.

Keywords: COVID-19, Impact, Private Practice, Restorative Dentistry, Nigeria

Introduction

The onset of Coronavirus disease (COVID-19) in Wuhan, China in early December 2019 was

considered nothing more than a severe acute respiratory disease; it has since shocked and overwhelmed the public healthcare of many nations.

On January 8, 2020, a novel coronavirus was officially announced as the causative pathogen of COVID-19 by the Chinese Centre for Disease Control and Prevention¹. Consequent upon its high infectivity and rapidity of spread across international borders, the World Health Organization (WHO)² in March 2020 declared COVID-19 a pandemic.

The index case (an Italian) of COVID-19 in Nigeria was reported on the 27, February, 2020³. Subsequent spread of the disease in Nigeria was facilitated by Nigerian elites returning to the country after vacations or business trips; a testament to the impact of globalization on the spread of communicable diseases⁴. COVID-19 has spread to all states in Nigeria with Lagos State as the epicentre^{3,5}. The updated report for 28 July 2020 put the number of infected Nigerians at 41,804³.

The COVID-19 pandemic has brought new challenges and responsibilities all across the world, placing healthcare professionals at risk. This is evident in the increasing numbers of the infection being detected among health care workers¹. The characteristics of dental settings may increase the risk of cross infection between dental practitioners and patients because the pathogen causes both upper and lower respiratory tract infections^{6,7}. The transmission of the infection is believed to be via inhalation of airborne droplets and spatter from respiratory secretions, blood and saliva from infected individuals or contaminated surfaces^{8,9}.

Clinical symptoms of COVID-19 range from fever, shortness of breath, cough, distortion of taste and smell, diarrhoea and vomiting to progressive respiratory failure and eventual death in some cases¹⁰. The presence of comorbidities such as diabetes and cardiovascular diseases as well as old age are commonly linked with worse prognosis¹¹. The high rate of infectivity as well as the modes of transmission via droplets, aerosol, direct contact, and surface contamination places dental health professionals in a group of high exposure risk¹². Critical to placing dental health practitioners in the high exposure risk category is their very close proximity to the oral cavity of patients during treatment¹³.

Dentists especially those in restorative dental practice or those that routinely perform aerosol-generating procedures (AGP) using the dental high-speed turbine, spray hand piece, or piezoelectric instruments without adequate protection are particularly vulnerable¹⁴. Although these are the primary aerosol producers, other less invasive dental treatments such as oral examination and intraoral

radiographs may produce infectious droplets through gagging and coughing¹⁰.

In addition to bio-aerosols and or aerosol generated during restorative procedures; studies have shown that the skin and mucous membranes of the mouth, respiratory passages and eyes of dental personnel may be contaminated by microorganisms in spatter of saliva^{15,16}. Hence, rigorous infection control protocols are recommended^{17,18}.

Owing to the high virulence of COVID-19, the potential transmission of disease during dental procedures has become a source of increased concern to the dental profession and the public^{19,20}. WHO recommends the use of N95 respiratory masks or its equivalent filtering facepieces respirators (FFP2) only in the context of aerosol generating procedures performed on patients with COVID-19²¹, which in addition to other personal protective equipment (PPE) greatly reduces the transmission of the virus. Other measures occasioned by COVID-19 pandemic include the enhanced three-level protective measures for dental personnel¹⁰, pre-procedural mouth rinse with 1% hydrogen peroxide or 0.2% povidone to reduce saliva load of oral microbes including COVID-19²², the use of rubber dam and a high volume suction to minimize aerosol or spatter²³ and the use of anti-retraction handpieces¹⁰.

Dental practices worldwide have witnessed unprecedented changes in the wake of the COVID-19 pandemic. This is largely at the instance of dental associations and societies²⁴ which have recommended among others total or partial shutdown of services, changes in patient's evaluation protocol, enhanced hygiene and personal protective measures for dental personnel; all of which may present financial burden to the dentist in the short and long term. Some healthcare practitioners may go out of business resulting in an acute shortage of providers²⁵; imposing greater occupational challenges with the implementation of routine dental services²⁶. Therefore, the aim of this study was to assess the implication of the COVID-19 pandemic on the practice of restorative dentistry in Nigeria.

Methodology

This cross-sectional study was conducted from 10th to 14th July 2020 using an online survey questionnaire after obtaining institutional ethical approval. A well-constructed questionnaire was designed using www.docs.google.com and the online survey link was circulated through social media (Whatsapp and Emails) for easy accessibility to dentists practising all across Nigeria irrespective of

cadre or place of practice. Only responses from participants who consented to fill the questionnaire were obtained. A total of 151 participants returned their questionnaires. After scrutiny, 14 unfilled or partially filled questionnaires were excluded and only the completely filled questionnaires (n= 137) were included in the study.

These were received through the online survey submission. Other auxiliary dental personnel i.e. technologists, dental nurses and therapists as well as dental students were not included in this study. The questionnaire comprised of a total of 38 closed-ended questions on socio demographics, practice of infection control measures, availability and use of personal protective equipment, long and short term impact of COVID-19 on routine and advanced restorative dental procedures as well as their practice modifications to combat COVID-19 outbreak in accordance with the guidelines put in place for dental practice in COVID-19 era by the Federal Ministry of Health and the Nigerian Centre for Disease Control

(NCDC). Statistical analysis was done on SPSS version 25.0. Categorical data were presented using frequency and percentages, while numeric data were presented using mean and standard deviation. The association between categorical data was assessed using Chi-Square. P-value was set at less than 0.05 at 95% confidence interval.

Results

One hundred and thirty seven dentists participated in our study. Majority of the respondents, 80 (58.4%), were males and a greater proportion of all respondents, 68 (49.6%), were within the age range of 35-44 years with a mean age of 37.54 (\pm 11.5) years. Most respondents, 107 (78.1%) work in public hospitals and 30 (21.9%) work in private practice. A greater proportion, 48 (35.0%) had specialist training followed by 39 (28.5%) who were dental officers and 25 (18.2%) of respondents each belonged to the junior and senior resident doctors category (Table 1).

Table 1: Socio-demographic characteristics

Variable	Frequency (n=137)	Percentage
Gender		
Male	80	58.4
Female	57	41.6
Age group (years)		
25-34	23	16.8
35-44	68	49.6
45-54	33	24.1
55-64	13	9.5
Place of practice		
Federal Medical Centre	9	6.6
General Hospital	12	8.8
Military Hospital	4	2.0
Private Practice (Employee)	15	10.9
Private Practice (Proprietor)	15	10.9
Teaching Hospital	82	59.9
Type of practice		
Public	107	78.1
Private	30	21.9
Cadre		
Consultant	48	35.0
Senior Registrar	25	18.2
Junior Registrar	25	18.2
Dental Officer	39	28.5
Practice Specialty		
Conservative Dentistry	58	42.3
General Dental Practice	45	32.8
Oral Medicine	1	0.7
Oral and Maxillofacial Surgery/Pathology	13	9.5
Orthodontics	4	2.9
Paedodontics	2	1.5
Prosthodontics	14	10.2

The outbreak of the COVID-19 pandemic led to anxiety in 67.2% of dentists that participated in this study while 22.6% and 10.2% of the respondents describe their response to the pandemic as frightening and nonchalant respectively. One hundred and thirty-two (96.4%) respondents immediately changed their mode of dental service delivery following the COVID-19 outbreak in Nigeria. Of these 132 respondents, 70 (53%) commenced patient screening, 65 (49.2%) reduced the clinic hours, 76 (57.6%) limited the number of patients that were seen daily and 91 (68.9%) restricted the type of clinical procedures that were carried out. A greater proportion of the respondents, 65 (47.4%), did not shut down dental services during the lockdown period while 72 (52.6%) respondents had some form of shut down during the lockdown period. Hospital /Clinics were shut for durations of 1 week to 3 months; with most clinics (19.7%) closed for 3-4 weeks and 2-3 months.

The changes made following the COVID-19 pandemic ranged from triaging of patients at the car park (43.1%) and provision of telephone consultation (55.5%) to taking patient's temperature reading before gaining entry into the clinic (84.7%), hand washing before entering the clinic (92.7%) and observing social distance in the waiting room and ensuring adequate time interval between patients appointments (94.2%). More than half (54.7%) of the respondents commenced both pre-examination and pre-treatment mouth rinse with antibacterial agents. One hundred and thirty two (96.4%) respondents reported that it is mandatory for all patients and dental staff to wear a face mask within the clinic. A significantly higher number of male respondents ($p=0.019$) and public dental workers ($p=0.036$) immediately made changes to their mode of dental service delivery following the COVID-19 outbreak in Nigeria (Tables 2 and 3).

Table 2: Immediate change in delivery of dental service following COVID-19 outbreak

Variable	Frequency (n=137)	Percentage
Immediate change in delivery of dental service		
Yes	132	96.4
No	5	3.6
Immediate changes (n=132)		
Shut the clinic	55	41.7
Reduced clinic hours	65	47.4
Limited number of patients	76	57.6
Restricted type of clinical procedure	91	68.9
Commenced patients screening	70	53.0
Duration of hospital shutdown following outbreak of COVID 19		
Not shutdown	65	47.4
1-2 weeks	18	13.1
3-4 weeks	27	19.7
2-3 months	27	19.7
Decision on clinical care at commencement of service		
Temperature reading before patient enters clinic	116	84.7
Handwashing mandatory before entry into dental facility	127	92.7
Social distance observed in the waiting room and adequate spacing of patients booking done	129	94.2
Patients travel history of COVID symptoms obtained before commencing any treatment	121	88.3
Patients gaggle with antibacterial mouthwash	75	54.7
Patients wear facemask	120	87.6
Triage of patients at the car park	59	43.1
Practice teledentistry/ telephone consultation	76	55.5
Mandatory for all patients and dental staff to wear mask in the clinic		
Yes	132	96.4
No	5	3.6

Table 3: Association between immediate change in dental delivery following covid-19 and socio-demographic characteristics

	Immediate change in delivery of dental service following COVID-19 outbreak		X ²	p-value
	Yes	No		
Gender				
Male	75(93.8)	5(6.3)	3.679	0.019*
Female	57(100.0)	0(0.0)		
Age group (years)				
25-34	23(100.0)	0(0.0)	3.689	0.297
35-44	64(100.0)	4(5.9)		
45-54	33(100.0)	0(0.0)		
55-64	12(92.3)	1(7.7)		
Place of practice				
Federal Medical Centre	9(100.0)	0(0.0)	5.677	0.339
General Hospital	12(100.0)	0(0.0)		
Military Hospital	4(100.0)	0(0.0)		
Private Practice (Employee)	13(86.7)	2(13.3)		
Private Practice (Proprietor)	14(93.3)	1(6.7)		
Teaching Hospital	80(97.6)	2(2.4)		
Type of practice				
Public Hospital	105(98.1)	2(1.9)	4.405	0.036*
Private Hospital	27(90.0)	3(10.0)		
Cadre				
Consultant	46(94.8)	2(4.2)	1.235	0.745
Dental Officer	37(94.9)	2(5.1)		
Resident Registrar	25(100.0)	0(0.0)		
Senior Registrar	24(96.0)	1(4.0)		
Type of practice				
Conservative Dentistry	55(94.5)	3(5.2)	1.751	0.941
General Dental Practice	43(95.6)	2(4.4)		
Oral Medicine	1(100.0)	0(0.0)		
Oral and Maxillofacial Surgery/Pathology	13(100.0)	0(0.0)		
Orthodontics	4(100.0)	0(0.0)		
Paedodontics	2(100.0)	0(0.0)		
Prosthodontics	14(100.0)	0(0.0)		

*Significant

One hundred and sixteen (84.7%) respondents practised standard treatment guidelines for COVID-19 prevention in the dental clinics. Most respondents, 83 (60.6%) carried out daily restorative dental procedures despite the COVID-19 pandemic. The fifty four respondents who avoided restorative dental procedures in their clinics; did so for fear of contracting the disease (31.5%), lack of personal protective equipment (PPE) (50.0%) and the concerns for aerosol production (92.6%). Majority of respondents, 113 (82.5%) provide emergency dental treatment and non-aerosol generating dental procedures. The procedures mostly performed by the respondents since the pandemic were root canal treatment (40.9%), atraumatic restorative treatment (ART) (54.7%) and dental fillings (57.7%). Only 10 (7.3%) respondents used rubber dam routinely in practice prior to COVID pandemic. The onset of COVID-19 did not affect the usage of rubber dam among the respondents as only 4 (2.9%) used it always while 9 (6.6%) respondents used it frequently (Table 4).

The PPE most readily available in the dental clinics

were gloves (97.1%) and surgical face masks (93.4%). Other PPE available were respiratory masks (51.8%), isolation gowns (54%) and face shields (71.5%). One hundred and six (77.4%) respondents wore isolation gowns during aerosol generating procedures. About two-third of respondents (68.6% and 67.9%) also wear isolation gowns during examination of patients and during non-aerosol generating procedures. Nine (6.6%) respondents do not wear isolation gowns at all. Only 24 (17.5%) respondents wore the respiratory mask once before disposal and 25 (18.2%) re-used their respiratory masks as many times as possible until it snaps and cannot be used. A minor proportion, 53 (38.7%), wear isolation gowns once while 15 (10.9%) re-use their gowns until it tears. Only 28.4% use aerosol suction machines in the dental clinic. About one-third of respondents each limit the number of staff allowed in the operatory room to 2 and 3 respectively while 14.6% do not observe any limit to the number of persons allowed. Thirty (21.9%) respondents use the dental operatory room immediately after an aerosol generating procedure while 107 (78.1%) allowed time interval between procedures (Table 4).

Table 4: Types of restorative dental procedures carried out and infection control practice observed since the COVID-19 outbreak

Variable	Frequency (n=137)	Percentage
Restorative dental procedures routinely performed		
Elective procedures	63	46.0
Dental emergencies	113	82.5
Non aerosol generating procedure	113	82.5
Aerosol generating procedures	69	50.4
Type of restorative procedures carried out since pandemic		
Dental fillings	79	57.7
Root canal treatment	56	40.9
Apicectomy	6	4.4
Crowns	47	34.3
Removable partial denture	49	35.8
Bridges	15	10.9
Implants	3	2.2
Veneers	6	4.4
Tooth whitening	18	13.1
Management of tooth wear lesion	30	21.9
Atraumatic restorative treatment	75	54.7
None	23	16.8
Routine use of Rubber dam before the pandemic		
Yes	10	7.3
No	127	92.7
Frequency of Rubber dam used since COVID pandemic started		
Always	4	2.9
Often	9	6.6
Sometimes	12	8.8
Rarely	33	24.1
Never	79	57.7

Variable	Frequency (n=137)	Percentage
PPE readily available in practice		
Gloves	133	97.1
Surgical mask	128	93.4
Respiratory mask	71	51.8
Goggles	85	62.0
Face shield	98	71.5
Isolation gown	74	54.0
Head cap	63	46.0
Shoe cover	21	15.3
Number of times respiratory masks are re-used before disposal		
1	24	17.5
2	9	6.6
3	17	12.4
4	11	8.0
5	9	6.6
6	2	1.5
7	5	3.6
Up until they snap and become completely unusable	25	18.2
Not applicable	35	25.5
Number of times isolation gowns are re-used before disposal		
1	53	38.7
3	16	11.7
4	2	1.5
5	2	1.5
7	2	1.5
Until the gown tears	15	10.9
Not applicable	47	34.3
Maximum limit to number of person allowed in the operating room		
2	44	32.1
3	49	35.8
4	20	14.6
5	4	2.9
5	20	14.6
No limit observed		

Over half (56.9%) of the respondents had received formal training on the proper use of PPE and infection control. The respondents reported that about half of the dental nurses and therapists at their workplace (49.6%) had received formal training on the proper use of PPE and infection control while training on mode of cleaning, proper handling of waste material and infection control had been conducted for about only one-third (35.8%) of cleaners at their health facilities. Majority of the respondents, 133 (97.1%) regularly updated themselves on information about the mode of transmission, prevention and other important facts about COVID-19 virus through the social media (73.7%) and webinars (70.8%) (Table 5). Majority of respondents, 121 (88.3%), reported that

the patient flow had decreased since the COVID-19 pandemic and 56 (40.9%) respondents stated that their patients are now selective in the treatment received. Over half of the respondents, 53.3%, reported that the need to wear the full PPE during the COVID-19 pandemic has increased treatment fee and 76.6% noted that cost of dental materials had also increased. The pandemic had an impact on the income generated for majority of respondents, 126 (92.0%), however, majority of respondents, 123 (89.8%), reported that the pandemic has not led to a slash in their staff salary. Only 20.4% of respondents have problems with their staff; the issues were demand of salary increase (4.4%), emotional problems (6.6%) and abandonment of work (9.5%) (Table 5).

Table 5: Trainings taken during the pandemic, mode of information obtained and the impact of COVID-19 on dental practice

Variable	Frequency (n=137)	Percentage
Formal training conducted for dentists on the proper use of PPE and infection control		
Yes	78	56.9
No	59	43.1
Formal training conducted for dental nurses and therapists on the proper use of PPE and infection control in place of practice		
Yes		
No	68	49.6
Don't know	38	27.7
	31	22.6
Any training conducted for cleaners at your dental facilities regarding mode of cleaning, handling waste material and infection control		
Yes	49	35.8
No	29	21.2
Don't know	59	43.1
Regularly update yourself on new discoveries on the mode of transmission prevention and important fact about COVID 19-virus		
Yes	133	97.1
No	4	2.9
Source of updates on new discovery on COVID-19 (multiple response)		
Social media	101	73.7
Webinar	97	70.8
Seminar	67	48.9
Newsletter	69	50.4
Do not update	4	2.9
Normal patients flow decrease during the COVID-19 pandemic		
Yes	121	88.3
No	16	11.7
Patients selective in the treatment received at the dental clinic		
Yes	56	40.9
No	81	59.1
Need of complete PPE and impact on treatment fees		
Yes	73	53.3
No	64	46.7
Cost of dental material become expensive when compared to pre-COVID era		
Yes	105	76.6
No	32	23.4
Pandemic affect income generated		
Yes	126	92.0
No	11	8.0
Pandemic lead to slash of dental staff salary in clinic		
Yes	13	9.5
No	123	89.8
No, but delay in payment	1	0.7
Plans to continue wearing complete PPE for aerosol generating procedure after COVID-19 pandemic		
Yes	28	20.4
No	109	79.6
The problems with staff superiors have experienced since the pandemic		
Abandonment of work	13	9.5
Demand for salary increase or allowance	6	4.4
Emotional problems	9	6.6
None	109	79.6

Overall, most respondents (92.0%) had good knowledge about standard precautions toward COVID-19 and the knowledge was significantly higher among respondents in public hospitals ($p=0.049$) and higher cadre dentists ($p=0.005$). Majority of respondents (64.2%) had good practice of observing the standard precautions/ infection control guidelines and was significantly higher among dentists in the higher cadre ($p=0.004$). Only 31.4% respondents were optimally prepared to render

dental services and the level of preparedness was significantly higher among the older age group ($p=0.003$) and private practice owners ($p=0.047$). The pandemic has had a negative impact on most respondents (74.5%) and seen across the gender, age groups, cadre of dentists and type of practice (Table 6). A significantly higher number of the respondents working in private practice compared to those in public hospitals ($p<0.001$) had their salary slashed since the onset of the pandemic (Table 7).

Table 6: Association between knowledge, practice, preparedness and impact of COVID-19 and socio-demographic characteristics

	Good overall knowledge	Poor overall knowledge	Good practice	Poor practice	Optimal preparedness	Sub-optimal preparedness	High impact	Low impact
Gender								
Male	74(92.5)	6(7.5)	50(62.5)	30(37.5)	24(30.0)	56(70.0)	64(80.0)	16(20.0)
Female	52(91.2)	5(8.8)	38(66.7)	19(33.3)	19(33.3)	38(66.7)	26(66.7)	19(33.3)
	$\chi^2=0.073, p=0.787$		$\chi^2=0.252, p=0.616$		$\chi^2=0.172, p=0.679$		$\chi^2=3.111, p=0.078$	
Age group								
25-34	19(82.6)	4(17.4)	11(47.8)	12(52.2)	2(8.7)	21(91.3)	16(69.6)	7(30.4)
35-44	63(92.6)	5(7.4)	43(63.2)	25(36.8)	21(30.9)	47(69.1)	49(72.1)	19(27.9)
45-54	31(93.9)	2(6.1)	24(72.7)	9(27.3)	11(33.3)	22(66.7)	26(78.8)	7(21.2)
55-64	13(100.0)	0(0.0)	10(76.9)	3(23.1)	9(69.2)	4(30.8)	11(84.6)	2(15.4)
	$\chi^2=4.008, p=0.253$		$\chi^2=4.672, p=0.197$		$\chi^2=14.210, p=0.003^*$		$\chi^2=1.526, p=0.676$	
Type of practice								
Public Hospital	101(94.4)	6(5.6)	66(61.7)	41(38.3)	31(29.0)	76(71.0)	76(71.0)	31(29.0)
Private Hospital	25(83.3)	5(16.7)	22(73.3)	8(26.7)	12(40.0)	18(60.0)	26(86.7)	4(13.3)
	$\chi^2=3.881, p=0.049^*$		$\chi^2=1.384, p=0.239$		$\chi^2=1.323, p=0.250$		$\chi^2=0.158, p=0.763$	
Cadre								
Consultant	47(97.9)	1(2.1)	34(70.8)	14(29.2)	19(49.6)	29(60.4)	35(72.9)	13(27.1)
Dental officer	31(79.5)	8(20.5)	21(53.8)	18(46.2)	12(30.8)	27(69.2)	31(79.5)	8(20.5)
Junior Registrar	23(92.0)	2(8.0)	11(44.0)	14(56.0)	3(12.0)	22(88.0)	17(68.0)	8(32.0)
Senior Registrar	25(100.0)	0(0.0)	22(88.0)	3(12.0)	9(36.0)	16(64.0)	19(76.0)	6(24.0)
	$\chi^2=12.711, p=0.005^*$		$\chi^2=13.343, p=0.004$		$\chi^2=6.115, p=0.106$		$\chi^2=3.013, p=0.084$	

*Significant

Table 7: Association between type of practice and the economic impact

Type of practice	Pandemic affected clinic revenue		Slash of dental staff salary since the pandemic		Staff having personal issues since the pandemic	
	Yes	No	Yes	No	Yes	No
Public	101(94.4)	6(5.6)	5(4.7)	102(95.3)	19(17.8)	99(82.2)
Private	25(83.3)	5(16.7)	8(26.7)	22(73.3)	9(30.0)	21(70.0)
	$\chi^2=3.881, p=0.049^*$		$\chi^2=13.197, p<0.001^*$		$\chi^2=2.160, p=0.142$	

*Significant

Discussion

The global outbreak of the novel coronavirus disease (COVID-19) has influenced every aspect of life resulting in practice modifications especially among dentists^{19,27}. COVID-19 is primarily transmitted through droplets and aerosols²⁸; A recent publication identified dentists as the group of workers at highest risk of being infected with the highly contagious COVID-19 virus from their patients²⁹; this is because they work in the patient's mouth in very close contact.

Most restorative dental procedures generate aerosols which is a mixture of water and patient's saliva or blood³⁰. These aerosols carry infectious micro-organisms including the COVID-19 virus which poses a great danger to the dental team and all individuals in the immediate surrounding³¹.

This present study revealed that the immediate reaction of a majority of the respondents to the COVID-19 pandemic was that of anxiety while about one-fifth were frightened by the development. This finding is similar to that of Ahmed et al¹⁹ who reported that over two-third of the general dental practitioners from 30 countries that participated in their study were anxious and scared by the devastating effects of COVID-19. This is not surprising because dental professionals work in close contact to patient's face and oral cavity which increases the risk of cross infection. Although more dentists employed in public service expressed anxiety over the COVID-19 outbreak than those in private practice; the proportions of dentists in both categories that showed anxiety were similar. The difference between response of dentists in public service and those in private dental practice was not significant ($p > 0.05$).

Majority of dentists (96.4%) that participated in the present study made immediate changes to their mode of dental service delivery following the COVID-19 outbreak in Nigeria. Some of the changes include triaging of patients at the car park, provision of telephone consultation, thermal screening with non-contact thermometers, hand washing before entering the clinic, observing social distance in the waiting room, maintaining adequate time interval in patients appointment, and a mandatory use of face mask by all patients and staff within the clinic. This is in compliance with the current guidelines issued by the Centre for Disease Control (CDC) and World Health Organization (WHO) for dental clinics and hospitals^{12,32} to curtail the spread of the disease. In a pandemic like COVID-19, it is crucial for dental professionals to comply with recommendations and guidelines to help curb the spread of the infection. However, in this study, dentists in public service readily implemented immediate changes to their

mode of dental service delivery unlike those in private dental practice ($p=0.036$). This may be linked to the poor compliance with guidelines and regulations amongst private health care providers³³.

Majority of our respondents claimed that they practised standard treatment guidelines for COVID-19 prevention as directed by both local and international agencies. On the contrary, most respondents provided emergency dental treatment and non-aerosol generating dental procedures; despite the recommendation by several international regulatory bodies to perform only emergency dental procedures during the pandemic. There was no difference between pre-COVID-19 and during the COVID-19 pandemic use of rubber dam among the respondents; despite the fact that the use of rubber dam during restorative dental procedures provides barrier protection against aerosols thereby limiting or eliminating the spread of micro-organisms emerging from saliva and respiratory secretions^{23,28,34}. Majority of the respondents did not use rubber dam routinely in their practices; a finding that is in agreement with the report of Ahmed et al¹⁹. This study showed that the most available PPE in the respondent's dental clinics were gloves, surgical facemasks and face shields but respiratory masks and isolation gowns were few or unavailable. Since airborne droplet is considered as the main route of spread of COVID-19 in dental clinics, barrier protective equipment is strongly recommended¹⁰.

A small proportion (17.5%) of the respondents limited the use of their respiratory masks and isolation gowns to a single use. A similar percentage of respondents re-used these PPE until they cannot be salvaged. The desire to re-use PPE might be attributed to their higher cost compared to the basic PPE (gloves, facemasks and goggles); this is contrary to universal infection cross-control protocols. However, the N95 respirator is re-usable and can be decontaminated³⁵. From our findings, only a minor proportion of respondents had head caps and shoe covers readily available at their work place; probably because they are considered less important. These PPE (head caps and shoe covers) are recommended and constitute an important component of the three-level protective measures for dental personnel while in direct contact with suspected or confirmed COVID patient^{10,36}.

Dental professionals should be familiar with how COVID-19 spreads, how to identify patients with the infection, and the extra-protective measures required during practice, in order to prevent the transmission of COVID-19¹⁰. Over half of the respondents in this study had received formal

training alongside their nurses, therapists and cleaners on the proper use of PPE, cleaning, proper handling of biomedical waste and infection control at their workplace. Training on infection control for the dental team should provide information on the transmission of COVID-19¹⁰, disinfection of working surfaces and equipment³⁶ and appropriate and safe waste disposal³⁷.

The information on the novel coronavirus disease is still evolving; it is therefore imperative that dental professionals update their knowledge on the virus regularly. Most (97.1%) of the respondents in this study had regular knowledge updates on the virus but their preferred sources of information were social media and webinars. The preference for social media as a source information on COVID-19 as observed in this study; is a cause for concern. The WHO declared that they are currently fighting not only an international epidemic but also a social media infodemic, because some media just accelerate information and misinformation on COVID-19 worldwide; fuelling panic and fear among people³⁸.

The findings of our study revealed that, thus far, the COVID-19 pandemic has had an economic impact on dental care providers and the dental clinics in Nigeria. Majority of our respondents indicated that their patient flow had decreased since the pandemic in addition to some patients being selective of the treatment received; translating to a reduced income ($p=0.049$). This is in agreement with the findings of Schwendickea et al³⁹ and Guo et al⁴⁰ who reported a reduction in utilization of dental services and a change in the oral health seeking behaviour of dental patients respectively. Another source of economic pressure as indicated by the respondents is the exorbitant cost of PPE and dental materials occasioned by the pandemic. Consequent upon the foregoing challenge, over 50% of the respondents reported an increase in treatment fees while some have slashed staff salary ($p=0.001$) to cushion the effect of the pandemic on running cost.

Closely related to the economic challenges experienced by about a fifth of the respondents who are in private dental practice, is the demand for higher wages and allowances, abandonment of work and emotional problems amongst employees. These work place challenges could go beyond economic impediment as observed in a study⁴¹ of Italian dentists who expressed worries about their professional futures showing anxiety and fear.

Looking into the future, 79.6% of the responding dentists will for economic reasons discontinue the use of PPEs post the COVID-19 pandemic for aerosol generating procedures (AGP). It is therefore

necessary to reiterate that the breathing zone in dental operatory is highly contaminated¹⁵ and that spatter evaporates, leaving smaller particles called droplet nuclei, which can carry bacteria and viruses capable of transmitting diseases such as SARS and tuberculosis⁴².

A recent survey by Irish Dental Association (IDA), foresees a financial loss of over 70% during the COVID-19 outbreak⁴³. Similarly, the British Dental Association predicts that the suspension of routine dental care will lead to losses in dental practices⁴⁴. In the USA, some practices are closed whereas; some remained open for fear of economic losses and non-payment of salaries to their employees⁴⁵. This disturbing situation has necessitated an economic response plan to support businesses including dental practices by governments in Ireland, UK and Canada⁴⁴. Similarly, the Federal government of Nigeria in March 2020, through the Central Bank of Nigeria instituted a low interest credit plan for the healthcare sector to ameliorate the effect of COVID-19 pandemic on Nigerian healthcare system⁴⁶.

The COVID-19 pandemic has caused fear and anxiety among restorative dentists in Nigeria due to the high risk of exposure to the virus in their practice. This situation requires an understanding of the implications of AGP and the adoption the ART option where necessary, identification of negligence in daily dental practice and compliance with the standard precautions to avoid transmission of disease in dental practice.

Conclusion

COVID-19 pandemic has changed the mode of restorative dental practice in Nigeria; resulting in a psychological impact on dentists and a financial burden on dental practice. Dentists especially those in private practice require urgent government financial support to cope with the several changes to routine and clinical protocols occasioned by the pandemic in their clinical practice.

References

1. Li Q, Guan X, Wu P et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020; 382(13):1199-1207.
2. World Health Organization – WHO. Rolling updates on coronavirus disease (COVID-10). 2020 May 11. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.

3. Nigeria Centre for Disease Control. (2020). COVID-19 Outbreak in Nigeria: Situation Reports. <https://ncdc.gov.ng/diseases/sitreps>.
4. Oppong JR. Communicable Diseases, Globalization of International Encyclopaedia of Human Geography. 2009: 209–213 doi: 10.1016/B978-008044910-4.00345-X
5. World Health Organisation. Coronavirus disease (COVID-19) advice for the public 2020.
6. Chen J. Pathogenicity and transmissibility of 2019-nCoV—a quick overview and comparison with other emerging viruses. *Microbes and infection* 2020; 22: 69-71.
7. Gorbalenya A.E., Enjuanes L., Ziebuhr J., Snijder E.J. Nidovirales: evolving the largest RNA virus genome. *Virus Res.* 2006;117:17–37.
8. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun.* 2020;109:102433.
9. Huang C., Wang Y., Li X., Ren L., Zhao J., Hu Y. Clinical features of patients infected with 2019 novel coronavirus in Wuhan China. *The Lancet.* 2020;395:497–506.
10. Peng X., Xu X., Li Y., Cheng L., Zhou X., Ren B. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci.* 2020;12:1–6.
11. Wang D., Hu B., Hu C et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *J Am Med Assoc.* 2020; 323:1061-1069.
12. Center of Disease Control (CDC) (Interim infection prevention and control guidance for dental settings during the COVID-19 response; 2020
13. Centers for Disease Control and Prevention. Interim Infection Prevention and Control Guidance for Dental Settings during the COVID-19 Response. Atlanta, GA, USA: Centers for Disease Control and Prevention; 2019.
14. Peditto M, Scapellato S, Marciandò A, Costa P, Oteri, G. Dentistry during the COVID-19 Epidemic: An Italian Workflow for the Management of Dental Practice. *Int J Environ Res Pub Health,* 2020;17: 3325.
15. Veena HR, Mahaantesha S, Joseph PA, Patil SR, Patil SH. Dissemination of aerosol and spatter during ultrasonic scaling: A pilot study. *J Inf Pub Health* 2015;8:260-265.
16. Bhatkhande R, Misal A. Microbial aerosols: An inconspicuous health hazard from a dentist's perspective. *Int J Oral Health Med Res* 2017; 3: 130-133.
17. Cleveland J, Gray S, Harte J, Robison V, Moorman A, Gooch B. Transmission of blood-borne pathogens in US dental health care settings: 2016 update. *J Am Dent Assoc.* 2016;147:729–738.
18. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations. Retrieved from <https://www.who.int/publications-detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>. 2020 .
19. Ahmed M, Jouhar R, Ahmed N et al. Fear and practice modifications among dentists to combat Novel Coronavirus Disease (COVID-19) outbreak. *Int J Environ Res Pub Health.* 2020;17:2821.
20. Sun J, Xu Y, Qu Q, Luo W. Knowledge of and attitude towards COVID –19 among parents of child dental patients during outbreak. *Braz Oral Res.* 2020;34:e066
21. WHO. Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19). Interim guidance 19 March 2020, https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019nCoV-IPCPPE_use-2020.2-eng.pdf?sequence=1
22. Ather A, Patel B, Ruparel N, Diogenes A, Hargreaves K. Coronavirus Disease19 (COVID-19): implications for clinical dental care. *J Endod.* 2020; 46: 584–595.
23. Samaranyake LP, Reid J, Evans D. The efficacy of rubber dam isolation in reducing atmospheric bacterial contamination. *ASDC J Dent Children*1989; 56:442–444.
24. Jamal M, Shah M, Almarzooqi SH et al. Overview of transnational recommendations for COVID-19 transmission control in dental care settings. *Oral Dis.* 2020;00:1–10.
25. Ferneini E. The financial impact of COVID-19 on our practice. *J Oral and Maxillofac Surg.* 2020; 78: 1047-1048.
26. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dent Res.* 2020; 99:481–487.
27. Gralinski, L., Menachery, V. Return of the coronavirus: 2019-nCoV. *Viruses* 2020; 12: 135.
28. Ge Z, Yang L, Xia J, Fu X, Zhang Y. Possible aerosol transmission of COVID-19 and special precautions in dentistry. *J Zhejiang Univ B.* 2020; 1–8.

29. The NewYork Times. The workers who face the greatest coronavirus risk. Available: <https://www.nytimes.com/interactive/2020/03/15/business/economy/coronavirus-worker-risk.html> [Accessed July 2020].
30. Ofori-Attah S. Dentistry and why it is a great career. *Br Dent J* 2017;223:81–84.
31. Nejatidanesh F, Khosravi Z, Goroohi H, Badrian H, Savabi O. Risk of contamination of different areas of dentist's face during dental practices. *Int J Prev Med*. 2013;4:611–615.
32. Guan W, Ni Z, Hu Y, Liang W, Ou C, He J et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020; 382:1708-1720 .
33. Basu S, Andrews J, Kishore S, Panjabi R, Stuckler D. Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS Med*. 2012;9: e1001244.
34. Madarati A, Abid S, Tamimi F, Ezzi A, Sammani A, Shaar M. Dental-dam for infection control and patient safety during clinical endodontic treatment: Preferences of dental patients. *Int J Environ Res Pub Health*. 2018; 15: 2012. <https://doi.org/10.3390/ijerph15092012>
35. Ong S, Tan Y, Chia P, Lee T, Ng O, Wong M. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) from a symptomatic patient. *J Am Med Assoc*. 2020; 323:1610-1612.
36. Vigarniya M, Sharma A. Covid-19 and Dentistry: An Unfolding Crisis. *Int J Med Sci Current Res*. 2020;3:138-148.
37. Centre of Disease Control and Prevention, Department of Health and Human Services, National Institute for Occupational Safety and Health. How to put on and take off a disposable respirator. CS207843; DHHS (NIOSH) Publication No 2010-133.
38. Hao K, Basu T. The coronavirus is the first true social-media infodemic. 2020. URL: <https://www.technologyreview.com/s/615184/the-coronavirus-is-the-first-true-social-media-infodemic/>
39. Schwendicke F, Krois J, Gomez J. Impact of SARS-CoV2 (Covid-19) on dental practices: Economic analysis. *J Dent*. 2020:103387. <https://doi.org/10.1016/j.jdent.2020.103387>
40. Guo H., Zhou Y., Liu X., Tan J. The impact of the COVID-19 epidemic on the utilization of emergency dental services. *J Dent Sci*. 2020. <https://doi.org/10.1016/j.jds.2020.02.002>
41. Consolo U, Bellini P, Bencivenni D, Jani C, Checchi V. Epidemiological Aspects and Psychological Reactions to COVID-19 of Dental Practitioners in the Northern Italy Districts of Modena and Reggio Emilia. *Int J Env Res Public Heal*. 2020;17: 3459. <https://doi.org/10.3390/ijerph17103459>
42. Harrel SK, Molinari J. Aerosols and splatter in dentistry. A brief review of the literature and infection control implications. *J Am Dent Assoc* 2004; 135:429-437.
43. IDA News. Scale of dental collapse highlighted in survey. Available: <http://irishdentalassociation.newsweaver.com/newsletter/13ctcsav7cz1cys22xtzj2?a=1&p=56657247&t=22322575> [Accessed July 2020]
44. Farooq I, Ali S. COVID-19 outbreak and its monetary implications for dental practices, hospitals and healthcare workers. *Postgrad Med J*. 2020. <http://dx.doi.org/10.1136/postgrad-medj-2020-13778>.
45. The Salt Lake Tribune. Some Utah dentists are closing because of coronavirus. Others don't think they can. Available: <https://www.sltrib.com/news/2020/03/17/some-utah-dentists-are/> [Accessed July 2020].
46. CBN- Credit support for healthcare sector in Nigeria;2020< <http://www.cbn.gov.ng>>