ORIGINAL ARTICLE

Infection Control Practices of Dentists in an Urbanized City in the Philippines during the COVID-19 Pandemic within the Period of General Community Quarantine

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ABSTRACT

Background. The global impact of the COVID-19 pandemic has instigated a profound public health crisis, particularly affecting professionals like dentists who, due to their close interaction with saliva—a potential viral reservoir—and the aerosols generated during specific procedures, face elevated risks of infection. To mitigate this, the Centers for Disease Control and Prevention (CDC) and the Philippine Dental Association (PDA) have established guidelines for averting cross-infection in dental settings.

Objective. This study, conducted in an urbanized Metro Manila City, delves into the infection control practices of dentists amid the pandemic.

Methods. Dentists from a Metro Manila city dental chapter were invited to participate in an online survey (Google Forms) consisting of participants' demographics, patient triage, engineering, administrative controls, disinfection personal hygiene, personal protective equipment (PPE), and waste management practices. Descriptive statistics, employing frequency distributions and percentages, summarized the dentists' adherence to infection control protocols.

Results. Out of forty-nine respondents (49), the majority (92%) provided their teams' orientation on COVID-19 infection control protocols before reopening. Notably, 57% deferred elective procedures and 43% postponed aerosol-generating procedures (AGPs). Only 39% utilized rubber dam isolation during AGPs. Most respondents reported full implementation of recommended administrative controls during the pandemic, with 92% isolating their treatment areas from other parts of the clinic. Most respondents adopted high-efficiency particulate air (HEPA) filtration units (82%) as one of their clinic's engineering controls, and an extraoral vacuum machine, accounting for 71% of the respondents. The most common disinfection product used by the participants was alcohol, which was at 94%. Additionally, over 90% adhered to all recommended hand hygiene practices for both dental staff and patients. For the waste management protocols, only 55% of the respondents have their infectious waste collected by third-party Treatment Storage and Disposal (TSD) facilities.

Conclusion. The data shows that with the guidelines posted by both the PDA and CDC, the city's dental practitioners could still provide services to the community in the safest manner at the time by being updated and following the infection control practices suggested by both organizations. Although some areas

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could have been improved, such as third-party waste management and the utilization of RT-PCR testing, some of these problems could have been attributed to the lack of availability in their areas.

Keywords: infection control, COVID-19, SARS-CoV-2, dentists

INTRODUCTION

Coronavirus disease 2019 (COVID-19), an infectious disease caused by a newly discovered coronavirus strain that spreads through respiratory droplets, has precipitated a global pandemic. Despite the stabilization of COVID-19 cases in the Philippines, infection control remains a pivotal aspect of healthcare practices. In particular, the practice of dentistry is hindered by the fear of cross-infection. Dentistry has been known to have one of the highest risks of cross-infection between practitioner and patient due to its involvement in producing large numbers of droplets and aerosols.[1] It is essential to be cautious to limit the spread of COVID-19, but it cannot be denied that many need urgent dental treatment. In response, several guidelines have been published to manage infection control in the dental setting during this pandemic.

Since COVID-19 is an emerging disease, and underpinning evidence on how to avoid the spread of COVID-19 in the dental setting is limited, researchers and dentists rely on various sources of infection control guidelines to avoid cross-infection in the dental setting. Reliable sources used by dentists practicing in the Philippines include guidelines from the Centers for Disease Control and Prevention (CDC) and the Philippine Dental Association (PDA).

The CDC and PDA have recommended different guidelines for controlling workplace hazards and protecting against cross-infection among patients and workers. The use of patient screening and triage, as well as proper engineering controls, administrative controls, and higher-level PPEs, has been suggested.

This study aimed to describe the infection control practices of dentists in an urbanized city in Metro Manila with one of the highest total and active COVID-19 cases. As of March 31, 2021, the highest total number of cases was 47,178, with 9,422 active cases. An online survey was conducted through Google Forms for dentists practicing in an urbanized city with the highest number of cases during the pandemic.

With the data gathered, the results may prove to be helpful in evaluating the preparedness of dentists during the pandemic. This, in turn, could help respective agencies implement or execute stricter infection control assessments in dental clinics during a pandemic. It could also identify gaps in the current infection control protocols and develop guidelines that prioritize the safety of everyone, thus instilling and promoting the highest standards of infection control among future dental professionals in their dental practices.

MATERIALS AND METHODS

Study Design

This quantitative descriptive study determined dentists' infection control practices in an urbanized city in Metro Manila, Philippines. The participants were dentists from a city that had the highest number of total and active COVID-19 cases, who were practicing during the pandemic and were members of their corresponding Dental Chapter Facebook group. Members of the exclusive Facebook group are only accepted if the group administrator or moderator has confirmed their active membership in the Dental Chapter.

Study Size and Sampling Design

The total population of the Dental Chapter group was 900 dentists, all assumed to be practicing during the general community quarantine period (September 2020–March 2021). The required sample size was calculated using Cochran's formula for proportions:

$$n_o = (Z^2 pq) / e^2$$

Where:
Z - the critical value of Z (90% was used)
p - population proportion
q - p-1
e - margin of error (5% was used)
n_o - sample size

The initial sample size was then adjusted for the finite population of 900, resulting in a minimum required sample size of 209 dentists.[2] A non-probability convenience sampling approach was used to recruit participants.

Participant Flow

A total of 900 dentists were potentially eligible and were examined for eligibility through their verified membership in the Dental Chapter's Exclusive Facebook group. Three respondents were excluded due to their answer that they are not members of the dental chapter. The 49 dentists who were confirmed eligible based on the inclusion criteria were included in the study, all of whom completed follow-up by submitting the full online questionnaire. The same 49 participants were analyzed.

Inclusion Criteria

1. If the dentist is a registered member of the Dental Chapter of Metro Manila City, with the highest number of total and active cases;
2. If the dentist has practiced in a dental clinic located in Metro Manila City, with the highest number of total and active cases during the COVID-19 pandemic;
3. If the dentist is a member of their corresponding Dental Chapter's Exclusive Facebook Group.

Exclusion Criteria

1. If the dentist is a registered member of their Dental Chapter but did not practice during the COVID-19 pandemic;
2. If the dentist practiced in a dental clinic located in Metro Manila City, with the highest number of active and total cases during the COVID-19 pandemic, but is not a member of their corresponding Dental Chapter;
3. If the dentist is a registered member of their Dental Chapter but is not a member of their Dental Chapter's Exclusive Facebook Group.

Data Collection

The data collection tool used is a self-administered questionnaire through Google Forms. Pilot testing was done within a month after approval from the UP-Manila Research Ethics Board (UPM-REB) was received, to ensure that the questions were comprehensive and appropriate. Volunteer members of the Manila Dental Chapter were asked to participate in pilot testing for convenience. The link to the Google Forms questionnaire was sent through their provided email address. At the end of the survey, feedback was gathered to see if there were unnecessary questions. The distribution and deadline for submission of the questionnaires were made within two weeks.

After the revision of the questionnaire, an invitation was sent by their President to the target population through the exclusive Facebook Group of their corresponding City Dental Chapter, together with the link to the online survey. The participant was asked to sign in using their Google account to prevent double responses.

The respondents who signed their consent were directed to the online survey questions. A multiple-choice question was used for the demographics, including whether they practiced during the COVID-19 pandemic from September 2020 to March 2021. In addition, a checklist with a predetermined list of options was given for the infection control-related questions, which is the central part of the questionnaire. An option of "Other" and a comment field were provided for some questions to avoid bias, not forcing the participants to limit their answer to a predetermined list of options. All questions were required to be answered. The survey was in English, and the researchers created the questions based on the infection control guidelines of the Centers for Disease Control and Prevention, the Philippine Dental Association, and the Department of Interior and Local Government.[3-5]

A post on the Facebook group was made weekly to remind other respondents to participate in the survey. The distribution and deadline for submission of the questionnaires were set within one month. However, since the target sample size was not reached, an extension of the data collection procedure was done through a webinar organized by their Dental Chapter, where additional participants were invited to answer the online survey. A link to the Google Forms questionnaire was posted at the end of the webinar that was accessible to the participants. Data was collected from February 24, 2022, to July 7, 2022.

Data Processing and Analysis

Statistical analysis was conducted using Microsoft Excel (Version 2403). Frequency distributions and percentages were calculated using Excel formulas and presented in a tabular format. All data were encoded and stored securely on a password-protected computer with restricted access to the research team.

The study employed a non-probability convenience sampling strategy with fixed inclusion and exclusion criteria; therefore, no analytical adjustments for sampling design were required. All analyses were based on fully completed, unweighted online responses, and no stratification, clustering, or weighting procedures were applied. As the sampling approach did not involve alternative sampling frames or variable analytic assumptions, no sensitivity analyses were conducted. The results reflect only the characteristics of the respondents and are not intended to represent population-level estimates. Analyses were limited to unadjusted descriptive summaries, and no regression modeling or inferential techniques were used. Consequently, no confounders were identified or adjusted for, and precision measures were not calculated.

Ethical Considerations

This research study was approved by the UPM-REB (2021-098-UND). It is assured that this study conforms to the ethical guidelines set by UPM-REB. The research conforms with the Data Privacy Act of 2012, following Section 11 General Data Privacy Principles, Section 12 Criteria for Lawful Processing of Personal Information, Section 13 Sensitive Personal Information and Privileged Information, and Section 16 Rights of the Data Subject.

This study has minimal risk, and the data collection tool used is self-administered online questionnaires via Google Forms. Informed consent with the following details of the research study was stated in the Google Form: objectives, benefits to the participants and the community, and the expected time to be consumed if the respondent chose to participate in the study. The respondent was also informed that the identity of the respondent and the city they are practicing in will be kept confidential and that they are free to refuse and withdraw from the study without any consequences. The participant should have ticked a box in the informed consent section to signify their consent to participate, and was then led to the online survey questions.

On the other hand, this research poses a social risk wherein participants could potentially feel self-conscious after participating in the study. They could feel uncomfortable after learning the study results since they will be publicly available. If the public finds out about the results, participants could possibly lose patients due to the public's generalization or judgment about the infection control practices of dentists in their city. To minimize this social risk, all respondent

information (first name, last name, email address, IP address) was excluded from the results. In addition, the city where they are practicing will be kept confidential and will not be reflected in the final paper. Another possible risk of this study is the respondent's inconvenience because of the internet connectivity requirement and lack of technical knowledge in answering an online questionnaire.

There is no other conflict concerning personal, business, legal, and professional matters other than the research's academic and scientific merit.

RESULTS

Over six weeks (February 24, 2022 – April 4, 2022), data collection was conducted for dentists in the urbanized city of Metro Manila. Only 47 practicing dentists from the City Dental Chapter responded to the target sample size of 209. Data collection was then extended by posting the online survey link in the City Dental Chapter's webinar on June 3, 2022; however, only two additional responses were gathered. The link for the online survey was officially closed by the researchers a month later, on July 8, 2022. Between February 24 and July 7, 2022, a total of 49 responses were received, indicating a response rate of 23.44%.

The original target sample size of 209 respondents was calculated using a 90% confidence level and a 5% margin of error. However, with only 49 responses obtained, the achievable precision was reduced. Based on the final sample size, the updated estimates correspond to approximately an 85% confidence level with a 10% margin of error.

Demographic Profile of Study Participants

Demographic data collected are presented in Table 1, which includes age, sex, type and length of practice, district of practice, weekly working hours, and whether staff were oriented on infection control protocols before reopening. A total of 49 dentists participated in the survey. The age distribution showed that the sample consisted largely of mid- to late-career practitioners, with the highest proportions belonging to the 45–54 and 55–64 age groups (32.7% each). Younger dentists were less represented, with 21.2% aged 25–34 and 13.5% aged 35–44, and no respondents were over 65. The group was overwhelmingly female, comprising 92.3% of the respondents, while only 7.7% were male.

In terms of professional roles, most respondents were clinic owners (78.8%), while a smaller portion were associate dentists (17.3%) and only a few served as visiting consultants (3.8%). The length of practice closely reflected the age distribution: 65.4% had been practicing for more than 16 years, demonstrating a largely experienced sample. Meanwhile, mid-career practitioners with 6–10 years and 11–15 years of experience each accounted for 13.5%, and only 7.7% had 0–5 years of practice, indicating limited representation from newer dentists.

Table 1. Dentists' Demographics and other Characteristics

Characteristics	N	%
District		
District 1	16	33
District 2	0	0
District 3	7	14
District 4	7	14
District 5	3	6
District 6	16	33
Registered		
Yes	49	100
No	0	0
Age (years)		
25–34	9	18
35–44	7	14
45–54	16	33
55–64	17	35
>65	0	0
Sex		
Male	3	6
Female	46	94
Qualification		
Visiting Consultant	2	4
Dental clinic owner	40	82
Associate dentist	7	14
Work Experience (years)		
0–5	3	6
6–10	6	12
11–15	7	14
>16	33	67
Working hours per week		
1–19	20	41
20–34	12	24
35–49	16	33
50+	1	2
Infection Control Orientation		
Yes	45	92
No	4	8
Total	49	

Working hours were relatively diverse. About 38.5% worked reduced hours of 1–19 hours per week, while 25% worked 20–34 hours, and 34.6% maintained near-full workloads of 35–49 hours. Only 1.9% reported working more than 50 hours weekly. Finally, the data shows strong adherence to safety measures: 92.3% of the dentists oriented their staff on infection control protocols prior to reopening, suggesting widespread commitment to maintaining safe practice operations.

Patient Triage in the Dental Clinic

Figure 1 shows the triage protocols adopted by the respondents. Most of them reported that they adopted checking the patient's body temperature upon entering the dental clinic and giving out a patient's travel history

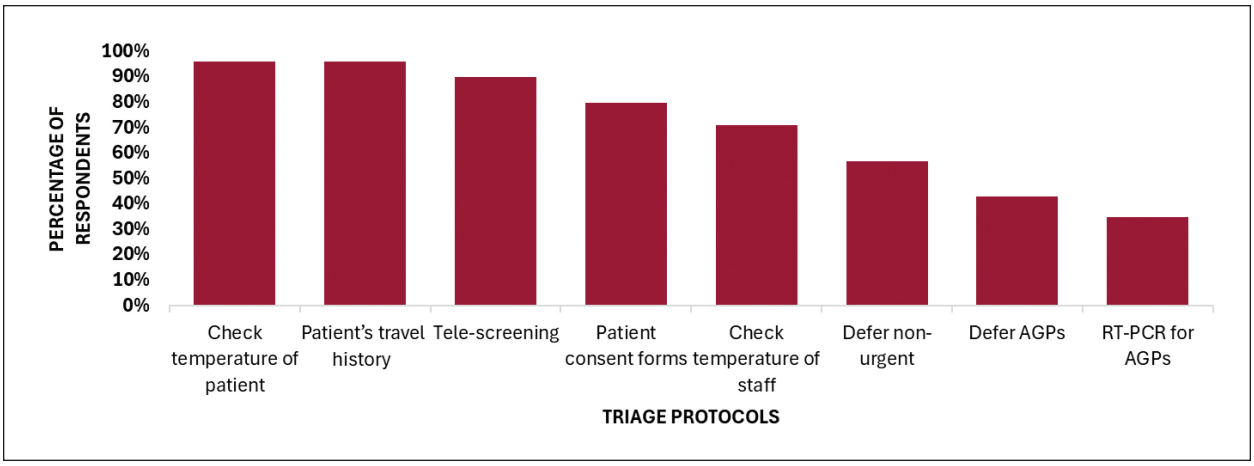

Figure 1. Triage protocols adopted by the respondents during the COVID-19 pandemic (n=49).

AGP – aerosol-generating procedure; RT-PCR – reverse transcription polymerase chain reaction

questionnaire as one of their triage protocols, which were both at 96%. Tele-screening or checking patients' signs and symptoms via phone or email before the appointment (90%) and giving out a consent form to patients (80%) were also major triage protocols reported. Checking the body temperature of all dental personnel was done by 71% of the respondents, and deferring elective and non-urgent dental procedures by 57%. Procedures that involved using a handpiece, three-way syringe, or ultrasonic scalers were deferred by 43% of the respondents. The requirement of presenting a negative RT-PCR test result for aerosol-generating procedures was only done by 35% of the respondents. On the other hand, treating fully vaccinated patients only and checking their oxygen levels were also described by a few dentists (2%) as part of their triage protocols.

For the patient screening forms used by the respondents in their dental clinic or facility, almost all the respondents reported having their forms based on the guidelines of the Philippine Dental Association (94%). The remaining 6% mentioned that their references include the American Dental Association, Center for Disease Control and Prevention, Department of Health–Philippines, and World Health Organization (WHO).

The top non-aerosol generating procedure (NAGPs) performed by the respondents was oral examination (90%), followed by impression taking (88%), denture records taking (82%), prosthodontic try-in (80%), and orthodontic adjustments (71%). While almost half of the respondents reported having taken intra-oral radiographs (47%), some dentists did periodontal charting (37%) and took extra-oral radiographs (18%). Additionally, fluoride varnish application, prescription of medicine, and tele-dentistry were described by a few respondents (2%) as some of the NAGPs they did during the pandemic.

Conversely, almost all the aerosol-generating procedures (AGPs) performed by the respondents during the pandemic included the use of high and low-speed dental handpieces (92%), three-way syringes (86%), and ultrasonic scalers (84%). Meanwhile, 6% of the respondents reported not performing AGPs during the pandemic.

Engineering Controls in the Dental Clinic

Most respondents adopted high-efficiency particulate air (HEPA) filtration units (82%) as one of their clinic's engineering controls, and an extraoral vacuum machine, accounting for 71% of the respondents. Additionally, more than half (65%) of the respondents stated that they have installed air vents and have adopted the use of an intra-oral high-volume evacuator (HVE) for the engineering control measures done by their dental clinic or facility (63%). The treatment area parallel to the airflow direction was adopted by 41% of the respondents, and 35% have mandatorily used only one chair per treatment schedule in clinics with multiple chairs but a single operatory room. Thirty-three (33%) of the participants have switched treatments and allotted empty schedules following the use of AGPs. In addition, 29% of the respondents have had their patient's head near the air vents, and less than 20% have reported using a physical barrier between patient chairs (16%) and following the 6 feet distance between patient chairs (8%) for multiple chairs but a single operatory room. On the other hand, a few respondents (2%) reported having installed a misting machine and having their windows open for their engineering control measures.

Administrative Controls and Work Practices in the Dental Clinic

Almost all the respondents (92%) reported conducting an orientation or meeting with their dental staff regarding implementing the COVID-19 infection control protocols before reopening their practice. Many participants (98%) confirmed adopting a mandatory reduction of patient volume per day and/or spaced appointments between patients during

the COVID-19 pandemic. Participants have also indicated that they provided a hand disinfection facility or 70% ethyl or isopropyl alcohol in every patient care location (96%). Respondents also stated that their treatment area was isolated from all other areas in their dental clinic or facility, and used a pre-operative mouth rinse for 60 seconds (92%). Most respondents reported removing magazines, books, tables, and other unnecessary items or furniture from the waiting area (90%). Additionally, most of the respondents (84%) have confirmed having a designated area for donning and doffing and employment of social distancing at all times. The respondents indicated having provided receptacles with covers for contaminated PPE (80%). Other administrative control measures adopted by the participants included mandatory handwashing for patients before and after procedures (4%), fogging/spraying of hypochlorous acid disinfectant on patients' and staff's clothes before and after entering the treatment area, a mandatory "no companion" policy, and making sure that no other persons were in the operating room.

For the respondents who adopted the use of pre-operative mouth rinse for 60 seconds, most have indicated explicitly that they use 1% povidone-iodine (80%). Some participants (39%) used 0.12% or 0.2% chlorhexidine digluconate, and 29% used 1% hydrogen peroxide. Almost a quarter (24%) of the respondents reported using cetylpyridinium chloride at 0.05%, and a few have used alcohol and essential oils as their pre-operative mouth rinse (12%).

Furthermore, for dentists who performed at least one of the AGPs mentioned in the questionnaire, most of the respondents reported that they used pre-operative mouth rinse (94%) and high-efficiency particulate air (HEPA) filtration units (80%). Over half of the respondents also used extraoral vacuum machines (76%) and intra-oral high-volume evacuation (67%) when performing AGPs. On the other hand, some dentists reported having observed four-handed dentistry and isolation with a rubber dam, which were both at 39%. Additionally, 35% of the participants have also reported that they require patients who will undergo aerosol-generating procedures to take an RT-PCR test approved by the Research Institute for Tropical Medicine (RITM) and the National Institutes of Health (NIH). Other respondents have added the use of exhaust systems (6%), air purifiers, and negative pressure rooms – both at 4% – when doing AGPs on patients. Lastly, 2% of the respondents mentioned that they required patients to undergo an antigen test instead of an RT-PCR test and have observed six-handed dentistry.

Disinfection and Personal Hygiene Practices of the Dental Team

The most common disinfection product used by the participants was alcohol (>or equal to 70%), which was at 94%, followed by hypochlorite or any chlorine-based solution (0.1%) at 84%. Less than a quarter (22%) of the respondents have reported using chloroxylenol (0.12-0.24%), and 4% have utilized UV light sterilization. A few (2%) have also described quaternary ammonium as one of the disinfection products they use.

For the post-operative cleaning or disinfection procedures, all respondents reported that cleaning and disinfection of all surfaces following every patient contact was observed. The majority (86%) have also employed cleaning and disinfection of all non-clinical surfaces (reception, waiting area, toilets), including door handles, chairs, and surfaces using a wet mop with warm water and detergent or hospital disinfectant (e.g., 0.1% Sodium Hypochlorite). Moreover, most of the respondents have used 70% alcohol for porous and non-porous surfaces (80%), as well as the utilization of ultra-violet germicidal irradiation (UVGI) as part of their post-operative disinfection (78%). More than half of the participants have also stated that the staff should wear puncture-resistant utility gloves when performing decontamination/disinfection procedures (63%) and that 0.1% chlorine bleach is used for non-porous surfaces (61%). The two least utilized post-operative cleaning procedures used by the respondents are 3% hydrogen peroxide for porous and non-porous surfaces and quaternary ammonium compounds (both at 27%). Lastly, 12% of the participants have also indicated that they employed defogging or misting of hypochlorous acid or electrolyzed water as part of their post-operative cleaning and disinfection (Figure 2).

Almost all (>90%) have employed the recommended hand hygiene practices, which include using 70% alcohol or alcohol-based sanitizers, performing hand hygiene before and after patient contact, after contact with potentially infectious material, before putting on and after removing PPE, and washing hands with plain or antimicrobial soap for at least 20 seconds.

Use of Personal Protective Equipment (PPE)

Among the triage staff who worked during the height of the pandemic, most reported using single-use head caps (27%), reusable full-face shields (24%), surgical masks (24%), and knee-length, long-sleeved isolation gowns (22%).

Dental assistants utilized single-use head caps, reusable full-face shields, surgical masks, and knee-length, long-sleeved isolation gowns, in addition to non-sterile disposable gloves (63%) and respirator masks (53%). More than half also reported using rubber-soled shoes (53%) and reusable moisture-repellent isolation gowns (51%).

Dentists reported using reusable full-face shields (84%), respirator masks (80%), single-use head caps (78%), non-sterile disposable gloves (78%), knee-length, long-sleeved isolation gowns (73%), rubber-soled shoes (71%), surgical masks (71%), with double gloving (69%) as an additional measure (Figure 3).

The disinfection of personal protective equipment (PPE), specifically reusable gowns, was also asked. Responses revealed that the most common disinfection procedure was washing with detergent and water (90%). Many respondents

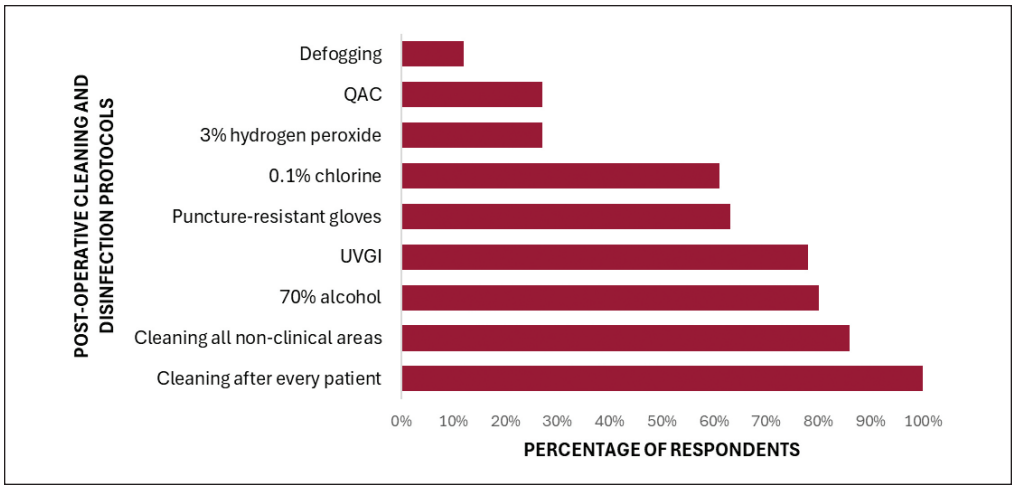

Figure 2. Post-operative cleaning and disinfection protocols employed by the respondents (n=49).

UVGI – ultraviolet germicidal irradiation; QAC - quaternary ammonium compound

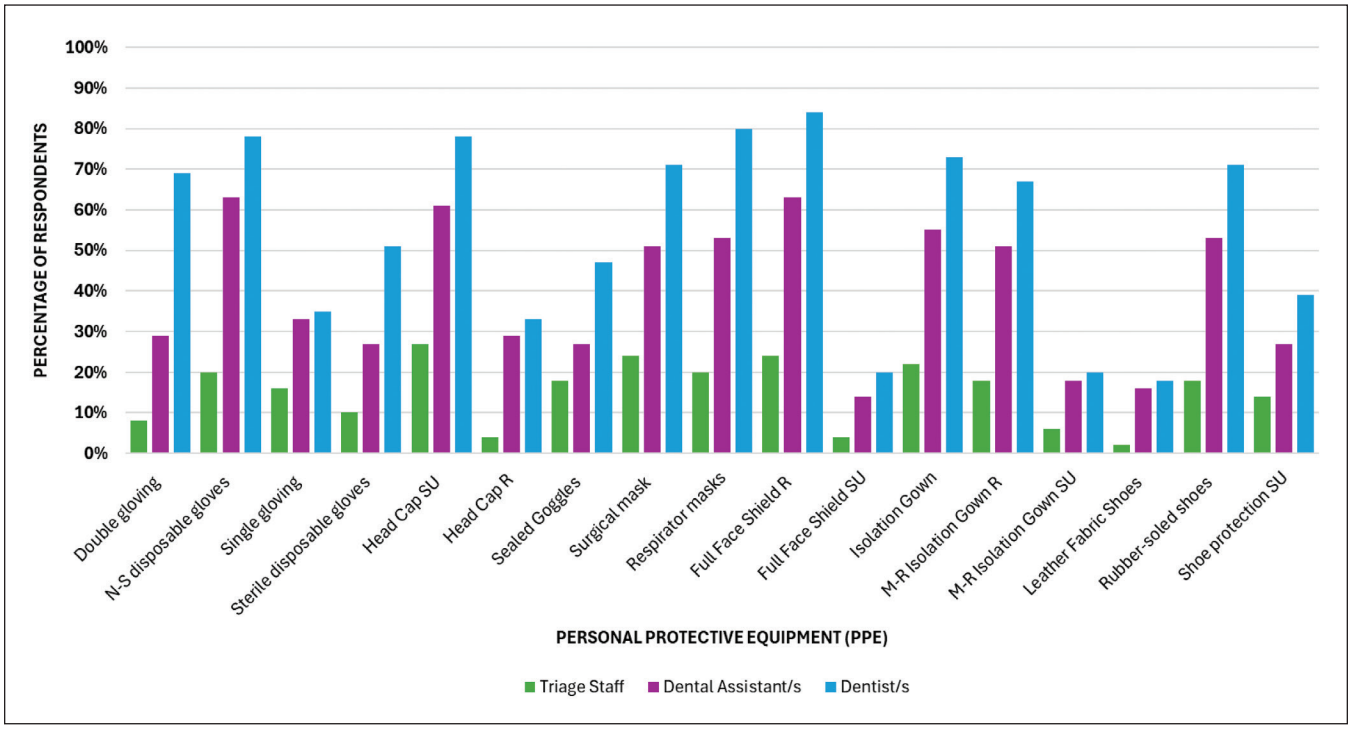

Figure 3. Personal protective equipment used by the dental staff of the respondents (n=49).

R – reusable; SU – single-use; M-R – moisture-repellent; N-S – non-sterile.

have reported soaking the reusable gowns in 0.1% chlorine bleach solution for five minutes (63%), followed by spraying the gowns with 0.1% chlorine bleach solution (14%). Few have employed UV light sterilization (6%), spraying with alcohol (4%), and soaking in Lysol disinfectant overnight (4%) as part of their disinfection procedure. Finally, 2% of the respondents stated that they use steam sterilization and soaking in hot water to disinfect reusable gowns in their dental clinic or facility (Figure 4).

Waste Management Practices of the Dental Clinic

For the waste management protocols utilized by the participants, many described having their waste segregated into appropriately colored containers/trash bags (78%) and separating waste bins per room (71%). Meanwhile, a little more than half of the respondents have stated that their infectious wastes are collected by third-party Treatment Storage and Disposal (TSD) facilities (55%) and that they employ minimal usage of plastics and instead use alter-

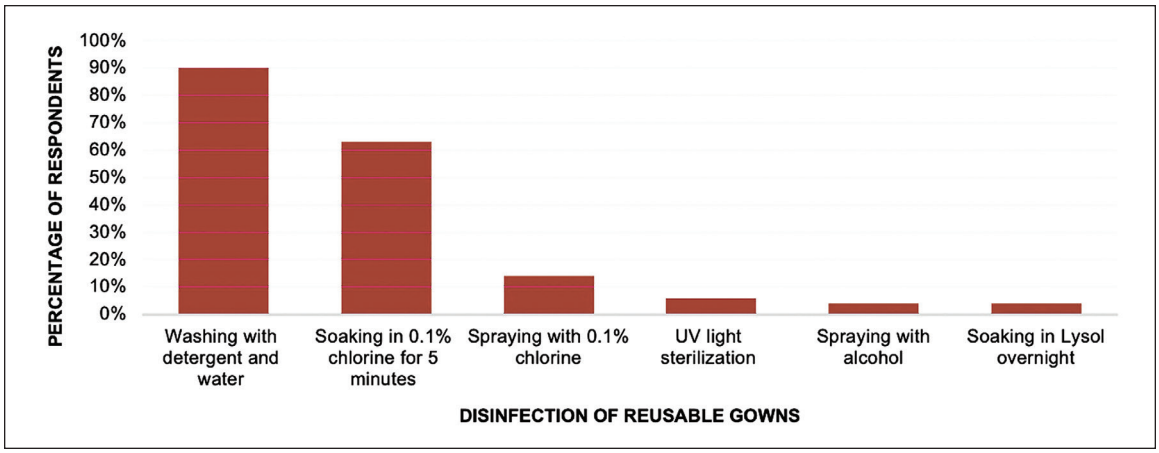

Figure 4. Disinfection of reusable gowns employed by the respondents (n=49).

native biodegradable materials (51%). Meanwhile, 2% of the respondents revealed that their waste management protocols are still under negotiation.

DISCUSSION

At the time of this research, COVID-19 infection was still widely spreading, and the development of a vaccine was still in progress. Hence, the reference for constructing the study's questionnaire was based on the guidelines set from September 2020 to March 2021, when the Philippines was in general community quarantine. Moreover, it is important to note that this study only aimed to describe the adherence of dentists to recommended guidelines rather than assessing their compliance with these guidelines.

During this period, the health system was severely overwhelmed by the rising number of COVID-19 cases, especially in Metro Manila. With this, there was difficulty in acquiring the materials and equipment for the recommended infection control protocols.[6] This problem was highlighted when the health system struggled with the shortage of PPE in the first few months of the pandemic. The global supply chain for medical gear faced challenges in production and logistics, leading to increased demand and soaring prices for PPEs. In response, it may be seen through the results of this study that most respondents turned to using reusable full-face shields and reusable moisture-repellent isolation gowns as alternatives, highlighting the impact of the supply chain issue on healthcare practices.

Despite this, the findings showed that dentists followed the guidelines set by the Centers for Disease Control and Prevention, the Philippine Dental Association, and the Department of Interior and Local Government to prevent COVID-19 transmission in their clinics, employing the minimum requirements for patient triage, engineering, and administrative controls before and after treatment.[3-5] Triage protocols included postponing elective procedures and using tele-dentistry, while engineering controls focused mainly on eliminating or isolating hazards through measures such as airtight barriers and improved ventilation systems. Administrative controls involved staff training on new guidelines, clinic layout adjustments, and workflow changes to ensure proper infection control and cleaning. Minimum public health standards were also consistently practiced by dentists, staff, and patients, including wearing face masks (80%), using alcohol or hand sanitizers for disinfection (96%), frequent handwashing (98%), and maintaining social distancing (82%). This strict observance of minimum public health standards may be due to regular reminders from dental staff and the availability of handwashing stations, alcohol, and sanitizers throughout dental clinics.

Significantly, the results from an exhaustive systematic review encompassing 172 studies (including 44 comparative studies with a total of 25,697 patients) focusing on COVID-19, SARS, and MERS offer compelling evidence on the effect of the minimum public health standards in the prevention of viral transmission. The results indicated that adhering to current policies of maintaining a minimum physical distance of at least 1 meter is strongly associated with a significant reduction in infection rates, and distances of 2 meters or 6 feet may prove even more effective. The findings also suggest that using face masks protects both healthcare workers and the general public against infection from these coronaviruses. Moreover, wearing eye protection may yield additional benefits. However, it is essential to note that none of these interventions can guarantee complete protection from infection.[7]

While minimum requirements were followed, some recommended protocols were also found not to be employed by a number of dentists. Regarding patient triage, the CDC recommends that dentists postpone elective procedures, surgeries, and non-urgent outpatient visits to prevent the spread of COVID-19.[3] However, the survey found that only 57% of respondents deferred elective and non-urgent dental procedures. Likewise, the CDC emphasized that triage protocols should not be limited to patients only but should

also include other clinic personnel. The results showed that 96% of the participants used triage protocols for the patients, but only 71% checked body temperature for all dental personnel.

Moreover, deferment of procedures, including using a handpiece, three-way syringe, and ultrasonic scalers, was also recommended, but only 43% of the participants followed this.[3] Since AGPs contaminate the entire treatment area due to the generation of mist from saliva, aerosol, or droplets, the PDA requires patients to present a valid RT-PCR test result that is not more than five days old and is approved by the Research Institute for Tropical Medicine (RITM) and the National Institutes of Health (NIH). By following this recommendation, practicing dentists could minimize the risk of COVID-19 infection despite the use of AGPs in the dental operatory by preventing interaction with an infected patient. The results showed that only 35% of the respondents who do AGPs require an RT-PCR result from their patients, and 2% opted to require an antigen test. However, a study by Brihn et al. suggests that antigen tests should be evaluated cautiously, given their lower sensitivity compared to RT-PCR tests, which are the gold standard.[8] False-negative antigen test results in healthcare settings might lead to failures in infection control and prevention practices.

Notably, one respondent required their patients to be fully vaccinated before treatment. This protocol may be brought about by other countries that had vaccination rollout before the Philippines did, and these may be patients who are returning Overseas Filipino Workers (OFWs). The WHO first approved the emergency use of the Comirnaty COVID-19 mRNA vaccine, widely known as the Pfizer/BioNTech vaccine, on December 31, 2020. This step laid the foundation for other countries to expedite approval processes to import and administer the COVID-19 vaccine.[9] Nevertheless, this did not cease the global effort to develop other COVID-19 vaccines that would ensure that there will be global access to them. Subsequently, COVID-19 vaccines such as AstraZeneca, Janssen, Moderna, Sinopharm, Sinovac, Bharat Biotech, Covovax, and Nuvaxovid vaccines were later developed.[10] The Philippines procured its first batch of vaccines, the CoronaVac vaccine developed by Sinovac Biotech Limited, on March 1, 2021, to be distributed to the priority groups.[11] With this, the vaccination rollout in the Philippines did not fall within the period coverage of this research, September 2020 – March 2021, and a few had only the first dose of the COVID-19 vaccine, possibly explaining why only a handful of respondents had required it at the time.

Furthermore, the reopening of the dental facilities required not only additional personal protective equipment (PPE) supplies for the dental team and supplementary patient triaging and screening but, most importantly, concerned institutions have required reconfiguration of clinic layouts, including the use of HEPA filtration units, extraoral vacuum machines, intraoral high-volume evacuators, and installation of air-vents and physical barriers among dental chairs. These changes in the dental facility led to increased costs, which have consequently affected the fees charged by dental offices through "infection control or PPE fees."[12] Subsequently, most of the respondents (82%) opted for HEPA filtration units as their primary engineering control protocol, compared to reconfiguring their dental facility's clinic layout. This might explain why only a few dentists adopted alterations in the physical layout, such as installing barriers or maintaining a six-foot distance. Presumably, they might be hesitant to impose additional financial strain on patients, fearing that this could potentially result in a decline in patient numbers. In addition, high-efficiency particulate air (HEPA) filtration units, ultraviolet germicidal irradiation (UVGI), intra-oral high-volume evacuator (HVE), and extraoral vacuum machines are recommended when performing AGPs. The majority of the participants have adopted these engineering controls – HEPA filtration units (82%), extraoral vacuum machines (71%), and intra-oral high-volume evacuation (63%) when performing AGPs. HEPA filtration units can theoretically remove 99.97% of dust, pollen, mold, bacteria, and airborne particles with a size of 0.3 microns or more, while extraoral vacuum machines and HVEs aid in reducing aerosol escapement from the patient's mouth. UVGI units help reduce airborne microbes by communicating with the DNA of bacteria and destroying nucleic acids and their reproductive capability through short ultraviolet wavelengths. With these advantages in hand, this could explain why many respondents opted for these forms of infection control compared to administrative controls, such as requiring RT-PCRs for aerosol-generating procedures, use of four-handed dentistry, or use of rubber dam isolation. Another possible reason is that it might be easier to implement engineering controls than some administrative controls that require further training. Four-handed dentistry, for example, would essentially require another trained assistant who could help treat patients, while using rubber dam isolation might be cumbersome for dentists who are not used to using such methods of saliva control. The requirement of RT-PCR could also deter patient treatment due to the difficulty of having these tests done during the pandemic. The Philippine Society of Microbiology and Infectious Diseases relayed in a press conference that tests should only be recommended for patients exhibiting symptoms of COVID-19, who had a history of contact with a COVID-19 patient or suspected probable cases. With all these factors in place, engineering controls seemed even more appealing.[13] On the other hand, not all dentists implemented the CDC recommendation regarding dental chair arrangement. The mandatory usage of only one chair per treatment schedule was only adopted by 35% of the dentists, and the dental chairs with a six-foot distance between chairs or dental chairs with physical barriers were followed by less than 20% of the participants, which were 8% and 16%, respectively. In addition, the PDA has highly recommended using rubber dam isolation when performing AGPs. However, only 39% of the dentists used rubber dams. A study investigated why

dentists do not use rubber dams, and more than half of the study's respondents (69.25%) stated that they did not use a rubber dam because they preferred other isolation methods.[14]

In the matter of administrative controls adopted by the respondents during the pandemic, the majority have confirmed that they implemented all recommended protocols, with 92% of the participants answering that their treatment area was isolated from all other areas in their dental clinic to minimize the possible inhalation of aerosol in the treatment area by the non-operative staff and patients. Over 90% have also employed all recommended hand hygiene practices for the dental staff and the patients.

For the waste management protocols, only 55% of the respondents have their infectious wastes collected by third-party Treatment Storage and Disposal (TSD) facilities. In comparison, 2% have revealed that their waste management protocols are still under negotiation. The role of the TSD facility is to protect the public from the potential risk of exposure to the COVID-19 virus and other hazardous wastes by implementing health, safety, and environmental plans. Local government units (LGUs) are expected to devise their own solid waste management plan, which is to be approved by the National Solid Waste Management Commission. In the Metro Manila region, 17 out of 17 LGUs had their 10-year solid waste management plan approved.[15] However, the increasing waste generated using several PPE by household and healthcare facilities has posed a significant concern. Whether this solid waste management plan is appropriately and strictly implemented by the LGU should be reviewed. The Department of Environment and Natural Resources should focus on the strict implementation and compliance of all LGUs with their submitted 10-year solid waste management plan to ensure the proper segregation, collection, transport, storage, treatment, and disposal of solid wastes, especially during this pandemic.

This COVID-19 pandemic became an opportunity to reshape and strengthen dental infection control practices to combat not only COVID-19 but also other infectious diseases that have been present for a long time. The results of the data gathered gave us an idea of whether dental practitioners implemented the recommendations set by the Centers for Disease Control and Prevention (CDC) and the Philippine Dental Association (PDA) in their dental clinics. It presented a brief snapshot of the infection control practices prepared by dentists during a time when COVID-19 was at an all-time high. For dentists to continue to treat patients in the safest manner, it becomes important to look at these data with the intention of improving their practice.

Study Limitations

The verification of data accuracy is limited because data was gathered via a self-administered online questionnaire via Google Form, without face-to-face interactions with the participants. This method limits the researcher's ability to thoroughly confirm whether the reported infection control practices are genuinely implemented in practice. Due to the limitations of the general community quarantine, in-person observation was not done. It is challenging to verify the authenticity of the respondents' claims regarding their adherence to infection control protocols. Participants may overreport compliance or interpret questions differently, which can introduce reporting bias. Therefore, while the online questionnaire provides valuable self-reported data, additional measures such as on-site visits would be necessary to validate the actual implementation of infection control practices among these dentists. Since the target sample size was unmet and very small, generalizations to the entire population from which the sample was taken cannot be made. However, as this provides baseline data, recommendations have been made for future studies.

Recommendations

For future researchers who would want to look further into this topic, we recommend the incorporation of in-person visits to validate the accuracy of the data gathered. Continuation of online and hybrid settings, and the use of webinars and online announcements, could also boost response rates. Finally, conducting a follow-up study on the same population could also be helpful in assessing the retention of implemented protocols post COVID-19 period.

CONCLUSION

This study shows that despite the risk of COVID-19, especially in the city with the highest number of active cases, the community of dentists in the area was not hindered by it. The data shows that with the guidelines posted by both the PDA and CDC; the city's dental practitioners could still provide services to the community in the safest manner at the time by being updated and following the patient triage, engineering controls, administrative controls, work practice, disinfection and personal hygiene, use of PPE, and waste management suggested by both organizations. Although some areas could have been improved, such as third-party waste management and the utilization of RT-PCR testing, some of these problems could have been attributed to the lack of availability in their areas.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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