

Monitoring Compliance with the Rules of Antiseptics and Decontamination by Dental Students at Work

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Abstract

Introduction: Dental personnel are potentially exposed to pathogenic microorganisms, as well as to possible sources of infection. The same is true for dental students, for whom it is crucial to acquire knowledge on infection control and appropriate dental techniques during their training.

Aim: The aim of the survey was to evaluate anti-epidemic regimens in dental practice during the COVID-19 pandemic.

Materials and methods: A cross-sectional study was conducted at Plovdiv Medical University Faculty of Dental Medicine from December 2021 to July 2022. The sample included 158 students who were monitored for their use of anti-epidemic measures. To check compliance with the rules for prevention and control of infections, a checklist was developed.

Results: Most of the observed students were in their fourth year of study (62.7%). Disinfection of hands was not performed by slightly more than half of those observed (51.3%) but 84.8% wore medical gloves during dental treatment of patients. When inviting and seating patients, approximately half of the students (46.8%) put on first their personal protective equipment (PPE) and this inevitably contaminated their gloves. The proportion of students who worked according to the requirements for complete wetting with disinfectant by spraying the work field with the optimal action time of 2 minutes, or until the disinfectant dries on the surface, was statistically significantly low (11.4%, $z=13.72$, $p=0.000$).

Conclusion: In terms of infection prevention, the behavior of dental students is inadequate. Both dental students and dental practitioners need to increase their level of knowledge and adherence to infection control protocols. Pre- and post-graduation refresher courses should be included in the future infection control curriculum.

Keywords

dental healthcare, dental students working behavior, pandemic, prevention of dental infections, SARS-CoV-2 infection,

INTRODUCTION

Knowledge of the theory and practice of the epidemiology of dental care-associated infections (DAI) is an important

part of dental practitioners duties. The definition of DAI/NI includes both patient-acquired infections in connection with the medical care of another disease, and infections acquired by medical personnel or third parties in connection

with patient care. Affecting these diverse groups suggests high epidemiological risk. Patients and dental staff may be exposed to pathogens including some blood-borne infections such as the hepatitis B and C viruses, the human immunodeficiency virus, airborne infections that are transmitted by sneezing, coughing, and speaking such as staphylococci, streptococci, herpes simplex virus types 1 and 2, *Mycobacterium tuberculosis*, some water-borne infections such as the Legionnaires' disease, etc.^[1] The dental staff, in addition to dental doctors, dental nurses, dental hygienists and dental technicians, also includes administration and support staff, who, although not directly related to diagnosis and treatment, are potentially at risk of being exposed to pathogenic microorganisms and to some possible sources of infection. The same applies to dental students, for whom it is crucial to acquire knowledge of the infection prevention and good dental practice during their studies.

All conditions for the presence of an infectious process are easy to realize in the dental medicine office due to working 2 to 3 meters away from the source of infection; the use of high-speed dental devices/handpieces, as well as frequent contact with blood, saliva and other body fluids, secretions and excreta.^[2] The risk of transmission of infections is also related to the presence of sources of infection, respectively a patient - sick or carrier and service personnel - sick or carrier. To the dental health-care associated infections, which are a global problem (with different levels of prevention and control according to the economic development of countries), we can add the extremely high risk of COVID-19.^[3] The introduction of some additional specific measures for prevention and control of COVID-19 in dental practice is crucial as dental personnel can play an essential role in limiting the spread of the disease.

AIM

We aimed at practical verification in a prospective study of the compliance with the rules of good dental practice by observing and completing a checklist. We also considered the errors made and prepared recommendations for optimizing the quality of the anti-epidemic regimen.

MATERIALS AND METHODS

Settings and sample size

A cross-sectional study was conducted at the Faculty of Dental Medicine in the Medical University of Plovdiv, Bulgaria, from December 2021 to July 2022. The participants - dental medicine students in their fourth or fifth year of training - were recruited using a non-random convenience sampling method. G*Power Software v. 3.1.9.7 was used to compute the sample size.^[4] Exact test family was applied with statistical test for proportion: difference from constant

(one sample case). The type of power analysis was chosen a priori: computation of the required sample size with a given alpha error probability (0.05), 1-beta error probability (95%) and effect size (0.2), two-tailed tests were preferred. The sample size determined by the input parameters was 79 minimum units of observation. The total sample size obtained was 158 respondents, which represented 78% of all students enrolled in these years of education at the Faculty of Dental Medicine in Plovdiv and approximately 25% of all dental students enrolled in the three Dental Faculties in Sofia, Plovdiv, and Varna during the study period.

Participants and eligibility criteria

Only dental medicine students in their fourth and fifth year were eligible for this study. This inclusion criterion was applied because students from these years of training have already had clinical practice with patients, and it is mandatory for them to know and apply the rules of antisepsis, decontamination, and disinfection in the workplace.

Checklist

In order to practically check compliance with the rules for prevention and control of infections in dental practice, a checklist was developed. It was filled by a dental doctor with more than ten years' experience after direct observation of students during their work with patients in the clinical rooms of the Faculty of Dental Medicine, Plovdiv Medical University and covers the period December 2021 - July 2022, which coincided with the COVID-19 pandemic. The advantage of direct observation is that one gets an idea of the actual compliance with the anti-epidemic regimen and gives an objective assessment of the actions in a work environment, while the survey method takes into account the subjective answers of the respondents.

The checklist contains 13 monitoring points, which are divided into the following categories: 1) wearing of personal protective equipment (coat, gloves, goggles/helmet, mask), 2) correct washing and disinfection of hands, which aimed at their personal infection prevention; 3) reduction of the contamination of the external dental environment as a result of the treatment of patients, proper decontamination of risky surfaces (table, spittoon, reflector handle, working buttons, photo lamps, saliva aspirators), used preparations, exposure and others.

Statistical analysis

Standard descriptive statistics was used to summarize demographic characteristics. Qualitative variables were presented as numbers/totals and percentages (n, %). Chi-square (χ^2) test was applied to test for associations between two categorical variables or Fisher's exact test for 2x2 tables. Differences between proportions were examined using the z-test. A 2-sided p-value of <0.05 was considered statistically significant. Statistical analyses were performed

using SPSS Statistics v. 26 software (IBM Corp., Chicago, IL, USA).

Ethics statement

The study was approved by the Ethics Committee of the Medical University of Plovdiv (No. 4/08.06.2022).

RESULTS

Given the inclusion criterion applied to the study (year of training), the age of the students had a consistent value. The majority of those observed were fourth-year students (62.7%, $n=99$) as opposed to fifth-year students (37.3%, $n=59$) ($z=4.52$, $p=0.000$). Male students outnumbered female students by 62.7% ($n=99$) ($z=4.52$, $p=0.000$). During the observation, everyone wore protective mask, but we found that 67.7% ($n=107$) of the students correctly placed on the face the medical mask, which tightly covers the mouth and nose ($z=6.29$, $p=0.000$). The study revealed that 84.8% ($n=134$) wore medical gloves during dental treatment of patients and 74.1% ($n=117$) wore safety goggles or face shield, both proportions were statistically significantly high ($z=12.37$, $p=0.000$ and $z=8.57$, $p=0.000$, respectively). All the students in the observation ($n=158$) washed their hands with soap and water before starting patient-related activities. We discovered that nearly all students (97.5%, $n=154$) washed their hands for 15 seconds or less, while only 2.5% ($n=4$) washed their hands for the recommended 30 seconds.

Disinfection of hands was not performed by slightly more than half of those observed (51.3%, $n=81$). Furthermore, the duration of hand disinfection was 30 seconds in 27.3% ($n=21$) and up to 15 seconds in 72.7% ($n=56$) of those who performed it at all (48.7%, $n=77$). A statistically significantly lower percentage of students ($z=5.63$, $p=0.000$) followed WHO recommendations for the standard minimum time for hand disinfection (30 sec).

When inviting and seating patients, approximately half of the students (46.8%, $n=74$), first put on personal protective equipment (PPE), which inevitably contaminated their gloves when they touched door handles and other surfaces. While observing whether objects or surfaces outside the work area were touched while wearing contami-

nated gloves, we discovered that 37.3% ($n=59$) of students did not do so, but they did request the dental nurse's help when necessary. This relative frequency was statistically significantly low ($p=0.000$, $z=4.52$). The observation of the decontamination of the work environment after finishing patient-related activities performed on the components of the dental unit is presented in **Table 1**.

Hydrogen peroxide and rubbing alcohol made up 22.8% ($n=36$) of the preparations used by the students for decontamination in the workplace, while a suitable disinfectant for surfaces was employed by 77.2% ($n=122$). The proportion of students who worked according to the requirements for complete wetting with disinfectant by spraying the work field with the optimal action time of 2 minutes, or until the disinfectant dries on the surface, was statistically significantly low (11.4%, $n=18$, $z=13.72$, $p=0.000$). We found that 65.8% ($n=104$) of the time was insufficient, ranging from instant wiping to waiting several seconds. We also discovered a lack of optimal waiting time of action between 30 seconds and 1 minute in 22.8% ($n=36$) of cases. The observation demonstrated that decontamination of the work environment was performed with gloves by 84.2% ($n=133$) ($z=12.16$, $p=0.000$) of students. All students (100%, $n=158$) dipped the used instruments in a disinfectant solution when handing them over to the dental nurse to prevent blood drying on them.

There was an association between the type of decontamination and the year of training of students (Fisher's exact test, $p=0.006$). The proportion of students using hydrogen peroxide and rubbing alcohol was statistically significantly higher in the fifth year of training (35.6%) than in the fourth year (15.2%) ($z=2.76$; $p=0.006$). Surface disinfectant was preferred by 84.8% of fourth-year students over 64.4% of fifth-year students ($z=2.96$; $p=0.003$). In terms of the students' working habits to clean and disinfect the environmental surfaces between patients, the fourth-year students were stricter in decontamination of: 1) dental unit spittoon (49.5%) vs. fifth-year students (30.5%) ($z=2.34$; $p=0.019$); 2) dental unit control buttons (72.7%) vs. fifth-year students (50.9%) ($z=2.78$; $p=0.005$); and dental unit reflector (67.7%) vs. fifth-year students (50.9%) ($z=2.11$; $p=0.036$).

Some of the variables demonstrated association with the gender: hand disinfection (Fisher's exact test, $p=0.049$); while performing patient-related activities, touching objects / surfaces outside the work environment with contam-

Table 1. Decontamination of work environment after finishing patient-related activities by the components of the dental unit

Dental unit components	Decontamination		p-value*
	Yes	No	
Dental unit table, % (N)	100.0 (158)	-	-
Dental unit spittoon, % (N)	42.4 (67)	57.6 (91)	0.006
Dental unit control buttons, % (N)	64.6 (102)	35.4 (56)	0.000
Dental unit reflector, % (N)	61.4 (97)	38.6 (61)	0.000

*(z-test)

inated gloves (Fisher’s exact test, $p=0.027$); type of decontamination methods applied (Fisher’s exact test, $p=0.049$); the working habits regarding the personal protective medical equipment ($\chi^2=21.72$; $p=0.000$); and working habits to clean and disinfect the environmental surfaces between patients ($\chi^2=9.88$; $p=0.043$). **Table 2** summarizes the statistically significant differences observed within the categories of the variables distributed between males and females.

The students who strictly adhered to the guidelines and wore all the personal protective medical equipment were also extremely cautious about handwashing (Fisher’s exact test, $p=0.038$).

DISCUSSION

Dental offices are of high priority regarding the risk of COVID-19 and other infections. Among health care professionals, dentists are more prone to infection due to their direct contact with patients’ bodily fluids like blood and saliva. Dental personnel must be informed of the risk of infection transmission and how to prevent it. The essential

importance of hand hygiene, the role of personal protective equipment (PPE), and all the duties connected with it should be emphasized. Furthermore, the continuing education of healthcare workers is indispensable regarding the prevention of infectious diseases.^[5]

Contaminated hands are one of the primary factors in the transmission of infectious diseases in a healthcare facility and knowledge regarding hand hygiene is crucial. Hand hygiene is the easiest and most effective method for reducing the risk of dental-care associated infections.^[6]

We found insufficient appliance of hand disinfection protocols among the dental students. Similarly, a cross-sectional survey among 84 medical, 74 dental, and 40 nursing undergraduate students in Mumbai, India^[7], reported that only 7.5% of the participants had good knowledge regarding hand hygiene while the majority (69.1%) had moderate knowledge and that <50% undergraduate students (medical 46.4%, dental 48.6%, and nursing 37.5%) knew that unhygienic hands of healthcare workers were the main route of transmission of infections, with only some undergraduate students (medical 40.4%, dental 37.8%, and nursing 32.5%) knowing the minimum time required for effective

Table 2. Differences between male and female students and their working habits

Variable	Sex		p-value*
	Men n=99	Women n=59	
Hand disinfection			
Yes	42.4%	59.3%	0.039
No	57.6%	40.7%	0.039
While working with a patient, touching objects/surfaces outside the work environment with contaminated gloves			
Yes	69.7%	50.8%	0.017
No	30.3%	49.2%	0.017
Duration of hand washing, %			
15 sec	100.0%	93.2%	–
30 sec	0.0%	6.8%	–
Type of decontamination methods applied			
Hydrogen peroxide and rubbing alcohol	28.3%	13.6%	0.033
Surface disinfectant	71.7%	86.4%	0.033
Personal protective medical equipment			
Doctor’s apron	100.00%	100.00%	–
Gloves	76.77%	98.31%	0.000
Facemask	59.60%	81.36%	0.005
Goggles or face shields	24.24%	28.81%	0.529
Disinfection of the environmental surfaces between patients			
Dental unit table	100.00%	100.00%	–
Dental unit spittoon	35.35%	54.24%	0.020
Dental unit control buttons	59.60%	72.88%	0.091
Dental unit reflector	57.58%	67.80%	0.201

*z-test

alcohol-based hand rub as per the WHO guideline. Other studies focused on dental students have also identified poor knowledge, low attitude, and behavior toward hand hygiene.^[8-10] These results only show that handwashing and disinfection should become an educational priority.^[11] It is of crucial importance to identify and address the gaps in the knowledge of the matter.

Regarding PPE and infection control protocols, a study comparing the attitudes and behavior of fourth year dental students in 1995 and 2005 showed a lesser frequency of the use of protective eyewear in 2005 ($p < 0.001$) and that no student used the individual protection equipment correctly or could describe the correct use of the autoclave.^[9] Similar to our findings and the results of the study mentioned above, other researchers have also reported that less than one-third always wore protective glasses.^[12,13] Amongst Romanian undergraduate and postgraduate dental students, notions of high-level disinfection and sterilization were confused by 19.5% with only 22% knowing the correct processing of handpieces ($p = 0.048$, $r = -0.071$).^[14] In Nepal, the level of knowledge and practice of infection control measures was also reported to be poor.^[15] Also, in a study conducted in Pakistan, almost half of the students would not use any antiseptic for sterilizing their hands and only one-third would wear PPE during a procedure. In addition, around one-third were unaware that ineffective sterilization during clinical practice can transmit infection from one patient to another.^[16]

Better results regarding infection prevention protocols were reported in a Saudi dental school^[13] where the highest compliance (100%) was reported for wearing gloves and use of a new saliva ejector with over 90% of changing gloves between patients, wearing face masks and changing hand instruments, burs, and handpieces between patients. A lower usage rate was reported for changing face masks between patients (81%), disinfecting impression materials (87%) and dental prosthesis (74%), and wearing gowns (57%), whereas in our study, 100% of the students were wearing medical coats/gowns, but only a small percentage of them decontaminated properly dental impressions and prostheses.

In Egypt, the knowledge scores reported were generally low, but similar to our findings, female students scored higher on self-protection and sterilization practices than male students, and the fourth-year students showed significantly higher scores for infection control practice than the fifth-year students.^[17]

Numerous studies have reported that although dental students report they have good knowledge and positive attitudes regarding the infection control in general, they show low to moderate compliance with the recommended infection control guidelines.^[15-18]

Given that the circumstances surrounding the coronavirus pandemic are new and rapidly changing, it is crucial now more than ever for dental offices and schools to follow the precautions stated. In Iran, the average percentage of knowledge and attitude score of students in dental schools

towards COVID-19 was 59.7% (moderate) and, like with some of our results, the association between the attitude of the students and their semesters was statistically significant ($r = 0.183$, $p < 0.001$).^[19] Students in Brazil presented a medium level of knowledge about dental biosafety measures during the COVID-19 pandemic.^[20] An investigation linked to the knowledge, attitude, and practices in dental student clinics with possible COVID-19 transmission has shown low use of personal protective equipment (PPE) in Sudan and moderate in Saudi Arabia (statistically significant, $p < 0.001$).^[18] Another study in Saudi Arabia^[21] found improved dental students' adherence to infection control measures during the COVID-19 pandemic with dental students in 2019 being 1.4 times more likely to violate infection control measures compared with those in 2020. Interestingly, in this study male students violated infection controls significantly less often than female students and compliance with PPE standards was higher than with hand hygiene practices and eye protection with goggles or shields. Our study was also conducted during the pandemic and still showed unsatisfactory results, which suggests a need to increase students' knowledge on the matter.

Students' insufficient practice during their training is frequently transferred to their professional behavior in the future. Therefore, similar studies amongst practicing dentists also have not shown satisfactory results both during the COVID-19 pandemic and in general.^[22-27]

CONCLUSION

Attitudes and behaviors of dental students regarding infection control are unsatisfactory. Our study was conducted based on monitoring students while they were working, whereas most of the available data on student behavior is from questionnaires. This may be the reason for the low scores we obtained in our study, as many students believed that they complied with infection control measures and knew them well, but in some cases did not apply them correctly in clinical practice. There is a need to improve the level of infection control knowledge and compliance for both dental students and dental practitioners. Future infection control education should introduce pre- and post-graduation refresher courses focused on hand hygiene, proper use of PPE, and environmental decontamination.

Author contributions

The listed authors have all contributed to the creation of the manuscript and have given permission to include their names as co-authors.

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Competing Interests

The authors have declared that no competing interests exist.

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Мониторинг за соблюдением правил антисептики и деконтаминации студентами-стоматологами на рабочем месте

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Резюме

Введение: Стоматологический персонал потенциально подвержён воздействию патогенных микроорганизмов, а также возможных источников инфекции. То же самое касается студентов-стоматологов, для которых крайне важно получить знания по контролю инфекций и соответствующим стоматологическим методикам во время обучения.

Цель: Целью исследования была оценка противоэпидемических режимов в стоматологической практике во время пандемии COVID-19.

Материалы и методы: Поперечное исследование проводилось на факультете дентальной медицины медицинского университета в Пловдиве с декабря 2021 года по июль 2022 года. В выборку вошли 158 студентов, за которыми велось наблюдение на предмет использования ими противоэпидемических мер. Для проверки соблюдения правил профилактики и контроля инфекций был разработан контрольный список.

Результаты: Большинство наблюдаемых студентов учились на четвёртом курсе обучения (62.7%). Дезинфекцию рук не проводили чуть более половины наблюдаемых (51.3%), но 84.8% носили медицинские перчатки во время стоматологического лечения пациентов. Приглашая и рассаживая пациентов, примерно половина студентов (46.8%) сначала надевали средства индивидуальной защиты (СИЗ), что неизбежно загрязняло их перчатки. Доля студентов, которые работали в соответствии с требованиями полной обработки поверхности рабочего участка дезинфицирующим средством путём распыления с оптимальным временем действия 2 минуты или до высыхания дезинфицирующего средства на поверхности, была статистически значимо низкой (11.4%, $z=13.72$, $p=0.000$).

Заключение: С точки зрения профилактики инфекций поведение студентов-стоматологов неадекватно. Как студентам-стоматологам, так и врачам-стоматологам необходимо повышать уровень своих знаний и соблюдение протоколов инфекционного контроля. В будущую учебную программу по инфекционному контролю следует включить курсы повышения квалификации до и после окончания обучения.

Ключевые слова

стоматологическое обслуживание, поведение студентов-стоматологов на рабочем месте, пандемия, профилактика стоматологических инфекций, инфекция SARS-CoV-2