

# Risk Stratification Tool to Develop Framework for Infection Control in Spectrum of Dental Procedures during COVID-19 Pandemic

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## ABSTRACT

**Objective:** To develop a framework for infection control in the spectrum of dental procedures during the COVID-19 pandemic.

**Methodology:** The study was conducted from Oct to Dec 2021 after approval for ethical review board of Foundation university college of dentistry Ref no ( ). Patients undergoing various dental procedures were enrolled after written and verbal informed consent. Risk Stratification of each procedure was done applying novel risk assessment scoring system, according to the level of risk contact with saliva was given score 1, contact with blood scored as 2, production of aerosol (low level) through triple syringe was given score 3, high aerosol production by ultrasonic piezoelectric instruments was scored as 4. If the complete duration of the dental procedure was >60 min score assigned was 0.75, for procedures with 30 to 60 mins duration score specified was 0.50, if the duration of the procedure was less than 30 min score for that procedure was 0.25. For each patient total score of all these parameters was accumulated to grade risk of SARS-CoV-2 transmission as low (score <4), medium (score 4 to 6), or high (score >6) depending upon the accumulative score of each procedure.

**Results:** Nine hundred and fifteen patients with a gender distribution of 163 (17.9%) males and 748 (82.1%) females with an age range < 18 – 45 years undergoing the dental procedure were enrolled. Out of 915, 436 (47.6%) procedures were found to be low risk, 38 (4.1%) moderate risk, and 437 (47.7%) high risk. Out of 174 maxillofacial procedures, only 18 (10.3%) were of high risk, similarly out of 113 orthodontics procedures, only 1 (0.9%) was of high risk and for 147 prosthodontic procedures, there were 55 (37.4%) high-risk procedures. On the other hand, for operative dentistry procedures (n=181), majority of 128 (70.7%) posed a high risk, among pediatrics procedures (n=92) there were 62 (67.4%) high-risk procedures and for periodontics (n=204) about 173 (84.8%) were of high-risk nature. Therefore, the majority of the high-risk procedures belonged to operative, pediatrics, and periodontics specialty as compared to other specialties (p<0.001).

**Conclusion:** The majority of the high-risk dental procedures belonged to operative, pediatrics, and periodontics specialty as compared to other specialties.

**Keywords:** COVID – 19, dental, risk, stratification.

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## I. INTRODUCTION

Global patient safety protocols during the spectrum of dental procedures have been severely jeopardized by the uncontrollable spread of SARS-CoV-2 virus reconceptualizing infection control from air-borne agents [1]. Dental procedures previously considered less infective with minimal blood contact are now on highest infectivity risk due to the risk of microbial aerosol production [2]. In recent times majority of patients are avoiding needed dental care resulting in a high rate of emergency attendance and cases of neglected dental care [3]. The Current situation is creating alarming fear in dental professionals due to the risk of being infected as

dentists are in the highest risk category of infectivity working in very close proximity to patients, having frequent contact with blood, saliva, and high aerosol production by ultrasonic/piezo instruments [4]. Operator should consider every patient infected and apply universal infection control protocol and individualized preventive strategy to every dental procedure based on risk assessment [5].

In SARS-CoV-2 degree of infectivity of dental procedure can be discerned by level of aerosol production using piezo/ultrasonic instruments aerosol, due to degree of diffusion can exponentially increase the risk of contamination /contagion [6]. Duration of dental procedure and contact with blood also increases the risk of viral diffusion from

contaminated patient mouth to the environment [7]. Risk stratification of dental procedures is essential to rationalize the use of personal protective equipment use in low-income communities like Pakistan. Minimum recommended PPE to be used are google, face shields, National institute of occupational health and safety certified N95, N99, or N100 respirator depending upon the level of risk of dental procedure to be performed [8]. During high-risk procedures it is recommended to ventilate the room for 20 to 30 mins between the patients if this is not possible then high-efficiency particulate air filters must be incorporated. Dental unit tubing and tubing of high-volume saliva ejectors must be regularly flushed with 0.1% sodium hypochlorite [9]. Selection of PPE should be relevant to risk assessment score of dental procedure to be performed effective hand hygiene must be practiced using antimicrobial soap, 60% alcohol-based hand rubs, triclosan or quaternary ammonium compounds-based hand hygiene agents [10].

This study aims to do risk stratification of the wide range of dental procedures based on a novel risk scoring system to rationalize the use of PPE in waves of the SARS-COV-2 pandemic. The objective of this study is to discern the level of risk of disease transmission with a wide range of procedural dynamics involved in different dental procedures and consequently specify the safety protocols and recommendations based on level of risk which will help dentists to make judicious and appropriate decisions.

## II. METHODOLOGY

The study was conducted from Oct to Dec 2021 after approval for ethical review board of Foundation university college of dentistry Ref no ( ). The minimum required sample size for this study was calculated to be 422 using the WHO sample size calculator for a cross-sectional survey study. For sample size calculation the population size (Islamabad/Rawalpindi) was considered to be 2,237,000, with the anticipated prevalence of 50.0% for infection transmission associated with dental procedures, which is the default value, as the exact prevalence of the anticipated problem has not been reported in literature yet, 95% level of significance, design effect of 1 and 10% rate of attrition.

Patients undergoing various dental procedures were enrolled after written and verbal informed consent. Risk Stratification of each procedure was done applying novel risk assessment scoring system [11], parameters in each procedure were scored according to the level of risk contact with saliva was given score 1, contact with blood scored as 2, production of aerosol (low level) through triple syringe was given score 3, high aerosol production by ultrasonic piezoelectric instruments was scored as 4. If the complete duration of the dental procedure was >60 min score assigned was 0.75, for procedures with 30 to 60 mins duration score specified was 0.50, if the duration of the procedure was less than 30 min score for that procedure was 0.25. For each patient total score of all these parameters was accumulated to grade risk of SARS -CoV -2 transmission as low (score <4), medium (score 4 to 6), or high (score >6) depending upon an accumulative score of each procedure. As a part of risk assessment age, gender, and ASA status of the patients was also recorded.

The data will be entered and analyzed using IBM SPSS (version 23.0) for this study. The descriptive statistics of continuous variables e.g. age and risk scores etc will be presented via mean and standard deviation, while for categorical variables e.g. gender, ASA status, etc frequency, and percentage will be used. For mean comparison among groups, independent samples T-test will be used, for more than two groups comparison one-way ANOVA will be used. For categorical group comparisons, the Chi-square test will be employed to drive significant associations. A p-value of  $\leq 0.05$  will be considered significant in this study.

## III. RESULTS

Nine hundred and fifteen patients undergoing some sort of dental procedure were enrolled in the study to identify the type of dental procedure and the level of risk associated with each of them. There were 163 (17.9%) males and 748 (82.1%) females in the study group. Around 341 (37.4%) patients belonged to the age group of fewer than 18 years, while there were 296 (32.5%) patients belonging to 35-45 years' age. The majority of the patients 548 (60.2%) were married. ASA status of 778 (85.4%) patients was observed to be of grade I. The baseline demographic characteristics of study participants are summarized in Table I.

For 915 patients, a total of 915 dental procedures were done during the study period. Out of 915, 436 (47.6%) procedures were found to be low-risk procedures, 38 (4.1%) procedures were of moderate risk while 437 (47.7%) were high-risk procedures as shown in Fig. 1. In terms of specialty, 174 (19.1%) procedures were of maxillofacial specialty, 181 (19.9%) operative dentistry, 113 (12.4%) orthodontics, 92 (10.1%) pediatrics, 204 (22.4%) periodontics and 147 (16.1%) prosthodontics procedures.

It was found that out of 174 maxillofacial procedures, only 18 (10.3%) were of high risk, similarly out of 113 orthodontics procedures, only 1 (0.9%) was of high risk and for 147 prosthodontic procedures, there were 55 (37.4%) high-risk procedures. On the other hand, for operative dentistry procedures (n=181), majority of 128 (70.7%) posed a high risk, among pediatrics procedures (n=92) there were 62 (67.4%) high-risk procedures and for periodontics (n=204) about 173 (84.8%) were of high-risk nature as shown in Fig. 2. Therefore, the majority of the high-risk procedures belonged to operative, pediatrics, and periodontics specialty as compared to other specialties ( $p < 0.001$ ).

Details of procedures among each dental specialty in terms of their level of risk are given in Table II. It was found that surgical extraction, root canal, surgery, dental filling, ultrasonic scaling, insertion, and crowing were among the high-risk procedures that could have been avoided to reduce the risk of COVID-19 infection transmission between patients and dentists.

It was found that 54.0% of dental procedures which included contact with blood were included in high-risk procedures ( $p = 0.009$ ). Similarly, 99.3% of the dental procedures involving aerosol production ( $p < 0.001$ ), 99.5% utilizing an ultrasonic scaler ( $p < 0.001$ ), and 57.3% of procedures requiring more than 30 minutes duration ( $p < 0.001$ ) were included in high-risk procedures as given in Table III.

TABLE I: DEMOGRAPHICS OF STUDY PARTICIPANTS (N=915)

Characteristics	Frequency/Percentage (n%)
Age groups	<18 years 341 (37.4%)
	18-24 years 91 (10.0%)
	25-34 years 183 (20.1%)
	35-45 years 296 (32.5%)
Gender	Male 163 (17.9%)
	Female 748 (82.1%)
Marital Status	Married 548 (60.2%)
	Unmarried 363 (39.8%)
ASA Status	ASA I 778 (85.4%)
	ASA II 131 (14.4%)
	ASA III 2 (0.2%)

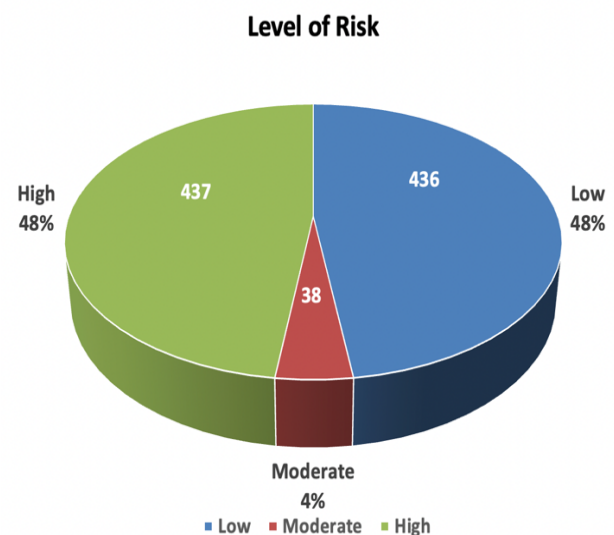


Fig. 1. Percentage of dental procedures posing a low, moderate, and high risk of spreading COVID infection during performing procedure.

TABLE II: LEVEL OF RISK OF DIFFERENT DENTAL PROCEDURES AMONG VARIOUS SPECIALTIES OF DENTISTRY

Specialty	Procedures	No. of procedures	Level of Risk n(%)		
			Low risk	Moderate risk	High risk
Maxillofacial surgery (n=174)	Suture removal	14	14 (100%)	-	-
	Surgical extraction	13	2 (15.4%)	-	11 (84.6%)
	Simple extraction	127	126 (99.2%)	-	1 (0.8%)
Operative dentistry (n=181)	Surgery	20	14 (70.0%)	-	6 (30.0%)
	RCT	93	29 (31.2%)	14 (15.1%)	50 (53.8%)
	Obturation	9	1 (11.1%)	7 (77.8%)	1 (11.1%)
	Filling	49	1 (2.0%)	1 (2.0%)	47 (95.9%)
	Surgery	30	-	-	30 (100%)
Orthodontics (n=113)	Wire change	48	48 (100.0%)	-	-
	Wire & ligature change	29	26 (89.7%)	3 (10.3%)	-
	Banding	17	14 (82.4%)	3 (17.6%)	-
	Insertion	19	17 (89.5%)	1 (5.3%)	1 (5.3%)
	Simple extraction	23	21 (91.3%)	-	2 (8.7%)
Pediatrics (n=92)	RCT	16	4 (25.0%)	-	12 (75.0%)
	Pulpectomy	14	2 (14.3%)	-	12 (85.7%)
	Filling	39	2 (5.1%)	1 (2.6%)	36 (92.3%)
Periodontics (n=204)	Ultrasonic scaling	153	-	-	153 (100.0%)
	Manual scaling	44	22 (50.0%)	2 (4.5%)	20 (45.5%)
	Splitting	7	5 (71.4%)	2 (28.6%)	-
Prosthodontics (n=147)	Trial	14	12 (85.7%)	1 (7.1%)	1 (7.1%)
	Impression	53	44 (83.0%)	-	9 (17.0%)
	Insertion	54	29 (53.7%)	3 (5.6%)	22 (40.7%)
	Crowning	26	3 (11.5%)	-	23 (88.5%)

TABLE III: ASSOCIATION OF THE LEVEL OF RISK WITH THE TYPE DENTAL TECHNIQUE INVOLVED IN DENTAL PROCEDURES

	Level of Risk			p
	Low	Moderate	High	
Contact with blood				
• Yes	273 (62.6%)	17 (44.7%)	236 (54.0%)	0.009
• No	163 (37.4%)	21 (55.3%)	201 (46.0%)	
Aerosol production				
• Yes	4 (0.9%)	37 (97.4%)	434 (99.3%)	<0.001
• No	432 (99.1%)	1 (2.6%)	3 (0.7%)	
Use of ultrasonic scaler/piezo tool/hand piece				
• Yes	0 (0%)	2 (5.3%)	419 (99.5%)	<0.001
• No	436 (100%)	36 (94.7%)	18 (4.1%)	
Duration of procedure				
• <30 mins	320 (73.4%)	21 (55.3%)	187 (42.8%)	<0.001
• 30-60 mins	97 (22.2%)	16 (42.1%)	203 (46.5%)	
• >60 mins	19 (4.4%)	1 (2.6%)	47 (10.8%)	

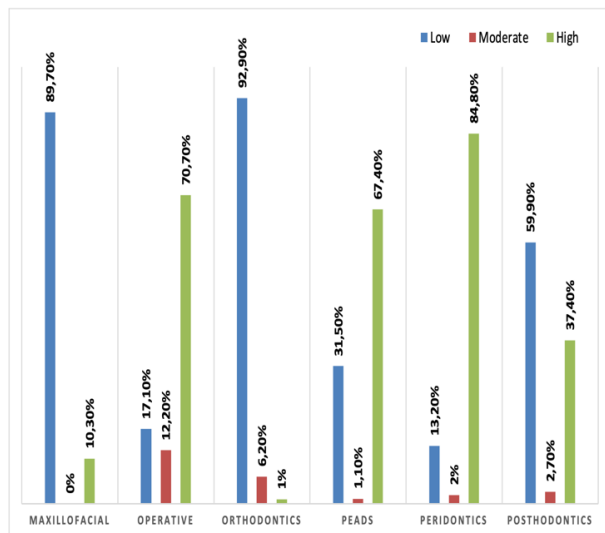


Fig. 2. Breakdown of dental procedures in terms of low, moderate, and high risk among various dental specialties.

#### IV. DISCUSSION

With the advent of the COVID – 19 epidemic since December 2019 each day world intellects and governing bodies anticipated and hoped that we would be able to combat this trojan horse but unfortunately it posed new challenges and threats to the general population and healthcare professionals not only in terms of disease burden, financial implications and stocking up of other medical and surgical procedures due to bar on elective procedures and decreased human resources owing to the affliction of disease. Now that the even year 2021 is about to end and we are abandoned with definitive solution ways and means are to be devised to cohabitate with COVID-19. This research proposal is designed for COVID-19 risk stratification associated with dental procedures and prioritize accordingly weighing risk-benefit ratio. In addition, brow-raising concern with developing countries is the paucity of medical resources and lack of substantial funds to support fractured infrastructure of healthcare hence rationalizing use of personal protective equipment wearing which is considered to be the holy grail in the contagion [12], [13].

Out of 915, 436 (47.6%) procedures were found to be low-risk procedures, 38 (4.1%) procedures were of moderate risk while 437 (47.7%) were high-risk procedures. In terms of specialty, 174 (19.1%) procedures were of maxillofacial specialty, 181 (19.9%) operative dentistry, 113 (12.4%) orthodontics, 92 (10.1%) pediatrics, 204 (22.4%) periodontics and 147 (16.1%) prosthodontics procedures. Considering these statistics, half of the dental procedures do not pose a significant risk of infection contact.

Reference [14] established guidelines for safe routine dental practices in COVID-19 and concluded successful accomplishment of infection control is achieved with breaking succession of infection which includes rapid recognition and curd of high-risk patients. Thus, the employment of risk stratification tools in clinical practice will help segregation and identification of potential high-risk cases.

This study elaborated that among maxillofacial and orthodontics procedures, only 18 (10.3%) and 1 (0.9%) were

of high risk respectively, similarly out of 147 prosthodontic procedures, there were 55 (37.4%) high-risk procedures. On the other hand, for operative dentistry procedures (n=181), majority of 128 (70.7%) posed a high risk, among pediatrics procedures (n=92) there were 62 (67.4%) high-risk procedures and for periodontics (n=204) about 173 (84.8%) were of high-risk nature. Therefore, the majority of the high-risk procedures belonged to operative, pediatrics, and periodontics specialty as compared to other specialties ( $p < 0.001$ ). Therefore, cautions to be taken appropriately.

Reference [15] employed Sechenov University Risk Assessment Criteria (RAC) and placed dental health professionals at medium to the high-risk propensity for COVID-19 and recommended that low-risk criteria in Sechenov University Occupational Classification System can chip in reduction of infectious risk of dental health care services [15]. Reference [16] surveyed dental care experts' perceptions for risk stratification and agreed on the consensus that infection control is crucial in aerosol-generating procedure [17].

The developed world didn't face a crisis of infectious diseases whereas we as third world countries are already stuck with chronic infectious hepatitis B & C, tuberculosis, etc., therefore, it is the need of the hour to pave the way for smooth functioning of health care system with Godzilla of COVID-19. A safety guideline-concordant with estimated risk should be established for individual procedures, thus reclassification of dental interventions based on risk magnitude. To improve safety standards of dental practices tele-dentistry, appropriate waiting areas, avoidance of aerosol-generating procedures, incessant educational programs, mandatory vaccination, pre-procedural mouth rinses, and rubber dam isolation can be adopted [18].

#### V. CONCLUSION

The majority of the high-risk dental procedures belonged to operative, pediatrics, and periodontics specialty as compared to other specialties.

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