

A dental response to the COVID-19 pandemic – Safe Aerosol-Free Emergent (SAFE) Dentistry

Habib Benzian, PhD

Research Professor, Associate Director WHO Collaborating Center Quality Improvement & Evidence-based Dentistry, Department Epidemiology & Health Promotion, College of Dentistry, New York University, 433 First Avenue, New York, 10010 NY, USA

Richard Niederman, PhD

Department Chair, Director WHO Collaborating Center Quality Improvement & Evidence-based Dentistry, Department Epidemiology & Health Promotion, College of Dentistry, New York University, 433 First Avenue, New York, 10010 NY, USA

Corresponding author:

Habib Benzian

habib.benzian@nyu.edu

+491797825420

Abstract

Dental services are significantly impacted by the COVID-19 pandemic. Almost all dental procedures carry a high infection risk for providers and patients due to spread of aerosols. As a consequence, national public health agencies, and dental professional associations have issued guidelines for enhanced infection control, personal protection equipment and limiting care to urgent or emergency services. However, there is no dental service concept for disaster preparedness or response that might be applied. Similarly, pathways to care provision in a post-pandemic future are missing.

We propose *Safe Aerosol-free, Emergent Dentistry* (SAFE Dentistry) as one approach to dental services during and emerging from pandemics. The concept's starting point is the identification of the most common patient needs. The next step is to replace common treatments relating to the most common needs with alternative interventions with less infection risk because they do not generate aerosols. SAFE Dentistry is innovative, safe, and responds to the requirements of a pandemic and post-pandemic emergence where the risk of disease transmission remains high. SAFE Dentistry thereby ensures continuity of dental services while protecting providers and patients from infectious pathogens. Moreover, SAFE Dentistry allows dental service providers to remain operational and generate income even under pandemic conditions.

Implementation and policy options for SAFE Dentistry include universal availability without co-payments by patients and a uniform bundled payment scheme for providers to simplify budgeting, reimbursement and to provide easier administration during a pandemic. Adaptations and adjustments of the concept are possible and encouraged, as long as the principle of avoiding aerosol-generation is maintained.

In a crisis, be aware of the danger, but recognize the opportunity. John F. Kennedy

SARS-CoV-2 disrupts health care and dentistry worldwide

Health care services are adapting to the COVID-19 pandemic, yet oral health care and dentistry are particularly affected due to the proximity to the patient and the generation of aerosols through common treatment procedures. The SARS-CoV-2 virus seriously disrupts routine dental procedures around the world. The reports, analyses and recommendations emerging with first-hand experience from dental settings in China are alarming.[1, 2] The risks of infection for oral health personnel, cross-infection between patients and anyone in the dental care setting are high.

The consequences of the COVID-19 pandemic on health systems and availability of dental care are unprecedented. In the U.S. about 80% of practices offer only limited emergency services and 17% do not see patients at all.[3] This impacts availability and patient access to essential services, while service limitations result in significant economic losses for the entire dental sector, including layoffs of dental teams and growing unemployment. In addition, the prospects of re-starting services remain bleak and uncertain for the months to come.[4] Little is known so far about the impact on dental services in low- and middle-income countries, though recommendations for service limitations to emergency care and increased precautions were issued in many countries.[5]

The infection risk from aerosols in dentistry

Dental teams are generally used to high standards of infection control and personal protection measures, owing to the fact that dental personnel are among the most at risk for any kind of infection transmitted via contaminated aerosols and saliva, bodily fluids, blood or tissue particles.[6, 7]

Current evidence suggests three main pathways for virus transmission in dental settings: 1) direct transmission through inhalation of cough, sneeze, or droplets containing virus; 2) transmission via eye, nasal or oral mucous membranes; and 3) contact transmission through contaminated surfaces.[2] All these transmission pathways are facilitated and possibly amplified by aerosols that are generated by most dental procedures.[7, 8]

In reaction to the COVID-19 pandemic, international and U.S. federal public health agencies, as well as dental professional associations, have issued specific guidance for the control of SARS-CoV-2 in dental practice.[5, 9–13]

These recommendations focus on three main areas where adaptation to the pandemic context is required to break potential transmission chains: patient management and teledentistry to prevent sick or possibly infected patients from coming to the practice; enhanced infection-control measures that include strict protocols for personal protective equipment (PPE), and limitation of dental care to urgent and emergency procedures. Some authorities demand that for patients with COVID-19 symptoms emergency oral health care should be performed in a negative-pressure operatory with maximum PPE to reduce infectious health hazards.[14, 15]

In the U.S., the Occupational Safety and Health Administration (OSHA) considers work environments where aerosols may occur, to be of high or very high infection risk for COVID-19.[14] In a specific update for dentistry, OSHA requires telephone triage, office engineering controls that include air circulation and patient isolation, universal precautions for airborne pathogens, the use of PPE appropriate for the pandemic, limiting care to urgent and emergency procedures that do not generate aerosols, and environmental cleaning post-care. The recommendation for airborne infection isolation rooms (AIIR) with negative pressure is in line with the U.S. Centers for Disease Control and Prevention's (CDC) existing guidance.[16]

Such measures beyond the standard dental infection-control procedures are challenging due to limited or costly supplies of PPE, or would require significant infrastructure investments. Many of the requirements are even unrealistic to achieve in university dental college settings, at least in the short term. For many dental care contexts, such as mobile dental services for schools, remote communities, nursing homes, prisons, homeless shelters or refugee camps, as well as dental services in low-resource settings where the shortage of supplies is a constant challenge, such enhanced protective measures are near to impossible.

The risks from infectious aerosols are central to all recommended alterations of current dental practice, yet uncertainties and open questions related to transmission details remain and oblige dental practitioners to assume they are operating under the highest possible infection risk and to act accordingly with appropriate precautions.

This may be the end of dentistry as we know it. At this point of the pandemic, dentistry needs a concept for continued dental services that avoids procedures generating infectious aerosols as much as possible.

Safe Aerosol-free Emergent (SAFE) Dentistry

With aerosol-generating procedures being at the core of the current challenge for dental services, interventions that avoid aerosol generation should be the interventions of choice. Such procedures exist and may replace possibly hazardous "standard" therapies in an emergency context related to airborne pathogens such as SARS-CoV-2. We propose the concept of *Safe Aerosol-free Emergent Dentistry* (SAFE Dentistry). SAFE Dentistry builds on a prioritization of the most common patient needs, and systematically selects bundles of effective, evidence-based, and value-based care that do not require aerosol-generating procedures.

Focusing on emergency and urgent dental services, SAFE Dentistry addresses common care scenarios with a set of bundled interventions. Table 1 details the treatment options without risk of generating aerosols, including scientific references for the respective non-aerosol options. They comprise:

1. Examination/diagnosis via in-person teledentistry. When performed in-person: Antiseptic mouthrinse, visual and/or tactile inspection without intraoral radiography for diagnosis.
2. Acute pain, swelling or infection: Depending on diagnosis, pulp devitalization/temporary filling (pulpitis), antibiotic therapy (acute inflammation) and/or local anesthesia and tooth extraction.
3. Toothache due to caries without pulpal involvement: Silver-diamine-fluoride application (SDF), glass-ionomer sealants/Atraumatic Restorative Treatment (ART), fluoride varnish/gel and/or toothbrushing with high fluoride-containing toothpaste (HFT, 5000ppm fluoride).
4. Acute periodontitis: Hand scaling and metronidazole/amoxicillin combination for one week.

5. Denture repair/reline, lost crown or orthodontic bracket, or orthodontic wire: Denture repair with soft re-line, crown and bracket re-cementation, and wire adjustment or repair, removal of stitches from previous surgery.

The interventions of SAFE Dentistry are safe, effective and realistic, even for resource-poor settings. Individually, they have been used for decades and have been promoted widely.[17] The systematic bundling and prioritization, however, is new and innovative and responds to a pandemic and post-pandemic context where the risk of disease transmission remains high or might be intermittently increasing or decreasing. This approach ensures that dental service can continue during a pandemic by providing oral health care for the most frequent patient needs, while protecting providers and patients from pathogens. Dental teams will require little to no additional training to perform the interventions of SAFE Dentistry, since none of the procedures are new or unknown.

Healthy system options for implementing SAFE Dentistry

Pandemics are a constant challenge to public health and reveal with relentless clarity the shortcomings of health systems in terms of capacity, coverage, quality and financing. The same applies to inequalities and differential impact of the pandemic on different population groups. Oral health status and access to dental care has long been recognized as a prime example for such challenges.[18] With millions of people unemployed due to the COVID-19 pandemic, many are losing their health insurance benefits when most needed. There is growing recognition that basic health (and oral health) services are a public good that should be universally available for everyone, irrespective of their employment status.[19] SAFE Dentistry, covering the most frequent oral health needs, is one starting point for a basic oral health benefit package. Further adaptations and evolving implementation may also include aerosol-free cavity prevention (dental sealants etc.) and other preventive measures to reduce the need for dental care as pandemics continue to emerge. In order to ensure maximum population coverage, we propose that SAFE Dentistry be universally available with no co-payments. Initial economic modeling for children shows that SAFE dentistry is cost-saving and cost-effective compared to conventional aerosol-generating interventions.[20]

Providers could be reimbursed through a single, uniform payment for any combination of examination and additional procedure, thereby simplifying documentation, billing and reimbursement which is of particular importance in an emergency context. Such an approach would work for health systems relying on a fee-for-service approach as well as for capitation-based systems. However, the details of the required changes in guidelines, service directives or other adaptations need to be determined nationally/locally depending on existing conditions, resources, local guidelines and political support. Aspects of teledentistry should be included in the benefit package, since they will become a more frequent practice and specific reimbursement positions are often not available.[21]

As the pandemic and related practice limitations endure, more and more patients will have to use emergency hospital services for relief of their dental problems. In the US, every 15 seconds a patient visits a hospital emergency for dental care, due to millions lacking dental insurance coverage.[22] Universally available SAFE Dentistry would reduce such hospital visits for common dental ailments, unburden hospital personnel, infrastructure and resources, and instead offer an opportunity for dental service providers to remain operational and generate income. At the same time, SAFE Dentistry allows providers to offer a safe

and hygienic service environment as a key component to regaining patient trust in the period of pandemic recovery.

Conclusions

The early experiences in dentistry from China in a COVID-19 pandemic are instructive and telling: They implemented rapid and bold actions to contain the pandemic, including limited emergency dental services in a tertiary care center with maximum precautions.[1] The UK and other countries also established specialized emergency care centers for dentistry.[23, 24] Yet, the level of infrastructure and service provisions possible in such centers are not realistic for general dental practices or oral health training programs in the U.S. or globally.

SAFE Dentistry, together with general measures to mitigate risk in dental settings, is an adaptation to a pandemic emergency, and a pandemic recovery process, by avoiding infectious aerosols. It is also a first step towards oral health care that does not require complex technology, as envisaged in the landmark Lancet Series on Oral Health.[25]

The dangers of the crisis are clear. Continuation of dentistry as usual during the COVID-19 pandemic will result in incalculable risks for patients and providers. For U.S. governmental agencies and professional organizations, oral health care training institutions, clinicians, and patients not willing to accept a complete shutdown of oral health care, including deterioration of health and wellbeing, there is no alternative to SAFE Dentistry.

Statements

Both authors have contributed equally to the manuscript.

Both authors declare no conflicts of interest.

No funding has been received to write the manuscript.

Table 1: SAFE Dentistry Packages and intervention options

	Package	Intervention Options Without Aerosol Risk	Conventional Options With Aerosol Risk	References
1	Examination	<ul style="list-style-type: none"> • Teledentistry – remote triage, examination and counseling • Pre-examination antiseptic mouthrinse • Visual examination • Examination with instruments <ul style="list-style-type: none"> ○ Probing, percussion test ○ Pulp vitality testing (ice-pellet/heated gutta-percha/ electric testing) • Extraoral X-ray if available and required (OPG) 	<ul style="list-style-type: none"> • Intraoral x-ray (risk of avulsion & coughing) • Temperature test with cold air blow (saliva splatter) • Tactile examination/ palpation 	[21] [2] [26] [27] [1] [28]
2	Pain: Swelling & infection	<ul style="list-style-type: none"> • Local anesthesia • Incision of abscess & drainage • Or/and antibiotic therapy • Or tooth extraction (avoiding surgical separation or drilling) 		[29] [1]
	Pain: Toothache & pulpitis	<ul style="list-style-type: none"> • Local anesthesia • Trepanation/opening of pulp chamber with hand instrument (excavator), extirpation & disinfection of root canal, temporary filling • Or tooth extraction (avoiding surgical separation or drilling) 	<ul style="list-style-type: none"> • Trepanation with drill & spray • Machine preparation and cleaning of root canals 	[28] [29] [30] [1]
3	Pain: Toothache & caries Caries prevention	<ul style="list-style-type: none"> • Silver diamine fluoride (SDF) • Glass ionomer sealants • Atraumatic Restorative Treatment (ART) with glass ionomer • Fluoride varnish • Fluoride gel / 5000 ppm F toothpaste 	<ul style="list-style-type: none"> • Caries excavation & traditional restorative care (drilling & filling) 	[31] [32] [33] [34] [35]
4	Acute periodontitis/ pericoronitis	<ul style="list-style-type: none"> • Cleaning and scaling with hand instruments • Antibiotic therapy (if indicated) • Antiseptic mouthrinse/gel (i.e. CHX) 	<ul style="list-style-type: none"> • Ultrasonic scaling and machine polishing 	[28] [1] [17]
5	Broken denture Orthodontic emergency & post-surgery care	<ul style="list-style-type: none"> • Direct reline/rebase • Removal/adjustment of broken orthodontic wire causing serious irritation • Removal of stitches from previous surgery 	<ul style="list-style-type: none"> • Indirect repair with impression/ laboratory technician (risk of avulsion & coughing) 	[36] [28]

References:

1. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): Emerging and Future Challenges for Dental and Oral Medicine. *J Dent Res*. 2020; 22034520914246.
2. 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: 9.
3. Health Policy Institute (HPI), American Dental Association (ADA). COVID-19: Economic impact on dental practices (week of April 20 results). Available at: <https://bit.ly/2z9tLcY>.
4. Nasseh K, Vujicic M. *Modeling the impact of COVID-19 on U.S. dental spending*. Chicago: Health Policy Institute/American Dental Association; 2020.
5. COVID-19 Dental Services Evidence Review (CoDER) Working Group. *Recommendations for the re-opening of dental services: a rapid review of international sources (Version 1.1. - updated 7th May 2020)*. Available at: https://oralhealth.cochrane.org/sites/oralhealth.cochrane.org/files/public/uploads/covid19_dental_reopening_rapid_review_07052020.pdf.
6. Gamio L. The workers who face the highest coronavirus risk. *New York Times*. 15 March 2020:
7. 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.
8. Ge Z-y, Yang L-m, Xia J-j, Fu X-h, Zhang Y-z. Possible aerosol transmission of COVID-19 and special precautions in dentistry. *Journal of Zhejiang University-SCIENCE B*. 2020;
9. Centers for Disease Control and Prevention (CDC). Dentistry: Interim infection prevention and control guidance for dental settings during the COVID-19 response (26 March 2020). Available at: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html>. 2020;
10. Indian Dental Association. COVID-19 Advisory 17 March 2020. Available at: https://www.ida.org.in/pdf/20200317_Advisory_on_Corona.pdf.
11. Lazzarini M, Putoto G. COVID-19 in Italy: momentous decisions and many uncertainties. *The Lancet Global Health*. 2020;
12. Ordre National des Chirugiens-Dentistes [French National Dental Council]. Recommandations d'experts pour la prise en charge des patients en cabinet dentaire de ville au stade 3 de l'épidémie de COVID-19 [Expert recommendations for patient care in urban dental clinics during phase 3 of the COVID-19 epidemic, 24 March 2020]. Available at: https://lescdf.fr/sites/default/files/inline-files/Recommandations%20COVID%2019%20v1%2024%20mars%202020_0.pdf.
13. Shan S. Study highlights cancer risks from betel-nut chewing. *Taipei Times*. 2006; 2.
14. Occupational Safety and Health Administration (OSHA), Department of Labor. Guidance on preparing workplaces for COVID-19 (OSHA 3990-02 2020). Available at: www.osha.gov/Publications/OSHA3990.pdf.
15. Ather A, Patel B, Ruparel N, Diogenes A, Hargreaves K. Coronavirus Disease 19 (COVID-19): Implications for clinical dental care. *J Endod*. 2020; 46: 584-595.
16. Cleveland JL, Robison VA, Panlilio AL. Tuberculosis epidemiology, diagnosis and infection control recommendations for dental settings: an update on the Centers for Disease Control and Prevention guidelines. *J Am Dent Assoc*. 2009; 140: 1092-1099.
17. Niederman R, Feres M, Ogunbodede E. Chapter 10: Dentistry. In: Debas H, Donkor P, Gawande A, Jamison D, Kruk M, Mock C Washington DC: World Bank; 2015:173-195.
18. Peres MA, Daly B, Guarnizo-Herreno C, Benzian H, Watt R. Oral diseases: A global public health challenge - Author's Reply. *The Lancet*. 2020; 395: 186-187.
19. Chakrabarti M. *COVID-19: Make health systems a global public good (27 April 2020; OECD Development Matters (Blog)*. Available at: <https://oecd-development-matters.org/2020/04/29/covid-19-make-health-systems-a-global-public-good/>.

20. Huang SS, Ruff RR, Niederman R. An Economic Evaluation of a Comprehensive School-Based Caries Prevention Program. *JDR Clin Trans Res*. 2019; 4: 378-387.
21. Alabdullah JH, Daniel SJ. A systematic review on the validity of teledentistry. *Telemedicine and e-Health*. 2018; 24: 639-648.
22. Health Policy Institute (HPI), American Dental Association (ADA). Emergency departments visits for dental conditions - A snapshot (April 2020). Available from: https://www.ada.org/~media/ADA/Science%20and%20Research/HPI/Files/HPIgraphic_0420_1.pdf?la=en.
23. NHS England, NHS Improvement. COVID-19 guidance and standard operating procedure. Urgent dental care systems in the context of the coronavirus (15.04.2020). Available at: <https://bit.ly/3b4BAhw>.
24. Bundeszahnärztekammer [German Federal Dental Council]. Position zur Ausbreitung von Sars-CoV-2/COVID 19. Risikomanagement in Zahnarztpraxen [Position on the Sars-CoV-2/COVID 19 epidemic. Risk management in dental clinics]. Version 27 March 2020; available at https://www.bzaek.de/fileadmin/PDFs/b/2020_Position_Sars-CoV-2.pdf.
25. Watt RG, Daly B, Allison P et al. Ending the neglect of global oral health – time for radical action. *Lancet*. 2019; 394: 261-272.
26. Chen E, Abbott PV. Dental pulp testing: a review. *Int J Dent*. 2009; 2009: 365785.
27. Bartoloni J, Basquill L. Infection control and dental radiography. *Infection Control in Practice*. 2003; 2: 1-8.
28. Alharbi A, Alharbi S, Alqaidi S. Guidelines for dental care provision during the COVID-19 pandemic. *The Saudi Dental Journal*. 2020;
29. Dave M, Seoudi N, Coulthard P. The Oral Surgery Response to Urgent dental care for patients during the COVID-19 pandemic. *The Lancet*. 2020;
30. Yu J, Zhang T, Zhao D, Haapasalo M, Shen Y. Characteristics of Endodontic Emergencies during COVID-19 Outbreak in Wuhan. *Journal of Endodontics*. 2020;
31. Seifo N, Robertson M, MacLean J et al. The use of silver diamine fluoride (SDF) in dental practice. *British Dental Journal*. 2020; 228: 75-81.
32. Marinho VC, Worthington HV, Walsh T, Chong LY. Fluoride gels for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2015; 6: CD002280.
33. Frencken JE. Atraumatic restorative treatment and minimal intervention dentistry. *Br Dent J*. 2017; 223: 183-189.
34. Slayton RL, Urquhart O, Araujo MWB et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. *J Am Dent Assoc*. 2018; 149: 837-849.e19.
35. Douglas GV, Ramsdale MP, Vinall-Collier K, Csikar JI. Using high fluoride concentration products in public policy: A rapid review of current guidelines for high fluoride concentration products. *Caries Res*. 2016; 50 Suppl 1: 50-60.
36. Felton D, Cooper L, Duqum I et al. Evidence-based guidelines for the care and maintenance of complete dentures: A publication of the American College of Prosthodontists. *Journal of Prosthodontics*. 2011; 20: S1-S12.