Risk mitigation for vaccine-preventable diseases in the dental clinic

Oana Săndulescu[1], *Mihai Săndulescu*[2,*]

The advent of the vaccination era has completely changed the landscape of vaccine-preventable diseases (VPD), making control and even elimination of certain infectious diseases a reality. During the past two decades alone, an estimated number of 50 million deaths and 2700 million disability-adjusted life years have been prevented by successful vaccination programs.[1]

However, vaccines can only work if they are used. Unfortunately, during the past decade, vaccine coverage for the main VPDs has plateaued globally[1] or even decreased in certain settings or for certain pathogens.[2,3] The problem of inadequate vaccine uptake has become even more acute during the COVID-19 pandemic when many routine vaccination opportunities were missed, and many countries are still struggling to (at least) return to pre-pandemic vaccine coverage rates.[4]

Among healthcare settings, the dental clinics present a particular risk profile for transmission of certain VPDs, in particular those with respiratory or blood-borne transmission. Correct use of personal-protective equipment, together with routine disinfection and sterilization practices efficiently mitigate the risk of transmission of blood-borne pathogens. However, complex multifactorial interventions are also needed for preventing the transmission of respiratory pathogens, and at times the corresponding infection prevention and control practices (IPC) are less standardized.

The objectives of dental clinic IPC programs are to safeguard the health of the dental practitioner and that of the patient by avoiding cross-transmission of infectious agents between patients and practitioners or between consecutive patients.

The Advisory Committee on Immunization Practices (ACIP) in the USA offer comprehensive recommendations regarding the set of vaccines that should be prioritized for dental healthcare practitioners, including all required booster doses for routine vaccinations as well as risk-based strategies for optional vaccinations.[5]

The main recommendation for blood-borne pathogens refers to full vaccination against hepatitis B, with documentation of a positive (>10 mIU/mL) anti-HBs titer after vaccination.[5]

The recommendations for respiratory pathogens include full vaccination followed by at least one adult booster dose of Tdap (tetanus, diphtheria, acellular *pertussis*) followed by Td boosters every 10 years, as well as complete vaccination against MMR (measles, mumps, rubella), varicella, along with yearly vaccination against influenza.[5] These recommendations have recently been complemented to include COVID-19 vaccination,[6] which refers to the primary vaccination regimen as well as subsequent epidemiologically-relevant boosters tailored to the dominant circulating variants.

To promote good guideline uptake, the ACIP recommendations are quite straightforward and, except for this recent addition of COVID-19 vaccination, have remained unchanged for more than 10 years.[5] Furthermore, for simplicity, the guidelines are applicable to all healthcare workers, regardless of specialty and field of work,

[1]MD, PhD, Professor, Department of Infectious Diseases I, Faculty of Medicine, Carol Davila University of Medicine and Pharmacy, Bucharest, National Institute for Infectious Diseases "Prof. Dr. Matei Balș", No. 1 Dr. Calistrat Grozovici street, Bucharest 021105, Romania; [2]DDS, PhD, Associate Professor, Department of Implant Prosthetic Therapy, Faculty of Dentistry, Carol Davila University of Medicine and Pharmacy, 17-23 Calea Plevnei, Bucharest 010221, Romania.

*Corresponding author: Mihai Săndulescu, mihai.sandulescu@umfcd.ro

Article downloaded from www.germs.ro
Published June 2023
© GERMS 2023
ISSN 2248 – 2997
ISSN – L = 2248 – 2997

and do not require special adaptations for dental practitioners. However, despite these important advantages, many dental practitioners are not familiar with these recommended vaccinations and are even unaware of their immunization status,[7] which hinders vaccination catch-up efforts.

A recent study has assessed the self-recalled vaccination status of dental practitioners from Switzerland, and reported that vaccination uptake was good for hepatitis B (94.7%, with 77.3% of respondents stating that they had also checked their anti-HBs titers at least once following vaccination), but it remained low for vaccines that require periodic boosters or administrations, for example 58.5% for Tdap and 17.4% for yearly influenza vaccination.[7] Rates of vaccine coverage also varied from 79.1% for MMR to 43.4% for varicella, in the same Swiss study.[7] A worrisome finding was the fact that almost one quarter of respondents did not provide reliable answers; they considered that a vaccine against hepatitis C not only exists but that they have received this vaccine in the past.[7] This highlights an important unmet need, that of developing education campaigns regarding VPDs for dental practitioners, to ensure that the recommendations for vaccination are known, understood, and put into practice.

These findings may be country- or setting-specific, and more effort should be channeled into understanding the exact knowledge, attitudes and practice needs of dental practitioners in different settings.

An older study from Italy surveyed dental practitioners who attended a national conference in 2009 and found that during the preceding 10 years only 53.8% of them had measured their anti-HBs titers, and only 13.2% had received a Td-containing booster,[8] which places them at high risk of adult-onset VPDs such as tetanus[9] or diphtheria and potentially whooping cough. Furthermore, less than 10% stated that they were immune to measles, mumps, rubella, or varicella, while the uptake of annual influenza vaccination was much higher (47.5%),[8] albeit still well below the targeted range of 75% coverage.

Interestingly, COVID-19 vaccine acceptancy was positively associated with influenza vaccine uptake among dentists, as reported from a more recent study in Italy.[10] This finding was likely an effect of a more general health-seeking or pro-health behavior, but it also suggests that targeted combined interventions could improve vaccination rates for both viruses when needed.

Such interventions are becoming increasingly important, particularly in the context of decreased vaccine coverage in the general population which, taken together with heightened international travel or population displacement, increases the overall risk that dental patients may be vectors for pathogens that could have otherwise been vaccine-preventable.[11]

Vaccines contribute to preserving human health in a twofold manner. First, the vaccines directly protect the person who receives them, and this is quantified in the pivotal registration trials that calculate each vaccine's efficiency against pre-specified endpoints, such as laboratory-confirmed infection, clinical infection, severe disease, or other complications or adverse outcomes of the disease that the vaccine is designed to prevent.

On the other hand, when appropriately used, vaccines also associate a "herd immunity effect", thus extending their protection beyond the vaccinee, to the few other people who might have a real contraindication to receiving that specific vaccine, or to those who might be misinformed and refuse vaccination. Unfortunately, this herd immunity cannot be taken for granted, as good levels of vaccine coverage are needed to effectively stop the circulation of pathogens in the population. The required level of vaccine coverage needed to obtain elimination of an endemic disease varies based on the transmissibility of the pathogen (expressed as the basic reproduction number – R_0) and based on the duration and degree of protection conferred by the vaccine. A general formula used to calculate the vaccine coverage that is needed to obtain herd immunity is $(1–1/R_0) \times 100$,[12] which indicates that the higher

the pathogen's transmissibility, the higher the proportion of the population that needs to be vaccinated in order to ensure elimination.[13]

To exemplify, for pathogens with airborne transmission such as measles, assuming a high R_0 of 20, an effective vaccination program should obtain a minimum vaccine coverage of $(1 - 1/20) \times 100 = 95\%$. For pathogens with slightly lower reproduction numbers, such as smallpox, where R_0=5, we can calculate $(1 - 1/5) \times 100 = 80\%$, which made it possible to first eliminate and then eradicate smallpox four decades ago.[13]

While vaccination of dental practitioners is the mainstay for preventing VPDs and can ensure that cross-transmission of preventable infections does not occur between patients and practitioners, general precautions and IPC measures are essential in preventing cross-transmission between consecutive or overlapping patients. These include measures implemented by each individual, such as respiratory hygiene, cough etiquette and hand hygiene, as well as measures implemented by the dental clinic, such as surface cleaning and disinfection, and appropriate air quality management. An action as simple as opening the windows can ensure air dilution through general ventilation, whereas for high-risk settings air cleaning many require techniques based on high efficiency particulate air (HEPA) filters or through germicidal ultraviolet (GUV) light and ionization.[14]

Indoor air quality in healthcare settings has come into much more focus during the COVID-19 pandemic.[15-17] However, guidelines for preventing the transmission of potentially airborne pathogens have been available for much longer, but perhaps were not as known to the dental practitioner as they are now. For example, to avoid transmission of tuberculosis, the US Centers for Disease Control and Prevention (CDC) recommend 12 to 15 air changes per hour (ACH) for patient waiting rooms in emergency departments, whereas in patient treatment rooms, a standard of 12 ACH may be sufficient, when coupled with the wear of an N95 respirator by the dental practitioner.[18]

Updated ventilation information, tailored for dental practices, were provided during the COVID-19 pandemic by different authorities or professional societies. For dental treatment rooms 10 ACH were considered to be generally advisable.[14] These air changes can be obtained through a combination of different methods, including natural window-based ventilation, and increased airflow through the building's built-in ventilation system, where available.[14]

Despite the availability of air quality recommendations or guidelines, only 50.5% of dentists from Colombia surveyed during the COVID-19 pandemic stated that they were familiar with the existing guidelines,[19] which again opens an opportunity for more targeted training to improve recommendation uptake.

In conclusion, multipronged interventions are needed to ensure that dental professionals have access to the best available knowledge regarding the general and the specific measures that are effective in preventing transmission of infectious diseases in the dental clinic.

Conflicts of interest: All authors – none to declare.
Funding: None to declare.

References

1. Toor J, Echeverria-Londono S, Li X, et al. Lives saved with vaccination for 10 pathogens across 112 countries in a pre-COVID-19 world. Elife. 2021;10:e67635. https://doi.org/10.7554/eLife.67635
2. Dube E, Pistol A, Stanescu A, et al. Vaccination barriers and drivers in Romania: a focused ethnographic study. Eur J Public Health. 2023;33:222-7. https://doi.org/10.1093/eurpub/ckac135
3. Yiltok ES, Daboer JC, Dachalson EM, et al. Immunization status of children 1-5 years old seen at the Emergency Pediatric Unit of a Teaching Hospital in North-Central Nigeria. Germs. 2022;12:63-74. https://doi.org/10.18683/germs.2022.1307
4. Rachlin A, Danovaro-Holliday MC, Murphy P, Sodha SV, Wallace AS. Routine vaccination coverage - worldwide, 2021. MMWR Morb Mortal Wkly Rep. 2022;71:1396-400. https://doi.org/10.15585/mmwr.mm7144a2

5. Advisory Committee on Immunization Practices; Centers for Disease Control and Prevention (CDC). Immunization of health-care personnel: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep. 2011;60(RR-7):1-45.
6. Razzaghi H, Srivastav A, de Perio MA, Laney AS, Black CL. Influenza and COVID-19 vaccination coverage among health care personnel - United States, 2021-22. MMWR Morb Mortal Wkly Rep. 2022;71:1319-26. https://doi.org/10.15585/mmwr.mm7142a2
7. Zeller B, Kulik EM, Zitzmann NU, Waltimo T. Awareness of vaccine-preventable diseases and self-reported immune status of Swiss dental healthcare workers. Swiss Med Wkly. 2021;151:w30036. https://doi.org/10.4414/SMW.2021.w30036
8. Petti S, Messano GA, Polimeni A. Dentists' awareness toward vaccine preventable diseases. Vaccine. 2011;29:8108-12. https://doi.org/10.1016/j.vaccine.2011.08.034
9. Meena M, Yadav V, Yadav MM, et al. Adult tetanus is not gone yet, but could be ready to leave: A case-series from central India. Germs. 2023;13:86-9. https://doi.org/10.18683/germs.2023.1371
10. Belingheri M, Roncalli M, Riva MA, Paladino ME, Teruzzi CM. COVID-19 vaccine hesitancy and reasons for or against adherence among dentists. J Am Dent Assoc. 2021;152:740-6. https://doi.org/10.1016/j.adaj.2021.04.020
11. Sandulescu O. The renewed threat of vaccine-preventable diseases in the war-struck European continent. Germs. 2022;12:7-9. https://doi.org/10.18683/germs.2022.1301
12. Fine P, Eames K, Heymann DL. "Herd immunity": a rough guide. Clin Infect Dis. 2011;52:911-6. https://doi.org/10.1093/cid/cir007
13. Kretzschmar M. Measurement and modeling: Infectious disease modeling. In: Quah S (ed). International Encyclopedia of Public Health (Second Edition): Academic Press; 2017. https://doi.org/10.1016/B978-0-12-803678-5.00229-0
14. Scottish Dental Clinical Effectiveness Programme. Ventilation information for dentistry: SDCEP; 2021.
15. Mousavi ES, Kananizadeh N, Martinello RA, Sherman JD. COVID-19 outbreak and hospital air quality: a systematic review of evidence on air filtration and recirculation. Environ Sci Technol. 2021;55:4134-47. https://doi.org/10.1021/acs.est.0c03247
16. Radu F, Mates I, Gheorghita V. Bucharest mobile military hospital -response to the COVID-19 pandemic. Rom J Mil Med. 2020;123:141-7.
17. Tzoutzas I, Karoussis I, Maltezou HC. Air quality in dental care facilities: update to current management and control strategies implementing new technologies: a comprehensive review. Vaccines (Basel). 2022;10:847 https://doi.org/10.3390/vaccines10060847
18. Jensen PA, Lambert LA, Iademarco MF, Ridzon R, CDC. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care settings, 2005. MMWR Recomm Rep. 2005;54(RR-17):1-141.
19. Plaza-Ruiz SP, Barbosa-Liz DM, Agudelo-Suarez AA. Ventilation and air-conditioning systems in dental clinics and COVID-19: How much do we know? J Clin Exp Dent. 2021;13:e692-700. https://doi.org/10.4317/jced.58119

Please cite this article as:
Săndulescu O, Săndulescu M. Risk mitigation for vaccine-preventable diseases in the dental clinic. GERMS. 2023;13(2):104-107. doi: 10.18683/germs.2023.1373