

COVID-19 risk management in dental practice.

Part 3: Are dental healthcare workers at greater risk of COVID-19 than other health professionals or general population?

Johan Hartshorne¹ and Andre van Zyl²

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Executive Summary

Rationale

- Dental practitioners are perceived to be at greater risk of occupational exposure and infection with SARS-CoV-2 due to close contact and prolonged contact with respiratory droplets and/or saliva contaminated aerosols from potentially infectious asymptomatic or pre-symptomatic patients.
- Part 3 of this review investigates the current available information on: (i) the global burden of COVID-19 on health care workers and in particular dental health care workers, (ii) why the dental practice setting is regarded as a 'high occupational risk' setting, and (iii) are dental health care workers and their families at increased risk of COVID-19 compared to the general population.
- This information is necessary to enhance dental health care workers (DHCWs) knowledge, awareness and appreciation of the importance of appropriate infection control and prevention measures to protect their safety, as well as patients, staff and public visiting their premises during the pandemic.

Key points

- DHCWs will increasingly be challenged: physically, psychologically and financially, in an uncertain economic and health care environment resulting from the COVID-19 pandemic.
- In South Africa alone, COVID-19 infections (n=27369) (5%) and COVID-19 related mortality rate (n=240) (0.9%) among HCWs has compounded the shortage of workers in the health sector.
- Overall COVID-19 infections amongst HCWs in South Africa (5%) are well below the global average of 10%.
- Dentistry is regarded or perceived as a very high risk occupation and environment because clinical dental practice exposes the dental team and patients to infectious airborne pathogens during aerosol generating procedures (AGPs).
- No studies were found on occupational risk of COVID-19 in DHCWs.
- Current media reports and social polls may bias towards perceptions of very high risk, increase morbidity, and maladaptive coping, enhancing anxiety and distress.
- The available evidence show that COVID-19 cases among frontline HCWs reflect

¹ Johan Hartshorne
B.Sc., B.Ch.D., M.Ch.D., M.P.A.,
Ph.D., (Stell), FFPH.RCP (UK)
General Dental Practitioner,
Intercare Medical and Dental
Centre, Tyger Valley, Bellville,
7530, South Africa
Email: jhartshorne@kanonberg.co.za

² Andre van Zyl
M.Ch.D. (Stell)
Specialist in Oral Medicine and
Periodontics
Honorary Professor: Department
of Oral Medicine and
Periodontology
University of Witwatersrand
Johannesburg, South Africa
Private practice: 9 College Road,
Hermanus, South Africa
Email: info@andrevanzyl.co.za

that of community exposure and that the risk of COVID-19 infection among HCWs are overall similar or lower than the population based risk.

- COVID-19 positivity rates among categories of symptomatic HCWs were not significantly different between "high-risk HCWs (high patient contact, high-risk AGPs) , 'medium-risk HCWs (moderate patient contact, no AGPs) and low-risk HCWs (no patient contact).
- Lack of, and inappropriate use of PPE, prolonged exposure to infected patients, work overload, poor infection control, age, and pre-existing medical comorbidities are risk factors that potentially contributed towards COVID-19 infection amongst HCWs.
- All HCWs are at some risk for exposure to COVID-19 during wide-spread community transmission, whether in the workplace, at home, or in the community.
- HCWs experienced a lower infection rate than their families, and did not represent a main transmission risk for relatives due to the controlled environment (PPE) in the workplace setting.
- There is no evidence available that suggests or proves conclusively that observed COVID-19 infections or deaths among HCWS are necessarily caused by occupational exposure.
- COVID-19 mortality rates among HCWs (0.3%) was also significantly lower compared to mortality rates in the general population (2.3%).
- HCWs who reused PPE or had inadequate access to PPE had a significantly increased risk of COVID-19
- DHCWs are not at increased risk of COVID-19 infection compared to the general population, provided that appropriate PPE are used and the necessary enhanced infection control and prevention precautions are adhered to.
- Occupation is not the only factor determining risk of infection, severity and death from COVID; it's a complex but delicate dance between occupation, behaviour, genetics, age, various underlying systemic health conditions and environment.

Practice implications

- Healthcare workers, including dentists and their nurses, play a central and critical role in providing essential services that promote health, prevent diseases and deliver accessible and quality health care services to individuals, families and communities they serve.
- Healthcare workers are not immune to injury of illness, therefore also have a moral and legal obligation to protect themselves and the healthcare system by ensuring that all

the required infection control and prevention precautions and protocols are followed.

- Healthcare workers however, not only have an obligation to ensure consistency in access to and quality care, but also have an ethical and legal obligation to their staff and the patients they care for.
- The only safe, realistic and controlled approach towards infection prevention and control is to consider all patients as infectious and the universal application of the principles of standard and enhanced precautions.
- One of the major challenges faced by DHCWs in controlling SARS-CoV-2 infection is the extreme shortage of PPE and inadequate training on the use of PPE.

The importance of health care workers within the context of COVID-19

Healthcare workers, including dentists and their nurses, play a central and critical role in providing essential services that promote health, prevent diseases and deliver accessible and quality health care services to individuals, families and communities they serve.¹ Oral health care is integral to overall health and dentistry is essential health care because of its role in evaluation, diagnosing, preventing and treating oral diseases, which can affect systemic health and therefore a potential risk for COVID-19 severity.²

The healthcare industry however is one of the most hazardous and stressful environments to work in due to exposure to biological, chemical, physical (radiation), and ergonomic hazards for long periods of time.³ Healthcare workers however, not only have an obligation to ensure consistency in access to and quality care, but also have an ethical and legal responsibility to protect themselves, their staff, and the patients they care for.

In addition to being exposed to infectious diseases such as COVID-19 at the workplace,⁴ non-communicable diseases such as diabetes and hypertension, as well as cardiovascular diseases and their modifiable risk factors are highly prevalent among HCWs.⁵⁻⁷

The most commonly reported comorbidities reported among hospitalized HCWs were hypertension (65.2%) and diabetes (43%).⁷ The most commonly reported modifiable risk factors reported among HCWs were unhealthy diet, tobacco use, harmful alcohol use, physical inactivity, overweight and obesity.⁶

All health care workers (HCWs), though vital for the functioning of healthcare services during this global pandemic are unequivocally exposed to increased risk of exposure to SARS-CoV-2 infection during wide-spread community transmission, whether in the workplace, at home,

or in the community.⁸ Healthcare workers are not immune to injury of illness, therefore also have a moral and legal obligation to protect themselves and the healthcare system by ensuring that all the required infection control and prevention precautions and protocols are followed.

Globally, there is a lack of information on the occupational risk of exposure to COVID-19 among DHCWs and a paucity of information on HCWs.

Purpose and literature search methodology

The purpose of Part 3 of this review is to investigate the current available information on: (i) the global burden of COVID-19 on dental health care workers, (ii) why the dental practice setting is regarded as a 'high occupational risk' setting, and (iii) are dental health care workers and their families at increased risk of COVID-19 compared to the general population.

Emerging literature on COVID-19 is rapidly evolving and scattered over various sources, is characterized by lack of, or incomplete or uncontested evidence-based data and by a plurality of voices within the health care, academic, environmental research community and media making it difficult to clearly and rapidly synthesize and articulate scientific evidence. There is need for timely evidence to inform and update dentists on emerging COVID-19 infections and infection prevention and control practices. Due to the time-sensitive nature of the review and the need to report the most up-to-date information for an ever-evolving situation, there were no restrictions on language, information sources utilised, publication status, and types of sources of evidence.

A comprehensive literature search of multiple bibliographic databases was conducted, including Medline PubMed, Embase, the Cochrane Collaboration and Google Scholar. COVID-19 repositories with lists of grey literature sources (e.g., LitCOVID, COVID-END and WHO-COVID-19) and pre-print servers or repositories for biological and medical sciences (e.g., medRxiv, bioRxiv) were also included in the search strategy. It should be noted that preprints are preliminary reports of research and have not been certified by peer review. Information derived from preprints thus have to be interpreted with caution. Studies and reviews in all languages were considered for inclusion. Search keywords used in this review include: COVID-19, SARS-CoV-2, exposure, occupational risk, health care workers, dental health care workers, doctors, dentists, nurses, frontline workers, and Boolean search terms AND/OR. Electronic databases were searched to August 31, 2020. Reference lists of full text articles screened were searched for relevant studies.

The global burden of COVID-19 on healthcare workers (HCWs)

• Health burden of COVID-19 - Morbidity and mortality

Since the start of the coronavirus pneumonia outbreak in December 2019 a total of 152,888 COVID-19 related infections and 1413 deaths among healthcare workers have been reported globally.⁹ Infections were mainly in women (71.6%) and nurses (38.6%), but deaths were mainly in men (70.8%) and doctors (51.4%).

In South Africa the overall COVID-19 infection rate among HCWs was 5% (n= 27369 HCWs).¹⁰ A total of 1644 (6%) of these HCWs were doctors, 14143 (52%) nurses, 28 (<1%) port health workers, and 11545 (42%) from other categories of HCWs. A total of 22% (n=6027) of COVID-19 cases among HCWs were in the private sector and 78% (21333) from the public sector. The recovery rate among HCWs as at 4 August 2020 is 58% (n=16005).¹⁰ As at August 7, 2020, there were 7500 registered active cases, of which 751 (10%) were being hospitalized, 6557 (87%) were in self isolation and 192 (3%) were being isolated at a facility. The median age of COVID-19 HCW admissions was 49 years, 382 (17.2% were 60 years and older. A total of 1598 (72% were female.¹⁰ Among 1613 (72.7%) HCW admissions with data on comorbid conditions, 45% had at least one comorbid condition and 36.4% had more than one comorbidity reported. The most commonly reported comorbid conditions were hypertension (65.2%) and diabetes (43.0%). There were 13.5% HCWs who were HIV positive, 1.9% with active tuberculosis (TB) and 0.7% with previous history of TB. A total of 149 (6.7%) HCWs had severe disease defined as receiving treatment in high care or intensive care unit (ICU) or ventilated or diagnosed with acute respiratory distress syndrome (ARDS)

Overall COVID-19 infections amongst HCWs in South Africa (5%) is well below the global average of 10%.¹⁰

The mortality rate among HCWs was (0.9%) (n=240) – 37 (15.4%) from the private sector and 203 (84.6%) from the public sector.¹⁰ Among those that died 65 (36.3%) had more than one comorbidity and 78 (43.6%) were 60 and older.

Overall, the global loss of HCWs to COVID-19 has further compounded the shortage of workers in the health sector.

• Psychological and physical burden of COVID-19

The recent spread of COVID-19 globally has led to considerable anxiety and concern amongst health care workers.⁴ HCWs, including DHCWs are at risk for caring for asymptomatic or pre-symptomatic and symptomatic

infected patients. They understandably worry not only about becoming infected but also infecting co-workers, patients and family members.⁴ Furthermore, COVID-19 has introduced psychological distress into the healthcare environment including stress from using strict infection control and prevention measures, physical strain from wearing protective equipment, need for constant awareness and vigilance, strict procedures and protocols to follow, physical isolation, increased demands for safety by patients in the workplace setting, reduced capacity to use social support due to physical distancing and stigma and insufficient knowledge and experience on appropriate use of PPE. Common PPE related complaints were constrained breathing, inability to speak properly and fogging of goggles. Prolonged PPE usage led to cutaneous manifestation and skin damage with the nasal bridge.¹¹

A review of the literature (10 articles) revealed that frontline HCWs are at risk of physical and mental consequences, directly as a result of providing care to patients with COVID-19.¹¹ A meta-analysis of studies showed that HCWs experience high levels of depression, anxiety, insomnia and distress.¹¹

Risk factors that were most commonly associated with physical and mental consequences of COVID-19 on HCWs were: (i) working in a high-risk workplace setting, (ii) positive diagnosed family member, (iii) Improper hand hygiene before and after patient contact, (iv) improper PPE usage, (v) close contact with patients (>12/day), (vi) long daily contact hours, and (vii) unprotected exposure.¹¹ Furthermore, healthcare providers are afraid they might affect their family members and live-in relatives.¹² Still in many workplace setting it is being reported that HCWs are working in fear of the virus and under poor conditions, without adequate protection or life insurance.¹³

• Economic burden of COVID-19 on dentistry

Globally, COVID-19 and associated policies have profound economic effects and has become a major challenge for dental practices.¹⁴ These effects range from reduced or altered utilization of services, mean income reduction, and altered supply chain of materials. In addition the dental health care workers are facing financial and emotional hardship due to closure of their practices. Major economic challenges that dentists have to face include practice sustainability, financial security, insurance, declining turnovers whilst practice overheads stay the same, increasing operational costs, cashflow problems, labour issues and debt relief.¹⁵ It is also suggested that as employees

lose their jobs, many individuals will lose their employer sponsored medical aid/dental insurance, with many at risk of losing access to dental care and decreasing demand for dental care.¹⁶ Dental practices and the dental industry will increasingly be challenged in an uncertain economic and health care environment as it resumes care delivery.

• Ethical burden on dental practices

The restrictive COVID-19 related policy measures imposed on oral healthcare workers, associated fear and anxiety, and social stigma of becoming infected with COVID-19, poses many potential ethical and legal implications and challenges. Consequences include -disruption and discontinuity of essential care, neglect, inappropriate use of medication and procedures, misdiagnosis, non-diagnosis, malpractice, misconduct under the protection of restrictive legislation.

A recent study¹⁷ that examined dentistry and the global context of the pandemic highlighted the moral status of dental health-care personnel in balancing care for patients and personal welfare.

Dental professionals felt a moral duty to reduce routine care for fear of spreading COVID-19 among their patients and beyond, but were understandably concerned about the financial consequences.¹⁷

Why is dentistry considered a potential high risk for exposure to SARS-CoV-2?

The Occupational Safety and Health Administration places DHCP in the very high exposure risk category, as their jobs are those with high potential for exposure to known or suspected sources of the virus that causes COVID-19 during specific procedures.¹⁸

The practice of dentistry and its unique working environment exposes dental health care professionals and patients in everyday practice to infectious airborne disease pathogens. This is due to close contact during clinical care, as well as the infectious aerosols from most dental procedures.^{19,20} The risk of exposure is considered to be higher in dental practices than in other health care settings mainly because there is (i) close and prolonged contact between the provider and the patient with increased risk of virus spreading through respiratory droplets and/or aerosols, (ii) most dental procedures generate aerosols that are potentially contaminated with a patients' blood and saliva, other secretions or tissue particles, (iii) direct contact with the oral cavity and saliva, a recognized reservoir and portal of exit and entry for SARS-CoV-2, and (iv) DHCPs have no idea whether patient is asymptomatic or pre-symptomatic.²⁰⁻²³

- **Asymptomatic carriers**

SARS-CoV-2 spreads mainly through symptomatic or asymptomatic persons and effectively through breathing (the airborne route).^{21,24-26} For this reason, it has been reported that healthcare professionals, family members, friends and patients who are in close contact with COVID-19 persons are at risk of getting infected or spreading the virus.^{27,28}

Dentistry is considered as a risk for COVID-19 due to face-to-face exposure with patients over extended periods in circumstances where patients or dental health care workers may be asymptomatic or pre-symptomatic carriers of the coronavirus.²² Protection of dental patients and oral health care workers during COVID-19 is challenging due to the existence of patients who are infectious yet asymptomatic.²⁹ According to the Center for Evidence Based Medicine there is not a single reliable study to determine the prevalence of asymptomatic patients.³⁰ What we do know is that between 5% and 80% of people testing positive for SARS-CoV-2 may be asymptomatic, that symptom-based screening will miss a lot of these cases, some asymptomatic cases will become symptomatic over following weeks (so called pre-symptomatics), and both children and young adults can be asymptomatic.³⁰

Close contact with positive patients, whether symptomatic or not, exposes health care workers to a higher risk of infection.³¹ "There are more infections that we don't know about (60% completely asymptomatic), than what we actually know about"

Approximately 40-45% of SARS-CoV-2 infections are likely to be asymptomatic and they can transmit the virus to others for an extended period, perhaps longer than 14 days.³² Lee and co-workers also reported that many individuals with SARS-CoV-2 infection remained asymptomatic for a prolonged period, and that the viral load was similar to that in symptomatic patients.³³

Even though the majority of patients seen by dentists are systemically healthy, they may be asymptomatic carriers of SARS-CoV-2, therefore the appropriate preventive measures should be taken to protect healthcare workers and patients. The disturbing reality is that we have no idea who among us is spreading the disease. This extreme evasiveness of SARS-CoV-2 makes it harder to control.

- **Direct and close contact with the mouth and saliva reservoir**

Dental care professionals are exposed to pathogenic microorganisms that infect the oral cavity and respiratory tract, both because they work in the oral area, and

they cannot maintain an advised global 1-meter public distance.²⁴ In light of the current Coronavirus Pandemic (COVID-19), health professionals working in this area are subject to considerable risk of contamination with SARS-CoV-2 due to face-to-face interactions and contact to saliva, blood, other secretions, and use of aerosol generating procedures. Inhalation of aerosols and airborne particles, especially during applications using ultrasonic and high-speed dental handpiece, poses an additional higher risk of contamination for COVID-19.²⁴ Current evidence suggest that the coronavirus originating from infected saliva from asymptomatic patients is a potential source of infection that should not be ignored.³⁴ The practice of dentistry produces aerosols and droplets, involves direct contact with potentially infected saliva and mucosa, and comprises procedures that may induce gagging or coughing of patients, all carried out in close proximity to the patients mouth and nose.³⁵

SARS-CoV-2 is primarily transmitted between people in close contact and most often by aerosolized virus containing respiratory droplets and aerosols as small as 5-10µm produced during procedures or when a patient or dental health care provider is talking, sneezing or coughing.^{21,22,36} Clinical dental procedures exposes the dental team and patients to infectious airborne diseases due to close and prolonged contact during clinical care, and the potentially infectious aerosols from most dental procedures.²⁰ Close contact within the first 1.5m creates high exposure to both large droplets and droplet nuclei.³⁷

Biological and clinical evidence supports oral mucosa as an initial site of entry and reservoir for SARS-CoV-2.²⁹ The main host cell receptor ACE2 is highly expressed on the epithelial cells of the oral mucosa, especially in the tongue and floor of the mouth,³⁸ suggesting that the oral cavity could be a high risk for SARS-CoV-2 infection,^{38,39} and transmission-based precautions should be taken in the dental clinic. Since many viruses including SARS-CoV-2 can be detected in saliva,^{40,41} the risk of transmission of viruses through droplets or aerosols are critical in the dental setting.^{22,39} Close and prolonged contact between provider and patients, and direct contact with the oral cavity and risk of exposure to potentially contaminated saliva, splatter and aerosols makes this a high risk environment for exposure to SARS-CoV-2.^{20,35}

The highest risk occur from splatter and droplet transmission to the midface of the dentist and/or dental assistant, such as the inner part of the eyes as well as the nasal area.⁴² SARS-CoV-2 has a predominantly respiratory transmission through aerosols (5 micron and droplets <50 micron).²³ It

is therefore reasonable to assume that any method for reducing the viable bacterial or viral load in saliva and/or oral environment and/or limiting the effects of viral diffusion could lower the risk of cross-contamination and therefore critically important for infection control.²³

• Aerosol generating procedures

The generation of aerosols in dentistry is practically an unavoidable part of most dental treatments. Dental aerosols produced from AGPs (e.g. ultrasonic scaler, high speed dental handpiece, air/water syringe, air polishing and air abrasion) has led to a new controversy during the COVID-19 pandemic, namely that it could facilitate the transmission of SARS-CoV-2 virus, thereby increasing the risk of exposure by dentists and dental assistants. However, to date there are limited data available to evaluate the scope and extent of AGPs that may generate potentially infectious aerosols, and a lack of expert consensus on whether AGPs represent and infection transmission risk for DHCWs.

Dental health care workers using AGPs are likely at greater risk of inoculating themselves and their patients from contaminated airborne salivary transmissions, splatter or respiratory droplets produced during AGP's.⁴²

Most dental procedures generate aerosols or splatter that are contaminated with a patients saliva, blood, other secretions, or tissue particles,⁴³ exposing both dental health care workers as well as patients and staff to airborne, aerosol, contact and contaminated surface transmission of SARS-CoV-2.^{21,22,39}

Biologic risk of SARS-CoV-2 inhalation transmission is extremely high when performing AGPs, which favours the diffusion of aerosol particles of saliva, blood and secretions.²²

AGPs facilitate contamination of the patient, dentist environment (instruments, dental equipment, surfaces and floor).²¹⁻²³ Given the direct contact transmission, the mucosa of the oral cavity has been recognized as a potentially high-risk route of SARS-CoV-2 infection,³⁸ as well as contaminated hands, which could facilitate virus transmission to patients.²³

The water coolant from a high-speed handpiece could generate aerosols during restorative, prophylaxis and surgical procedures.⁴⁴ When combined with bodily fluids in the oral cavity, such as blood and saliva, contaminated bioaerosols are potentially created.⁴⁵ These bioaerosols are commonly contaminated with bacteria, fungi, and viruses, and have the potential to float in the air for a considerable amount of time and be inhaled by dentists and patients.⁴⁶⁻⁴⁸

Use of ultrasonic scalers, dental handpieces, air polishers, air abrasion units and 3-in-1 syringes produce the most visible

and viable bioaerosols.⁴⁹ Ultrasonic and sonic transmission during nonsurgical procedures had the highest incidence of particle transmission, followed by air polishing, air/water syringe, and high-speed hand piece aerosolization.⁴³

Most international sources recommend avoiding or minimizing the use of AGPs if possible, to reduce the risk of creating contaminated aerosols.⁵⁰ One has to seriously question the ethical and legal validity of these recommendations because minimizing the use of important tools such as the 3-in-1 water spray syringe, air turbine and ultrasonic scalers for instance have implications on the standard of care provided, and whether minimizing its use would be in the patients' best interest.

Minimizing or not using a 3-in-1 water-spray syringe will leave saliva on teeth and inadequate dried tooth surface resulting in poor etching and bonding. Using alternative handpieces and drill bits without water cooling will increase the risk of pulpal damage. Using hand instruments as an alternative to ultrasonic handpieces is not an option as it may create other risks of sharps injuries or damage to teeth. Instead of avoiding or minimizing the use of essential dental equipment the focus should rather be on what physical, chemical, and technical barriers and measures should be used to reduce or eliminate contaminated aerosols (e.g. pre-procedural mouth rinses, rubberdam, HVE and PPE) resulting from different AGP's.

More importantly, it seems plausible to adopt the principle of 'consider all patients as potentially infectious for air droplet /airborne disease and treat every case with equal and uniform precaution measures' as a more realistic, effective and safe approach towards infection prevention and control. Aerosols is unavoidable, however using physical, technical barriers, and chemical barriers may reduce the risk of exposure to SARS-CoV-2. These details will be described in greater detail in Part 4 of this series.

Are DHCWs at greater risk than other HCWs or general population – A summary of key evidence reports?

The risk of SARS-CoV-2 infection by healthcare workers has been a great concern since the start of the outbreak and the first person to raise concerns about the illness to the international community was Dr Li Wen-Liang, an ophthalmologist in Wuhan who sadly died of the disease that he likely contracted while at work.⁵¹ By mid-February 2020, a large number of COVID-19 infections in medical staff had already been reported.⁵² In China studies documented over 3300 confirmed cases of infected HCWs in early March.

In the USA, as high as 19% of COVID-patients have been identified as HCWs.⁵³ Unmitigated, rising infection and mortality rates in HCWs, will not only paralyse a country's response to COVID-19, it is bound to have a significant long-term impact in healthcare delivery, particularly in healthcare systems already grappling with workforce shortages and geographic maldistribution.⁹

• Dental health care workers

Although dentistry is considered or perceived a high risk occupation, there is no reliable, peer-reviewed COVID-19 morbidity and mortality statistics available for dentists and their assistants to substantiate that dental health care workers are at greater risk than other HCWs or the general population. Currently there is a paucity of publications and national situation reports that provide information on the number of COVID-19 related infected HCWs and case fatalities.⁸

HCWs exposed to oro-nasal secretions such as otorhinolaryngologists, anaesthesiologists and oral maxillofacial surgeons, are especially at risk for COVID-19 infection and this group comprised 12% of all physician deaths.⁵⁴ In comparison dentists who are in close proximity to oral secretions for prolonged periods and their high-speed handpiece and ultrasonic instruments aerosolize body fluids had only 5% of the fatalities. In a recent paper from China,²² no dentists were reported to have died from COVID-19 contracted during patient encounters.

Considering the paucity and/or lack of reliable risk data relating to DHCWs in particular, the approach of this review is aimed at analysing general trends observed among frontline HCWs relating to occupational risk of exposure to COVID-19 and how these trends compare in relation to that of the general population, and then to extrapolate from this data to DHCWs in the dental practice setting.

• The South African experience of HCW exposure to COVID-19

As of 15 August 2020, 2220 (4.3%) of the COVID-19 hospital admissions recorded on the DATCOV surveillance database, were HCWs, reported from 237 hospitals (63 public sectors and 174 private sectors in all nine provinces of South Africa.¹⁰ The overall COVID-19 infection rate among HCWs was 5% (n= 27369 HCWs).¹⁰ A total of 1644 (6%) of these HCWs were doctors, 14143 (52%) nurses, 28 (<1%) port health workers, and 11545 (42%) from other categories of HCWs. A total of 22% (n=6027) of COVID-19 cases among HCWs were in the private

sector and 78% (21333) from the public sector. Overall COVID-19 infections amongst HCWs in South Africa (5%) is well below the global average of 10%.¹⁰ The mortality rate among HCWs was 0.9% (n=240), with 37 (15.4%) from the private sector and 203 (84.6%) from the public sector.¹⁰

It is also suggested that lack of PPE, exposure to infected patients, work overload, poor infection control, and pre-existing medical co-morbidities are risk factors that potentially contributed towards COVID-19 infection amongst HCWs.⁵⁵

• The UK experience of HCW exposure to COVID-19

A new analysis from the Office of National Statistics looking at COVID-19 related deaths between 9 March and 25 May, 2020 found that healthcare workers, including dental nurses and dental practitioners, do not have higher rates of COVID-19 deaths when compared to the general population.⁵⁶

An independent analysis of NHS data in the UK until April 12, 2020, analysed 106 cases of deaths of UK health and social care workers from COVID-19. Of the 106 COVID-19 deaths most were nurses (33%), health care support workers (25%), and doctors (17%). Only one case of a dentist was reported.⁵⁷ This data however is unreliable because in 89 cases (84%) it could not be established whether the individual had been working during the epidemic.

In another study amongst 9809 health care employees in a UK Hospital, 11% of staff had evidence of COVID-19.⁵⁸ Staff with confirmed household contact were at greatest risk [Adjusted ODDs Ratio 4.63 (95% CI: 3.30 to 6.50)] and higher rates of COVID-19 were found in staff working in COVID-19 facing areas (21.2%) as compared to the general population (8.2%).

Dentists are generally not considered as frontline workers and not exposed to COVID-19 patients, and most dentists are for most of the time only involved in emergency care.

HCWs work very closely with patients (at arms-length and/or touching) and are exposed to COVID-19 (asymptomatic, pre-symptomatic or symptomatic) on a daily basis. Occupations involving close proximity to individuals, and those where there is potential or regular exposure to COVID-19 are generally perceived to have higher mortality rates from COVID-19. However, findings from this analysis do not prove conclusively that the observed mortality rates involving COVID-19 are necessarily caused in occupational exposure.⁵⁶ Other studies indicate that COVID-19 mortality statistics amongst HCWs (doctors and nurses) have similar statistics as that of the general population.⁵⁶

• **Alberta Health Services COVID-19 Rapid Response Report on HCW occupational risk**

In the absence of reliable peer-reviewed occupational risk data, the perception of personal COVID-19 risk in HCWs is at risk of being driven by preferential media reporting.¹² This perception that HCWs are at risk is substantiated by a recent informal social media based poll of over 500 physicians across Canada which indicated that 86% felt they had a greater than 50% chance of acquiring COVID-19 during the coming months.¹²

Key research questions addressed in the Rapid Response Report were: (i) Among countries who were past their initial peak of COVID-19 cases, what proportion of total cases were in health care workers (nurses and physicians), and what is the estimated proportion of the total number of HCWs who developed COVID-19 from presumed occupational exposure? (ii) Is there any evidence that household members of HCWs are at elevated risk of COVID-19 disease, and if so, are there guidelines for mitigating that risk.

Based on the available evidence the following key messages relating to the above-mentioned research questions were presented:¹²

(i) The evidence for occupational risk among HCWs is highly variable. HCWs make up 9.6% of Ontario's 2392 cases.⁵⁹ However, the regional COVID-19 infection rates vary widely ranging from 3.7% in Toronto to 43% in Peterborough.⁵⁹

(ii) The current absolute occupational risk of documented COVID-19 infection in healthcare workers is 0.01%.

(iii) Overall incidence of COVID-19 infection in HCWs is higher than that of the general population.

(iv) The relative risk of documented COVID-19 for HCW, confined to the analysis of nurses and physicians was 9-11 higher than the general population.

(v) The absolute risk of documented risk of COVID-19 amongst HCWs (2.93%) remained quite low, regardless of country risk status (under 3% in high risk countries).

(vi) COVID-19 epidemic dynamics among HCWs closely follow community dynamics, representing an argument against significant occupational transmission.⁶⁰

(vii) When contact times were under 15 minutes there was no increased risk of infection. No transmission was detected among 21 HCWs who were exposed to COVID-19 patients, despite minimal PPE.⁶¹

(viii) Occupational risk to HCWs could be mitigated by diligent hand hygiene and appropriate use of PPE.

(ix) COVID-19 positivity rates among categories of symptomatic HCWs were not significantly different between

“high-risk HCWs (high patient contact, high-risk AGPs), ‘medium-risk HCWs (moderate patient contact, no AGPs) and low-risk HCWs (no patient contact).⁶²

(x) Calgary has the preponderance of COVID-19 hospitalized cases within Alberta at this time. There has been no evidence of aerosol generating medical procedures as cause of COVID infection on any of the four Calgary “Designated COVID-19” acute care wards. This data supports that there is no SARS-CoV-2 airborne transmission in high-risk settings where infection control and prevention precautions and PPE (gowns, gloves, medical masks, and face shields or goggles in routine care and the addition of N95 respirator for AGPs) use are meticulously followed and executed.¹²

(xi) There are no reliable data on hospitalization and mortality rates for HCWs and most available data were from media reports. Within high-risk countries, these limited data suggested case fatality was substantially lower in HCWs (0.01%) than in the general population in Italy (13.9%) and Hubei (4.7%).¹²

(xii) Current data suggest that 90% of cases in HCWs in Alberta, Canada currently reflect community exposure and that the occupational risk is overall similar or lower than the population based risk of documented COVID-19.¹² This data is in keeping with the estimates of risks seen in some of the low risk countries, reflecting both a relatively low exposure risk within health care settings currently, and potentially reflecting effectiveness of recommended PPE and other infection prevention and control measures.

• **A global perspective of ‘low’ and ‘high’ incidence of COVID among HCWs**

Most of the data from new studies was presented as incident COVID-19 in HCWs rather than risk. Four studies reported low incidence for HCWs: United States - 2.9%⁶³; China- 4.4%⁶⁴; China - 8.2%⁶⁵ and USA - 2.5%.⁶⁶

Four studies, all from Europe, described incidence rates for HCWs at or above the global rate of 10%, namely: Lombardy (Italy) - 13.8%⁶⁷; Sardinia - (41%)⁶⁷; Italian average - 10%⁶⁸; and Spain - 20%.⁶⁹ The evidence around occupational exposure risk is highly variable. Observations from Spain showed that the epidemic dynamics among HCWs closely followed community dynamics, representing an argument against occupational transmission (no increased risk compared to community risk).⁶⁰

Early evidence from Singapore show that no HCWs developed COVID-19 after contact with 68 confirmed cases.⁷⁰

A new pre-print study reported a 7% greater absolute

risk (95%CI for risk difference 4.7% - 9.3%) of SARS-CoV-2 among HCWs compared to non-HCWs in a university and university hospital setting in New Jersey.⁷¹ The highest infection rate was in nurses (11.1%), and ICU workers had a low rate of infection (2.1%) compared to those on other units (4.9-9.7%). A case study from Switzerland in a primary care hospital found that when contact times were low (less than 15 minutes), there was no increased risk of infection (no transmission was detected among the 21 HCWs who were exposed to the patient, despite minimal PPE).⁶¹ In another study, an analysis of data from 41 countries revealed 67569 cases of COVID-19 infected HCWs. The median HCW infection percentage among total cases globally was 10.04% (range 0-24.9%). The median case fatality rate among HCWs was 0.8% (range 0-18.95%).⁸ The median age of HCWs who died was 62 yrs (range 24-93 years). The researchers noted that it is impossible to compare HCW infections across countries, due to different testing policies, underreporting of cases or prioritization of HCW testing and variability of the stage of the epidemic in a particular country.

A meta-analysis of 11 studies, (China n= 7; USA n= 3, and Italy n=1), consisting of 119,216 patients (including 13,199 HCWs) showed that nearly 10% of COVID-19 positive cases were HCWs. This study also revealed that the incidence of severe disease in HCWs (9.9%) was significantly lower compared to that of the general population (29.4%). Furthermore, COVID-19 mortality rates among HCWs (0.3%) was also significantly lower compared to mortality rates in the general population (2.3%).⁴

It is suggested that physicians and health care professions exposed to oronasal secretions (ENT specialist, anaesthetists and dentists) may be considered a potential high risk and should therefore not be underestimated.⁹

• The UK /USA experience of HCW exposure to COVID-19 using a social media survey

A prospective observational cohort study of front-line workers (n=99795) and general population in the UK and USA (2,035,395), using a social medial platform survey between March 24 to April 23, 2020 showed an overall 0.2% COVID-19 cases in the general population compared to 2.7% COVID-19 cases among front-line HCWs.⁷²

Frontline HCWs with inadequate PPE caring for patients with documented COVID-19 had a six-fold increased risk for COVID-19 compared to those HCWs with adequate PPE that have no exposure to patients with COVID-19.

Risk of frontline HCWs reusing PPE and exposed to patients

with documented COVID-19 was also increased five-fold.

However, it is suggested that media reports and social polls may bias towards perceptions of very high risk, increase morbidity, and maladaptive coping.¹²

• Are family members of HCWs or DHCWs at elevated risk of exposure to COVID-19

There are no available data on the transmission of COVID-19 from infected HCWs to household members.¹² Several publications have considered the exposure risk to COVID-19 of the general population and healthcare workers. A recent and only paper available discussed the risk of exposure by family members of health care workers.⁷³ The conclusions made by the authors in this study was: (i) the general populations exposure to COVID-19 is less controlled than that of health care workers, (ii) healthcare workers experienced a lower infection rate than their families, and (iii) health care workers did not represent a main transmission risk for relatives.⁷³ This brings into question the relative risk of HCWs infection from community versus workplace exposure and is consistent with current Alberta data for HCWs infections where most are currently from the community. There were no qualitative or quantitative data sources to address transmission from HCW back to members of their household in the broad search string employed. As a result, there are no estimates of risk of transmission of infection from HCWs to household members.

• Possible reasons that may impact on HCW exposure risk

The potential for high exposure to SARS-CoV-2 is generally higher for healthcare workers due to direct exposure and proximity to COVID-19 patients, long exposure time and failure to use effective PPE, lack of proper training how to use PPE and inadequate supervision and monitoring of infection prevention and control measures.¹³ A study amongst frontline HCWs suggested that HCWs that reused PPE or had inadequate access to PPE had a significantly increased risk of COVID-19.⁷²

Based on the evidence from SARS-CoV-1, risk to HCWs could be mitigated by diligent hand hygiene and careful use and doffing of PPE⁷⁴ and enhanced surface disinfection within health care settings.¹²

Although dentists and dental nurses have the highest level of proximity and potential exposure to COVID-19 on a daily basis out of all the occupations evaluated, they were most likely to be using PPE.

The use of standard infection control and prevention,

including high levels of PPE, and dental health care workers who are specially trained in decontamination and cross-infection measures has been normalized in the dental profession over the past 40 years. However, extended precautions for preventing airborne transmission of respiratory viral infectious disease have been added to the standard precautions.

- **Extrapolating the reviewed data to the DHCW population**

The available evidence shows that COVID-19 cases among frontline HCWs reflect that of community exposure and that the risk of COVID-19 infection among HCWs are overall similar or lower than the population based risk. COVID-19 positivity rates among categories of symptomatic HCWs were not significantly different between “high-risk HCWs (high patient contact, high-risk AGPs) , ‘medium-risk HCWs (moderate patient contact, no AGPs) and low-risk HCWs (no patient contact). HCWs where dentists and dental nurses were included in the study population, did not have higher risk of COVID-19 infection compared to the general population.

Furthermore, the available data do not prove conclusively that the observed COVID-19 cases and mortality rates are necessarily caused by occupational exposure. Abovementioned data suggest that COVID-19 morbidity and mortality epidemic dynamics among frontline HCWs follows the trend seen in general population dynamics, representing an argument against occupational transmission.

Considering that abovementioned risk % and estimated

proportions of total number of HCWs who developed COVID-19 were mostly front-line workers (nurses and physicians) exposed to COVID-19, it is reasonable to assume that dentists and their staff, who are not direct frontline workers would likely have the same or less risk of developing COVID-19. Furthermore, diligent hand hygiene, appropriate use of PPE and enhanced infection control and prevention measures would further decrease the likelihood of exposure risk among DHCWs.

It has been suggested that there is an urgent need for a registry among HCWs to establish facts, enable robust and systematic morbidity and mortality data analysis on how COVID-19 infection are impacting on individuals in the health professions during the conduct of their duty, and to enable effective mitigation practices.⁵⁷

Conclusion

Dentistry is an essential service, therefore the safety of dental health care workers and their patients should be an urgent focus and priority to protect the integrity and effectiveness of the healthcare system in the global response to the pandemic. DHCWs will increasingly be challenged, physically, psychologically and financially in an uncertain economic and health care environment resulting from the COVID-19 pandemic. The COVID-19 pandemic has to date exerted a significant physical, psychological, and economical burden on all HCWs globally, highlighting the need for appropriate psychological support to prevent the emergence of the widespread psychological morbidity characterized by considerable anxiety and distress among HCWs.

Globally there is a paucity of research into the occupation risk of exposure to hazards such as infectious diseases like COVID-19 faced by HCWs and in particular DHCWs. Dentistry is regarded or perceived as a very high risk occupation and environment because clinical dental practice exposes the dental team and patients to infectious airborne disease pathogens due to close and prolonged contact with potentially asymptomatic or pre-symptomatic patients, and the increased risk of exposure to potentially infectious aerosols from most dental procedures. DHCWs are not only at increased risk of SARS-CoV-2 exposure but can also amplify outbreaks within their practices or at home if they become ill.

The available evidence show that COVID-19 cases among frontline HCWs reflect that of community exposure and that the risk of COVID-19 infection among HCWs are overall similar or lower than the population based risk. Furthermore, the available data do not prove conclusively that the observed COVID-19 cases and mortality rates are necessarily caused by occupational exposure but more likely incidental. It is therefore reasonable to suggest that dentists and their staff, who do not have direct contact with documented positive COVID-19 cases (except for the possibility of exposure to asymptomatic and/or pre-symptomatic cases), would likely have the same or less risk of developing COVID-19. A plausible explanation why frontline HCWs, including DHCWs, are likely to have the same or reduced risk rate of exposure to infection is because they work in a controlled environment with appropriate infection control and prevention protocols.

Considering the evidence presented in this review, it is plausible to conclude that DHCWs are not at increased risk of COVID-19 infection compared to the general population, provided that appropriate PPE are used and the necessary enhanced infection control and prevention precautions are adhered to. However, one of the major challenges faced in controlling COVID-19 is the extreme shortage of PPE and inadequate training on the use of PPE.

There is no information available on the question whether DHCWs pose an elevated risk to their relatives or family members. However, in a single available study the authors

suggested that because HCWs work in a controlled environment and that the general populations exposure to COVID-19 is less controlled to that of HCWs, it was reasonable to assume that HCWs experienced a lower infection rate than their families. HCWs, including dentists, did not represent a main transmission risk for relatives.

In the absence of reliable risk data, the perception of personal COVID-19 risk with DHCWs is at risk of being driven by preferential media reporting of cases in DHCWs or social media based polls. It is suggested that media reports and social polls may bias towards perceptions of very high risk, thus further enhancing anxiety and distress among DHCWs.

A primary limitation of the data presented in this review was the quality of the data, countries were at different stages of their epidemics when reporting took place, heterogeneity of HCW classification and availability as well as the variability of testing in different countries which could have influenced infection and mortality rates among health care workers.

Occupation is not the only factor determining risk of infection, severity and death from COVID; it's a complex but delicate dance between occupation, behaviour, genetics, age, various underlying systemic health conditions and environment.

This will not be our last pandemic. DHCWs should learn how to balance their moral, legal and professional obligations towards ensuring a safe working environment. This will benefit not only themselves, but also their patients and staff. Yet, as practice owners, dentists have to face the consequences of reduced patient visits, loss of incomes, and increased costs of infection control and prevention protocols. Reconciling the conflict between risking one's life, or livelihood under the COVID-19 pandemic is not an easy choice. Dentists are ethically obliged to provide the best possible care, including the elimination of potential risks and harms. Fulfilling moral obligations, compassion and commitment towards patients, providing safe and quality care are what professionalism is all about. In acting in the ethical principle of 'doing no harm' maximum protective measures should be taken.

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