Monitoring of Aerosol Production and Movement in a Dental Clinic

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Introduction

The suspension of routine dental care during the COVID-19 pandemic was decided based on the extent that dental health care providers and patients can be exposed to COVID-19 viral pathogens through various routes of transmissions including aerosol producing dental procedures.[4] The Center for Disease Control and Prevention (CDC) have issued guidelines that all aerosol generating dental procedures should ideally take place in an airborne infection isolation room.[1] During the production of aerosols in the dental clinic, small disturbances in air movement can allow particles to spread throughout the room and into other parts of the dental clinic.[3] Engineering controls have been suggested to reduce exposure to infectious aerosols in the dental settings.[2] However, effective infection-control strategies and modifications to room designs need to be based on a thorough understanding of the 3D spatial topography of particle flow, distribution, and behavior of aerosols. Therefore, there is an increasing need for a better understanding of how aerosols interact in a dental clinic so that the risk of exposure to infectious dental aerosols can be reduced. This study examines the 3D spatial relationship of aerosols by measuring the concentration of aerosols in clinical and nonclinical areas over a 45-day period within a large dental clinic.

1. CDC. URL https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html
2. D. Cocârţă,et al. *Sustainability,* 13:599, 2021
3. D. Dabiri et al. *Frontiers in Dental Medicine*, 2:726395, 2021
4. J. Allison et al. *Journal of Oral Rehabilitation,* 48: 61– 72, 2020

Hypothesis

There is no difference in concentration of airborne particles between clinical and nonclinical areas within a dental clinic.

Purpose

The aim of this study was to analyze the aerosol production and topographical movement in real-time within a dental clinic while standard dental procedures were completed.

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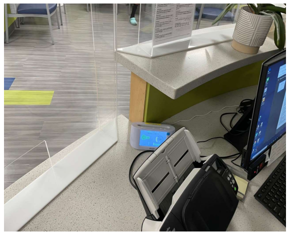
Methods

IQAIR AirVisual Pro indoor air quality sensor

Five IQAIR Indoor AirVisual Pro air quality sensors with ability to measure aerosol particle concentration up to PM10 (aerosolized particles ≤10µm in size) were placed at specific locations within the dental service at the University of Toledo. Sensor 1 was placed at patient check-in, sensor 2 was placed in restorative operatory 5, sensor 3 was placed in exam/restorative/hygiene operatory 14, sensor 4 was placed in hygiene operatory 3, and sensor 5 was placed at patient check-out.Each Dental operatory was a closed room operatory (not airtight nor negative pressure) with doors shut during treatment. Air quality sensors recorded PM10 (aerosolized particles ≤10µm), carbon dioxide, temperature and humidity every 10 seconds for 45 days continuously.



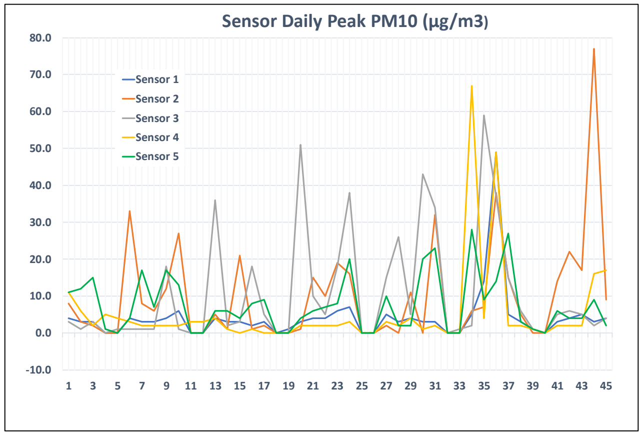
Sensor 1 Check-In Location

Sensor 2 Operatory 5 Location

Sensor 4 Operatory 3 Location

Sensor 5 Check-Out Location

Results



An analysis of variance test concluded that daily peak PM10 values between at least two sensors had a statistically significant difference (F=3.200, *P*=0.015). Tukey's Honest Significant Difference shows statistical significance between sensor 1 (check-in) and sensor 3 (operatory 14) (*P*=0.038). Fisher's Least Significant Difference shows statistically significance between sensor 1 (check-in) and sensor 2 (operatory 5) (*P*=0.012), sensor 1 (check-in) and sensor 3 (operatory 3) (*P*=0.005), sensor 2 (operatory 5) and sensor 4 (operatory 3) (*P*=0.033), and sensor 3 (operatory 14) and sensor 4 (operatory 3) (*P*=0.014).

Discussion

- Sensor 1 (check-in) had more difference in PM10 when compared to the other sensors and registered on average the lowest PM10; sensor 5 (check-out) showed no significant difference between any of the sensors.
- The maximum particle concentration throughout the data collection peaked around 77 µg/m³ by sensor 2 on day 44.
- Rising CO_2 concentration data indicated an increase in patient density during clinical hours.

Conclusion

Results demonstrate a difference in the concentration of PM10 between several sensors with increased aerosol concentration in dental operatories versus patient check-in and check-out area. Therefore, aerosol topographical movement of PM10 within a dental clinic is not equivalent throughout the facilities.