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Microbiology Research Report

Sabiha S. Bunek, D.D. S., Fiona Collins, B.D.S, M.B.A., M.A. and Delaney Graham, B.A.

DENTAL ADVISOR Microbiology Research Center
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Aerosol and Spatter Reduction Efficacy of shieldVAC™

Clinician: Ona Erdt, D.M.D., M.S., M.S.H.S., CDA.

Purpose:

A pilot study to assess the amount of bacterial load derived from aerosol and spatter when using ***shieldVAC™*** compared to a high-volume evacuation system (HVE) and low-volume evacuation (saliva ejector; SE).

Challenge Device:

shieldVAC™ is a circular shield and suction device which is clamped to the dental chair headrest and uses the existing HVE valve and hose as an added external suction. The arm can be adjusted to a desired position, between six and eight inches from the patient's mouth. Simply turn on the suction as you would normally use it and work underneath any of the 3 provided shields: 8 inch, 10 inch, and 12 inch. ***shieldVAC™*** is designed to protect the dental professional from spray and spatter generated during dental procedures.

Experimental Design:

Controlled Variables: Volume of air flowing onto contact plates, the air-driven low-speed hygiene handpiece used at a consistent PSI, RPM, and water spray level with HVE for all conditions, prophy paste all fine grit, ultrasonic scaler set to 60Hz.

Materials:

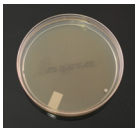
shieldVAC (TBS Dental), ***Cavitron*** ultrasonic scaling unit with 30k 10s ***FSI*** (Dentsply Sirona), ***Prophy Star 3 Hygiene Handpiece*** (Dental EZ), ***Sparkle Soft Disposable Prophy Angle*** (Crosstex), ***Enamel Pro Prophy Paste*** (Premier Dental), standard HVE and SE with suction tips, SAS Super 180 Bioaerosol Sampler, TSA with Lecithin and Poly 90 Contact plates, TSA Settling plates, patient volunteers (A, B, and C), licensed dental professional, PPE including an N95 respirator.

Methods:

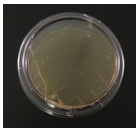
Each ultrasonic scaling and polishing procedure was completed while the office was closed, and all procedures were completed in one designated operatory. Prior to the first patient, HVE lines were cleaned with an evacuation line cleaner and traps were changed. Additional SE and HVE lines were running in all four operatories during the study to simulate simultaneous treatment in each operatory. The dental professional wore PPE, including an N95 respirator for all procedures. No face shield was used. The same dental professional performed all ultrasonic scaling and polishing procedures in this study. The ultrasonic scaler was consistently set to 60Hz and operated at the highest water spray level. An air-driven, low-speed hygiene handpiece was used at a consistent PSI, RPM, and water spray level for all conditions. Fine grit prophy paste was used for all polishing procedures. A control sample of the operatory air was taken for 5 minutes while patient A and the dentist were in the room, prior to any aerosol generation, using the SAS Super 180 Bioaerosol Sampler with a TSA with Lecithin and Poly 90 Contact Plate (SAS CP) placed 18 inches from the patient's mouth, a TSA

Device

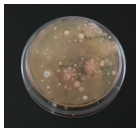
Control



Control: Chest (CFU = 1)



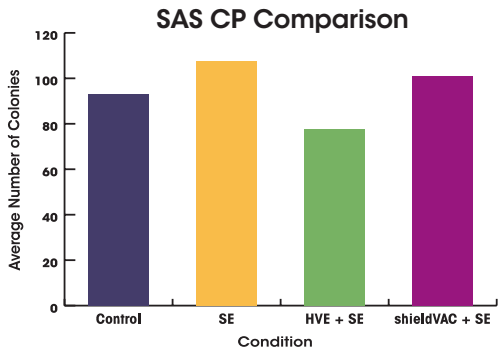
Control: Mask (CFU = 0)

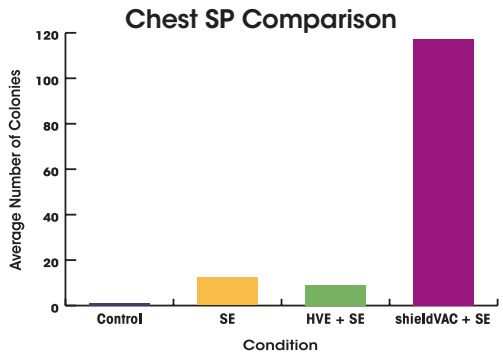


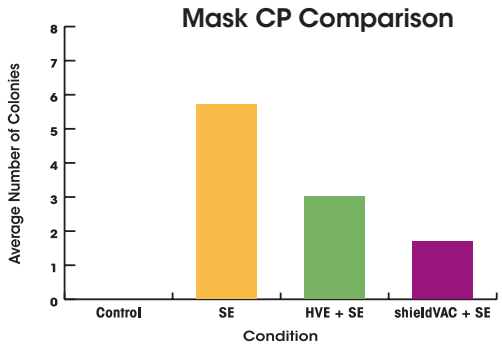
Control: SAS (CFU = 93)

Settling Plate placed on the patient's chest 8 inches from their mouth (Chest SP), and a second TSA with Lecithin and Poly 90 Contact Plate to culture the N95 mask worn by the dentist (Mask CP) following 5 minutes of contact time with the patient where no aerosols were generated. The positioning of each plate was consistent for all testing for the duration of the study. For each procedure, all quadrants of the mouth were treated. This consisted of 2.5 minutes of ultrasonic scaling and 2.5 minutes for polishing using a prophy angle and prophy paste. The SAS CP in the bioaerosol sampler and the Chest SP were used to routinely collect air quality samples for 5 minutes during each procedure. Both plates were replaced after each 5-minute interval and after each procedure a new Mask CP was used to culture the N95 respirator worn during aerosol generation.

Three separate conditions were utilized for comparison purposes on each of the three patient volunteers. The first condition utilized SE, the second condition utilized standard HVE together with a SE, and the third condition utilized the ***shieldVAC™*** together with SE. The positioning of the SE was consistent throughout all testing and the ***shieldVAC™*** was consistently placed 7 inches from the patient's mouth. There was a 20-minute room turnaround time between each patient, during which appropriate clinical contact surface cleaning and disinfection protocols were followed. After each test run, the exposed plates were immediately processed and incubated at 37°C for 48 hours. Microbial growth was quantified, analyzed and recorded for all plates. All testing procedures were repeated on all three patient volunteers. Before testing, all volunteers agreed to participate in the study and to having their photos taken.





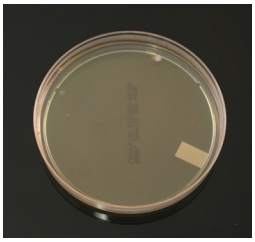


Results:

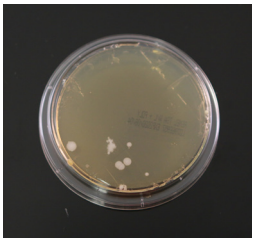
The bacterial load collected on the SAS CPs decreased by 5.9% when using the ***shieldVAC™*** compared to only using a SE and increased by 29.9% when compared to HVE. The bacterial load collected on the Chest SPs increased by 853.7% when using the ***shieldVAC™*** compared to only using a SE and increased by 1203.3% compared to use of HVE. The bacterial load collected on the Mask CPs decreased by 70.1% when using the ***shieldVAC™*** compared to the SE and decreased by 43.3% when using ***shieldVAC™*** compared to the HVE. The results for each of the three patients varied are shown below.

Patient A

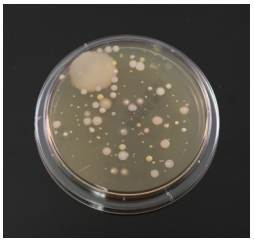
Patient A: SE



SE: Chest (CFU = 3)



SE: Mask (CFU =13)



SE: SAS (CFU =127)

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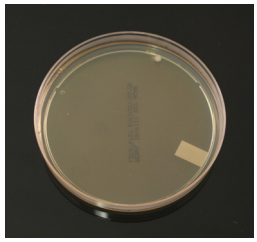
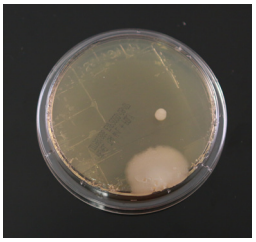
Patient A: HVE + SE



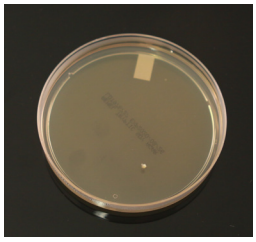
HVE + SE: Chest (CFU = 3)



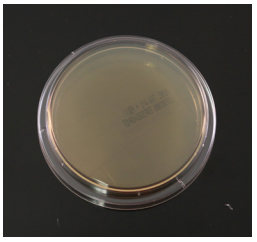
HVE + SE: Mask (CFU = 2)

HVE + SE: SAS (CFU =116)

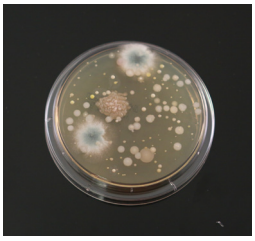
Patient A: shieldVAC + SE



shieldVAC + SE: Chest
(CFU = 3)



shieldVAC + SE: Mask
(CFU = 0)



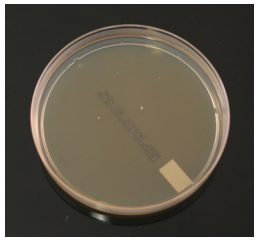
shieldVAC + SE: SAS
(CFU = 133)

Patient A Summary:

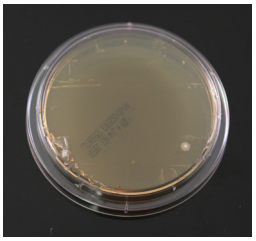
Containment of bacterial load spatter showed no difference on chest plates between ***shieldVAC***, HVE, and SE.

Patient B

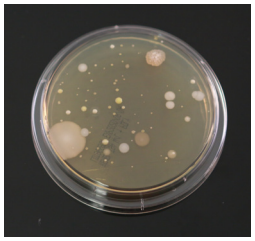
Patient B: SE



SE: Chest (CFU = 2)

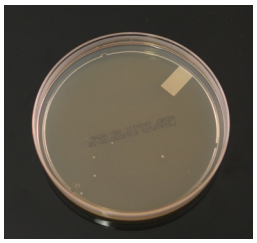


SE: Mask (CFU = 2)

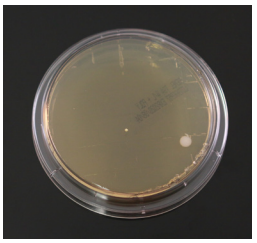


SE: SAS (CFU = 76)

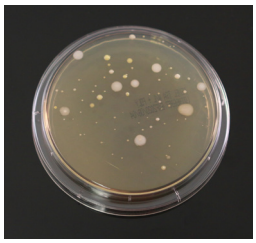
Patient B: HVE + SE



HVE + SE: Chest (CFU = 11)

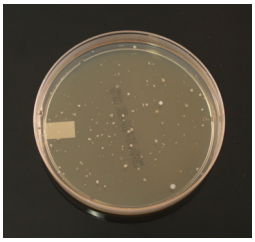


HVE + SE: Mask (CFU = 2)

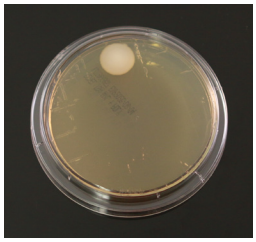


HVE + SE: SAS (CFU = 74)

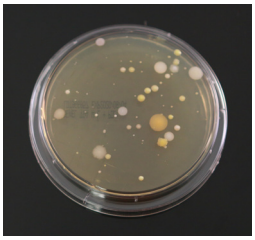
Patient B: shieldVAC + SE



shieldVAC + SE: Chest
(CFU = 284)



shieldVAC + SE: Mask
(CFU = 1)



shieldVAC + SE: SAS
(CFU = 70)

Patient B Summary:

shieldVAC contained 142x more collected bacterial load spatter on chest plates compared to SE and 26x more than HVE.

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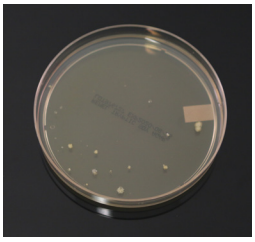
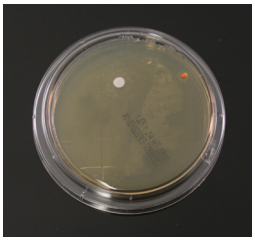
Patient C

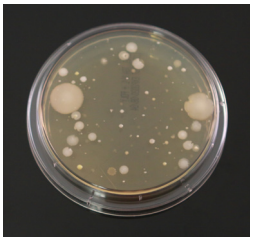
Patient C: SE



SE: Chest (CFU = 32)

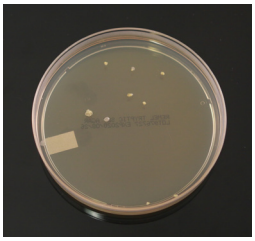


SE: Mask (CFU = 2)

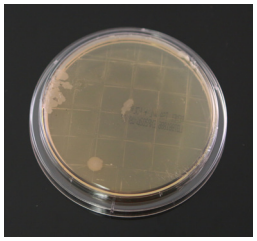


SE: SAS (CFU = 119)

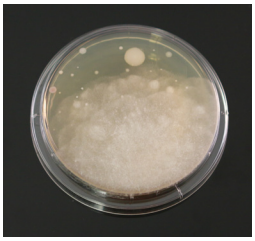
Patient C: HVE + SE



HVE + SE: Chest (CFU = 12)

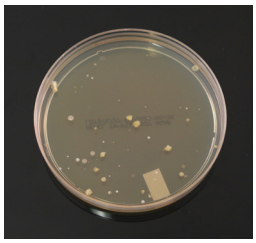


HVE + SE: Mask (CFU = 5)

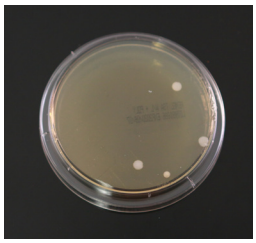


HVE + SE: SAS (CFU = 43)

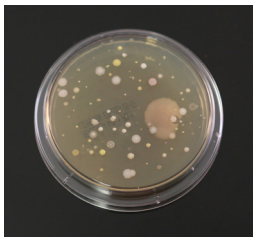
Patient C: shieldVAC + SE



shieldVAC + SE: Chest (CFU = 65)



shieldVAC + SE: Mask (CFU = 4)



shieldVAC + SE: SAS (CFU = 100)

Patient C Summary:

shieldVAC contained 2x more collected bacterial load spatter on chest plates compared to SE and 5x more than HVE.

Discussion:

The data show that the use of the ***shieldVAC™*** and SE together reduced the amount of bacterial load from spatter on an N95 respirator worn by a dental professional during an aerosol generating procedure, but increased the bacterial load found on the patient's chest during the same procedure. The data also show that the ***shieldVAC™*** decreased the bacterial load found in aerosols when compared to using only a SE, but increased the bacterial load found in aerosols when compared to a HVE. The increase in bacterial load on the patient's chest while using the ***shieldVAC™*** could have been due to the build-up of spatter on the shield causing bacteria to ricochet or fall back onto the patient, thus protecting the dental professional. This is also supported by the decrease in the bacterial load found on the dentist's respirator while the ***shieldVAC™*** was being used in comparison to during use of a SE alone of with HVE. The increase in the bacterial load found in aerosols while using the ***shieldVAC™*** system in comparison to an HVE could be due to the unequal comparison of an intraoral suction device to an extraoral suction device. There were some limitations in this study, including the limited number of patients. A larger sample size could provide a better representation of the population and would enable determination of statistical significance.

Conclusions:

Preliminary data showed that ***shieldVAC™*** provided the dental professional protection from spray and spatter during ultrasonic scaling and polishing.