Advances in Dentistry & Oral Health
ISSN: 2472-6389

Juniper Publishers
key to the Researchers

Research Article
Volume 15 Issue 3 - March 2022
DOI: 10.19080/ADOH.2022.15.555912

Adv Dent & Oral Health
Copyright © All rights are reserved by Chisom Adaobi Nri-Ezedi

Contaminated Musical Wind Instruments as a Vector for Disease Transmission

Debbie Eisen[1], Robert YL Zee[2], James Farmelant[3] and Steven E Eisen[1]*

[1]*Department of Comprehensive Care, Tufts University School of Dental Medicine, Boston, USA*

[2]*Department of Pediatric Dentistry, Tufts University School of Dental Medicine, Boston, USA*

[3]*Software Engineer, Private Consultant*

Submission: March 15, 2022; **Published:** March 23, 2022

***Corresponding author:** Steven E Eisen, Department of Comprehensive Care, Tufts University School of Dental Medicine, 1 Kneeland Street, Boston, USA

Abstract

Contemporary medical industry standards in healthcare settings mandate that an instrument is not placed in contact with the mucosal tissue of two different patients without intervening sterilization of the instrument. Yet it is a routine practice, especially in school settings, for different students to play the same wind musical instruments without sterilization even though these instruments may have been in contact with the mucosal tissue of multiple persons. Multiple laboratory-based microbiological experiments designed to investigate issues concerning bacterial existence and survival on musical wind instruments were conducted. Bacterial growth and survival on musical wind instruments were demonstrated, establishing the viability of pathogenic bacteria on musical wind instruments and their mouthpieces. These findings suggest that standard infection control procedures ought to be applied to the practice of sharing musical wind instruments to reduce the risk of spreading infections between users.

Keywords: Wind instruments; Cross-contamination; Bacteria; Virus; Transmission

Abbreviations: CDC: Center for Disease Control and Prevention; CFU: colony-forming unit; TB: tuberculosis; PFU: plaque-forming unit

Introduction

Over the past couple of decades, we have witnessed increasing interest in improving infection control in dentistry [1-5]. Concerns over the spread of viruses -such as HIV, HBV and most recently the Covid-19 pandemic- in health care settings has energized efforts at improving infection control [6-9]. In the early 1990s, the dental profession experienced an upheaval regarding infection control practices because of a failure to sterilize dental handpieces, and the alleged resulting reported occurrences of HIV cross-contamination emanating from a Florida based dental practice [10-12]. In response to the growing public awareness coupled with a widespread media focus on the public health risks associated with the dental profession's then prevailing practices, the Center for Disease Control and Prevention (CDC) issued sterilization protocols for dental handpieces along with other safety measures [12,13]. Not only did the profession subsequently change its practices regarding the sterilization of handpieces and other dental equipment but personal protective equipment mandates were implemented as well. The behaviors and practices prevalent today in the music industry constitute one area of concern where knowledge acquired by the dental profession regarding infection control might be judiciously applied. It seems that a similar risk of cross-contamination might exist for musicians who play wind instruments that is not unlike the risk of cross-contamination that existed before dentists began to routinely sterilize handpieces. And in the case of musical wind instruments, this cross-contamination hazard arguably exists regardless of whether these are used or newly manufactured instruments [14].

Such a public health threat regarding musical wind instruments exists would seem to be self-evident when viewed in the light of contemporary medical industry standards. In healthcare settings, contemporary infection control procedures mandate that an instrument is not placed in contact with the mucosal tissue of two different patients without intervening sterilization of the instrument. Yet it is a routine practice, especially in school settings, for different students to play the same wind musical instruments without sterilization even though

these instruments may have been in contact with the mucosal tissue of multiple persons. In other words, we see in regard to the playing of musical wind instruments, practices which, if they had occurred in healthcare settings, would be the cause for concern if not outright condemnation and censure. If nothing else, this practice is inconsistent with the public health message relative to the sharing of personal items. What is even more surprising is that this health risk exists even for newly manufactured musical instruments. This is because it is a common industry practice for musical wind instruments to be played, in the interest of quality control, prior to their being shipped from the factory (many of which are now located in offshore manufacturing regions like China or Southeast Asia). Thus, even newly manufactured musical wind instruments may potentially be "used" in a microbiological sense, and so can place their users at risk.

There are also several other considerations that should be considered to inform our understanding of the public health risks associated with musical wind instruments. The use of wind musical instruments in public schools is an area of special concern because of the ways through which student musicians typically acquire their instruments. Students (or their parents) generally acquire their instruments either through school affiliated music dealers, or through local music retail stores. Both new and used instruments may be acquired either by outright purchase, or they may be obtained via "rent-to-buy" programs offered by school music dealers. The International Music Products Association has reported that in 2002, sales of "new" school based musical instruments were at 516.6 million dollars in the United States [15]. Applying an average sell price of approximately $910.00, this suggests that about 567,000 new wind instruments were sold that year. School music dealers routinely indicate that they purchase new instruments to support approximately 50% of their annual requirements, while the other 50% are supported via recycled instruments returned from canceled "rent-to-buy" contracts. Therefore, each year there are approximately 1,134,000 school music students purchasing or renting new or used musical wind instruments [16].

We also know based on our own conversations with school music officials, that it is common practice for school districts to own musical instruments that are not commonly available from school music dealers, and that are often cost prohibitive for beginning music students to purchase. However, these instruments are required for properly balancing school bands and/or orchestra programs. Therefore, school music teachers will frequently recruit young musicians to play these instruments and offer them to the students from their school districts' inventories at little or no cost. At the end of the school musical season, these instruments will be returned to the schools and placed back in the school districts' inventories for use in the next school music season. The United States Department of Education reports that there are approximately 15,000 school districts in the United States [17]. If we conservatively estimate that each school district owns about 25 wind instruments, then this means that there are about 375,000 used wind instruments held in inventory by school districts across the United States.

Therefore, looking at the school-based market for musical wind instruments, there are over 1.5 million musicians who each year receive a wind instrument that may be harmful to their health. And when we also take into account the consumer-to-consumer sale of musical wind instruments whether via the Internet (e.g. eBay) or through classified advertising in newspapers or merchandise "bargain hunter" guides and journals, we find over two million people every year in the United States whose health is being put at risk simply by acquiring and playing potentially contaminated musical wind instruments. Current privacy laws limit the ability of teachers and school administrators to know which students may be suffering from serious infections, but these same students might place fellow students at risk by transmitting their oral and pulmonary microbiological flora via wind musical instruments. Simply based on scientific principles, it appears that the manner in which musical wind instruments are conveyed from one student to the next pose special risks for the transmission of infectious diseases.

Materials, Methods and Results

We describe a series of investigations that we performed over an extended period of several years whose results demonstrated that musical wind instruments can indeed function as a vector for the transmission of infectious diseases, and thus constitute a potentially major public health threat. These studies were multiple laboratory-based microbiological experiments designed to investigate issues concerning bacterial existence and survival on musical wind instruments. The first such experiments were performed in October 1999 at the Laboratory Services, Division of Andersen Products in Haw River, North Carolina. We gathered twelve pieces of used musical wind instruments gathered from a local public-school district's inventory and submitted them to Andersen Products. Andersen Products tested these items to determine the total aerobic bioburden present in them. The report issued by Andersen indicated that the colony-forming unit (CFU) counts on those instruments ranged from a low of 2 to a high of 13,568 [15].

The organisms identified included:

i. *Sporosarcina*
ii. *Staphylococcus epidermis*
iii. *Micrococcus kristinae*
iv. *Planococcus*
v. *Staphylococcus caseolyticus*
vi. *Micrococcus lylae*
vii. *Azotobacter*
viii. *Acetobacter*

How to cite this article: Debbie E, Robert YL Z, James F, Steven E E. Contaminated Musical Wind Instruments as a Vector for Disease Transmission. Adv Dent & Oral Health. 2022; 15(3): 555912. DOI: 10.19080/ADOH.2022.15.555912

After receiving these results, it was decided that it would be prudent to conduct a further investigation of the bioburden associated with used musical wind instruments. To this end, we purchased sixteen musical wind instruments, of which thirteen were used and three were new, along with fifteen mouthpieces from a school music dealer in the greater Boston area. In December 2002, these instruments were submitted to AppTec Laboratory Services in Marietta, Georgia for bioburden testing. From these instruments, AppTec recovered CFU counts ranging from a low of 50 to a high of 4,300,000 [18]. AppTec also found that the mouthpieces had CFU counts ranging from a low of <30 to a high of 78,410. In February of 2003, three of these instruments plus one mouthpiece was sub-cultured and submitted to Acculab for organism identification. The following organisms were identified on these items:

i. *Methylobacterium extorquens*

ii. *Kocuria species*

iii. *Unidentifiable yeast*

iv. *Rhodotorula muciloaginosa*

v. *Microbacterium arborescens*

vi. *Crytococcus laurentii*

vii. *Spingomonas species*

The studies described above demonstrate that bacteria can grow and survive on musical wind instruments, but they do not establish the viability of pathogenic bacteria on musical wind instruments and their mouthpieces. To investigate the viability of pathogens on musical wind instruments we had additional laboratory testing performed. In February of 2000, the Laboratory Services Division of Andersen Products in Haw River, North Carolina inoculated four wind instruments mouthpieces with four different pathogens (*Echerisa coli*, *Streptococcus pnuemonae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*) and then stored them in a sealed humid atmosphere for seven days. The pathogens were recovered and enumerated. The findings indicated that CFU count of three of the four pathogens grew by 62% or more, and that the CFU count of one pathogen dropped by approximately 98%. The fact that all four pathogens were still present on the mouthpieces after seven days encouraged us to have additional testing performed regarding the survival kinetics of pathogens on musical wind instruments. For this investigation we engaged in December of 2002, AppTec Laboratory Services to study the survival kinetics of pathogens utilizing sixteen musical wind instruments and fifteen mouthpieces that had been used in the earlier previously cited bioburden study.

Ten of these instruments and nine of these mouthpieces were inoculated with a bacterial cocktail containing one million CFU each of *Staphylococcus aureus*, *Streptococcus mutans*, *Candida albicans*, *Moraxella catarrhalis* (*meningitis surrogate*), and *Mycobacterium szulgai* [*tuberculosis* (TB) surrogate], which were then sealed in their cases and stored at room temperature. A set of four instruments and three mouthpieces were recovered on day 7, three instruments and three mouthpieces were recovered on day 14, and three instruments and three mouthpieces were recovered on day 21. The reports issued by AppTec on these recoveries indicate that of the 95 opportunities for infection to be present (5 pathogens across 10 instruments and 9 mouthpieces); a pathogen was still alive in 32% of these opportunities. When viewed by date of recovery the "infected" percentages were 31% of day 7 opportunities, 37% of day 14 opportunities, and 27% of day 21 opportunities. Of note, while this test was designed to have a duration of twenty-one days, and the fact that there was a 27% infection on day 21 suggests that these pathogens are likely to survive for periods of time in excess of 21 days.

The two pathogen survival studies performed by Andersen Products and AppTec Laboratory Services support the commonsense notion that pathogenic bacteria will survive and potentially thrive on a musical instrument that has been infected by a sick owner. We know from the tests described previously that pathogens have a 21-day survival rate but by virtue of unplanned laboratory results we also know that the *Mycobacterium szulgai* (TB surrogate) pathogen can survive on a musical instrument for over five months. When AppTec used three of the instruments and two mouthpieces from the December 2002 AppTec survival kinetic study as an untouched control group for a June 2003 experiment for us, enumeration testing discovered that the *Mycobacterium szulgai* was still present on two of the instruments more than five months after it had been inoculated. For our most recent investigation, we obtained 17 instruments from various sources. These instruments included both woodwinds and brass: Trumpets, French horns, clarinets, saxophones. We tested three different locations on each instrument with the locations being selected on the basis of their having a high chance of contact with saliva. Most locations were the mouthpiece, spit valve, or bell horn of the instrument.

Therefore, we had initially 51 different samples (17*3=51). The samples were first inoculated on Tryptic Soy Agar with 5% Sheep's Blood (TSA plate). TSA plates allow the growth of a variety of bacteria. Sheep's blood incorporated in the plates allows for detection of bacteria that can hemolyze red blood cells (characteristic of some Streptococcal species). Viable bacterial colonies or plaque-forming units (PFU) were then re-streaked on sterile TSA plates twice in order to obtain pure colonies. Samples that did contain growth after two rounds of isolation were discarded. Therefore, we now had 15 samples of bacteria that we were trying to identify. All the samples were then grown on a Mannitol Salt Agar (MSA) plate. MSA plates contain a high amount of salt, therefore discouraging the growth of a variety of bacteria except Staphylococcal species, which can grow in these high salt conditions. Additionally, mannitol is a carbohydrate that can be fermented by *Staphylococcal aureus*. This can be confirmed on these media plates by the media turning from a

How to cite this article: Debbie E, Robert YL Z, James F, Steven E E. Contaminated Musical Wind Instruments as a Vector for Disease Transmission. Adv Dent & Oral Health. 2022; 15(3): 555912. DOI: 10.19080/ADOH.2022.15.555912

red to a yellow color due to the acidic conditions associated with fermented mannitol. Out of our 15 samples: four samples were tentatively identified as *Staph aureus*, one sample may have been a Staphylococcal species, but possibly not *S. aureus*. The last 10 had either no growth or very slight growth indicating that they were probably not Staphylococcal bacteria. Further testing will attempt to identify the additional 10 bacteria and confirm the hypothesis that we had isolated at least 5 samples of Staphylococcal bacteria.

Discussion

The microbiological data from the studies described above demonstrate that harmful pathogens can survive and even thrive on musical wind instruments for extended periods of time. This data may not seem sufficient to prove conclusively that musical wind instruments constitute a threat to public health. However, there are also some recent studies that do seem to demonstrate that musical wind instruments can indeed be a source of infection to their users. A case report [19] describes an investigation by SINTEF research scientist Catrine Ahlén of a patient who had played various brass instruments (i.e. trombone and cornet) in the same band since she was nine years old and at the age of fifteen, started playing baritone horn. A short time later, she was diagnosed with her first incidence of pneumonia. After this, she continued to experience frequent recurrence of pneumonia throughout a two-year period. Microbiological surveys of sputum and from the inside of the instrument showed very similar pictures as to microbial flora with a dominance of a multi-drug resistant Chryseobacterium population. Antibiotic treatment with a novel 15-member macrolid – Azithromycin cured her in short time, and she did not suffer any subsequent respiratory diseases whatsoever. Metzger et al. [20,21] report a case where a man was diagnosed of having nonspecific interstitial pneumonia. A computed tomography (CT) scan showed mosaic ground-glass opacities in the ventilated parts of the lung, the centrolobular predominance of inflammation on the lung sections, and the presence of a lymphocytic alveolitis at bronchoalveolar lavage (BAL) indicative of a hypersensitivity pneumonitis. He was found to be a white-collar worker.

There was no evidence that he had any contact with pets, birds, drugs, or molds at home, but he was found to have played the saxophone as a hobby. Upon examination, the instrument was found to have two molds, *Ulocladium botrytis* and *Phoma sp*., while the patient, in turn, was found to have precipitating antibodies to these molds in his serum. An additional study has confirmed the frequent colonization of saxophones with potentially pathogenic molds, such as *Fusarium sp*, *Penicillium sp*, and *Cladosporium sp*. [22]. A somewhat similar case [23] has been reported of pneumotitis in a trombone player. Likewise, our findings are consistent with those of Marshall & Levy [24], who found when testing wind instruments played less than three days, prior to testing, bore typical mouth flora, while the bacteria recovered after 72 hours following play would consist of normal environmental flora. It was also found that when testing for the survival of potentially pathogenic bacteria (*Staphylococcus*, Streptococcus, Moraxella, Escherichia coli and attenuated Mycobacterium *tuberculosis*) when applied to reeds or following simulated 'play' of a clarinet, that all species would survive for a maximum of 24-48 h on reeds, except Mycobacterium, which persisted through 13 days. And similar findings have also been reported by Glass et al. [25]. More recently, Holly Drover has conducted a study at the University of Nottingham, where she found that for members of the university's orchestra, who played wind instruments, there was an incidence of 62 chest infections per 1,000 people per year; this compares to 49-54 per 1,000 within the general population [26].

Conclusions

Our present findings combined with recent case reports indicate that the microbes that colonize wind instruments can indeed pose a significant health risk to some users of these instruments. Such users in turn might pose a somewhat elevated risk of spreading pulmonary infections to dental office personnel, insomuch as the performance of dental procedures on such patients might cause the generation of aerosols that might transmit infectious microbes in the office. At the same time, our own studies as reported here demonstrate that cross-contamination is a real risk in regard to wind instruments. Therefore, these case reports, taken in combination with our own findings, provide more than ample justification for the application of standard infection control procedures, including sterilization, to the use of musical wind instruments in public school settings.

References

1. Molinari JA (2003) Infection control: Its evolution to the current standard precautions. JADA 134(5): 569-574.
2. Molinari JA (2003) The evolution of standard precautions. Compend Contin Educ Dent 24: 190-192.
3. (2003) Centers for Disease Prevention and Control. Guidelines for infection control in dental health-care settings-2003. MMWR Morb Mortal Wkly Rep 52(No. RR-17): 1-66.
4. (1992) Infection control recommendations for the dental office and the dental laboratory. American Dental Association t p. 1-8.
5. Miller CH (1992) Sterilization and disinfection: What every dentist needs to know. JADA 123(3): 46-53.
6. Molinari JA (2005) Centers for Disease Control and Prevention. Updated CDC infection control guidelines for dental health care settings: 1 year later. Compend Contin Educ Dent 26: 192-196.
7. (1989) Centers for Disease Control and Prevention: Guidelines for prevention and transmission of HIV and HBV to health care and public safety workers. MMWR 38: 1-37.
8. (1991) Centers for Disease Control and Prevention: Recommendations for preventing transmission of the human immunodeficiency virus and the hepatitis B virus during exposure prone invasive procedures. MMWR LIO(RR-8): 1-5.

How to cite this article: Debbie E, Robert YL Z, James F, Steven E E. Contaminated Musical Wind Instruments as a Vector for Disease Transmission. Adv Dent & Oral Health. 2022; 15(3): 555912. DOI: 10.19080/ADOH.2022.15.555912

9. Molinari JA (1994) Practical infection control for the 1990's: Applying science to government regulations. JADA 125(9): 1189-1197.

10. (2000) Centers for Disease Control and Prevention, COVID-19 Guidance for Dental Settings, 2020.

11. (1991) New York Times on the Web. Aids Infected Doctors and Dentists are Urged to Warn Patients or Quit.

12. (1993) Centers for Disease Prevention and Control. Recommended Infection Control Practices for Dentistry. MMWR42 (RR-8).

13. (2016) Centers for Disease Control and Prevention. Summary of Infection Prevention Practices in Dental Settings: Basic Expectations for Safe Care. Atlanta, GA: Centers for Disease Control and Prevention, US Dept of Health and Human Services.

14. Bryan AH (1969) Band wind instrument mouthpieces may harbor countless disease viruses and bacterial flora.

15. (2000) NAMM, the International Music Products Association. Music USA 2000 A Statistical review of the Music Products Industry ISBN: 09641677-5-1.

16. (2002) National Center of Education Statistics. Digest of Educational Statistics, 2002. Table 87. Number of Public-School Districts and Public and Private Elementary and Secondary Schools: 1860-70 to 2000-2001.

17. DePaola LG, Mangan D, Mills S, Costerton W, Barbeau J, et al. (2002) A review of the science regarding dental unit waterlines. JADA 133(9) 1199-1206.

18. The data for the experiments performed at the Laboratory Services Division of Andersen Products, App Tec Laboratory Services, are from reports prepared at these two companies, which are available on request.

19. Tønseth S (2002) Horn with nasty microbes. Gemini: Research from NTU and the SINTEF Group.

20. MEDEC Dental Communications. Dental Practice Report, Protect Your Patients, Your Staff, Yourself. Waterlines.

21. Metzger F, Haccuria A, Reboux G, Nolard N, Dalphin C, et al. (2010) Hypersensitivity Pneumonitis Due to Molds in a Saxophone Player. Chest September 138(3): 724-726.

22. Cormier Y (2010) Wind-Instruments Lung: A Foul Note. Chest September 138(3): 467-468.

23. Metersky M, Bean SB, Meyer JD, Mutambudzi M, Brown-Elliott BA, et al. (2010) Trombone Player's Lung: A Probable New Cause of Hypersensitivity Pneumonitis. Chest September 138: 754-756.

24. Marshall, Bonnie M, Levy, Stuart B (2011) Microbial Contamination of Wind Instruments. International Journal of Environmental Health Research 21(4): 275-285.

25. Glass RT, Conrad RS, Kohler GA, Bullard JW (2011) Evaluation of the microbial flora found in woodwind and brass instruments and their potential to transmit diseases. Gen Dent 59(2): 100-107.

26. Drover H (2019) Playing wind instruments linked to higher risk of chest infections – according to new study - presentation at British Thoracic Society (BTS).

This work is licensed under Creative Commons Attribution 4.0 License
DOI: 10.19080/ADOH.2022.15.555912

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
  (Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
https://juniperpublishers.com/online-submission.php

How to cite this article: Debbie E, Robert YL Z, James F, Steven E E. Contaminated Musical Wind Instruments as a Vector for Disease Transmission. Adv Dent & Oral Health. 2022; 15(3): 555912. DOI: 10.19080/ADOH.2022.15.555912