

# REDUCING THE INVISIBLE THREAT OF INFECTION IN FIRE & EMS PERSONNEL



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## Regular, enhanced disinfection practices substantially reduced unscheduled time off

The Winter Park Fire Department, in an effort to reduce the personal and fiscal impact caused by infectious disease, instituted enhanced disinfection practices using AeroClave equipment as an adjunct to normal cleaning procedures of the stations and apparatus. A retrospective analysis using unscheduled leave time as one metric of effectiveness showed an approximate 34% reduction since the inception of the AeroClave program over five years ago. We feel that in addition to enhancing the personal health and safety of our firefighting/EMS personnel, the program has also provided a significantly positive fiscal impact to the Department.

# Reducing the invisible threat of infection in fire & ems personnel

**REGULAR, ENHANCED DISINFECTION PRACTICES SUBSTANTIALLY REDUCED UNSCHEDULED TIME OFF**

## INTRODUCTION

It has always been my personal belief that sometimes it's the things that we can't see that can hurt us the most. Of these "invisible threats", perhaps none is more potentially dangerous to our personnel as the illness and death caused by infectious disease. Even without the threat of Ebola, MERS or other exotic diseases, firefighters face a substantially increased risk of contracting a debilitating or even life-threatening disease such as Methicillin-resistant *Staphylococcus aureus* (MRSA). Multiple scientific studies have documented that MRSA can be found in 50% of ambulances<sup>1,2,3</sup>. Other studies have documented the tremendous frequency in which MRSA can be found on various surfaces throughout the fire stations<sup>4</sup>. But perhaps the most alarming statistic of all is that 1 in 5 firefighters (22%) have become carriers of MRSA compared to 1.5% of the general population<sup>5,6</sup>. Infectious disease in the fire service is rapidly becoming one of the leading causes of death and disability. Given these statistics, when a local company approached us several years ago about testing out their ambulance decontamination equipment, we felt it would be a good opportunity to try to reverse these alarming industry trends while improving the health and safety of our department personnel.

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<sup>1</sup> Nigram Y, Cutter J. A preliminary investigation into bacterial contamination of Welsh emergency ambulances. *Emerg Med J* 2003; 20: 479-482.

<sup>2</sup> Roline CE, Crumpecker C, Dunn TM. Can methicillin-resistant *Staphylococcus aureus* be found in an ambulance fleet? *Prehosp Emerg Care* 2007; 11: 241-244.

<sup>3</sup> Alves DW, Bissell RA. Bacterial pathogens in ambulances: results of unannounced sample collection. *Prehosp Emerg Care* 2008; 12: 218-224.

<sup>4</sup> Roberts C, No B. Environmental surface sampling in 33 Washington State fire stations for methicillin-resistant and methicillin-susceptible *Staphylococcus aureus*. *American Journal of Infection Control* 2014; 42: 591-596.

<sup>5</sup> Al Amiry A, Bissell RA. Methicillin-resistant *Staphylococcus aureus* nasal colonization prevalence among Emergency Medical Services personnel. *Prehosp Disaster Med* 2013; 28: 348-352.

<sup>6</sup> Roberts MC. MRSA colonization high in firefighters, paramedics. *Am J Infect Control* 2011; 39: 382-389.

## BACKGROUND

AeroClave, LLC is a privately held company founded in 2003 by Ronald D. Brown, MD, a local Emergency Physician who had also served as a local county EMS Medical Director for 15 years. Dr. Brown started AeroClave in response to the Severe Acute Respiratory Syndrome (SARS) epidemic that was occurring at the time. His goal was to develop cost-effective ways to decontaminate commercial aircraft from pandemic producing viruses like SARS, Ebola, etc. They were successful in developing this technology and to this date remain the world's only FAA and DOD approved method of whole aircraft sterilization. As a spin-off of their aircraft decontamination work, and at the suggestion of state and local emergency management officials, AeroClave then adapted the technology towards the sterilization of police, fire and EMS vehicles. When we were first asked to participate in the trial program in 2009, the process took over four hours to complete and the equipment cost several hundred thousand dollars, not exactly attractive to a busy department on a budget. Over the years AeroClave has continued to develop novel techniques and equipment that brings the same level of disinfection in a process that takes under 30 minutes and costs about one dollar per treatment.

## THE PROGRAM

Initially, the AeroClave unit consisted of a drive-in vehicle decontamination chamber located at their facility, which is in close proximity to our stations. We brought our ALS rescues, engines and battalion vehicles to the chamber for treatment on about a once-a-month basis. The vehicles were placed in the treatment chamber and all the interior and exterior doors and compartments were opened (Figure 1). Jump bags, monitors and other equipment were placed on ventilated shelves located within the chamber. Because this is a surface decontamination process only, we did not have to remove any packaged medications or other prepackaged items. Radios and computers were left in the vehicles though powered down. The effectiveness of the process was validated using industry standard biologic indicators placed throughout the vehicles and harvested after the completion of the treatment cycle. After some initial fine-tuning of the process, we were able to show a consistent and high level disinfection of all the interior and exterior surfaces of the vehicles. Repeated inspections over a several year trial basis failed to reveal any damage to vehicle finishes, electronic equipment or other equipment.



**FIGURE 1 RESCUE INSIDE AEROCLAVE TREATMENT CHAMBER**

Satisfied that the process was both effective and safe for the vehicles and equipment, we began to explore ways to incorporate this as an adjunct to our normal cleaning methods. Because we knew that every vehicle was “clean” until the next patient, the goal became to find a cost effective way to “AeroClave” the unit on a daily basis and ultimately after every patient transport without adversely affecting unit availability and response times. In 2011 we started running the units through the treatment chamber every week and sometimes after certain “high-risk” calls, e.g., multiple trauma victims, suspected infectious disease patients, etc.

In 2012 we were asked to field trial AeroClave’s new portable unit, the RDS 3110. This 45 pound unit is about the size of a carry-on suitcase and because of its dual application capabilities (hand spray and fogging), we were now able to start treating the fire station as well as the rescues and engines (Figure 2). Studies have shown (and we can all attest to the fact) that fire stations can be dirty places with multiple individuals sharing common spaces, a recipe for contagious disease outbreaks. The RDS 3110 allowed us to treat the dayroom, bunkrooms, kitchen, gym and other areas of the station at least weekly but also on an as-needed basis (figure 3). For example, if a firefighter developed a cold, flu or other potentially contagious disease, his bunkroom and gear could immediately be treated using the AeroClave system.



FIGURE 2 USING RDS 3110 FOR AMBULANCE DECON



FIGURE 3 USING RDS 3110 FOR STATION INTERIOR DECON

Although we initially designated individuals as “keepers” of the unit, its ease of use made it possible for all personnel to quickly be trained in the proper and effective use of the equipment. It soon became a regular part of the daily cleaning routine. Because we had three stations and only one RDS 3110, the unit was kept in the Battalion Chief’s vehicle and transported to wherever it was needed.

In 2014 we were once again asked to beta test the newest AeroClave innovation, the AeroClave Ambulance Decontamination System (ADS). The ADS is a self-contained unit that is mounted directly in the patient compartment of the rescue. The ADS is controlled from a touch

screen computer located in the front console (Figure 4). It was installed during the construction of our new rescues by a local ambulance manufacturer. It is a highly sophisticated yet compact device that performs the same high level decontamination, and enables the AeroClave process to occur wherever or whenever desired. For example, our crews regularly initiate the decontamination process after unloading the patient at the Emergency Department. Because the process only takes about 20-25 minutes, the cycle is usually complete by the time they are ready to go back into service. Our crews take great comfort in the fact that they are doing everything possible to break the chain of disease transmission between patients and perhaps even between different crew members. Recently, there was great concern about possible exposure to Ebola to the multiple patients and personnel from different shifts that occupied the Dallas rescue for several days after the initial Ebola patient was transported. We believe that by using the AeroClave process after each patient (or at least after any suspected high-risk patient) might prevent future concerns to patients, crews and their families. Our current policy requires the units be “AeroClaved” at least once daily at morning truck check, however, we encourage the crews to initiate the process whenever they deem it necessary.



FIGURE 4 TOUCH SCREEN CONTROLLER FOR ADS UNIT

## A PLEASANT SURPRISE

We have calculated that using the AeroClave ADS costs approximately \$1.00 per treatment cycle. As with any new policy or procedure there is always the concern about the impact to the budget. Are we seeing a positive return on investment for our efforts or is this simply another “cost of doing business” that we must absorb into an already tight budget?

Using biologic indicators, ATP measurements and other scientific procedures, we were satisfied in the *antimicrobial effectiveness* of the AeroClave process. The issue then became how does one evaluate the *cost effectiveness* of process? At a weekly staff meeting someone suggested we look at departmental sick time over the last several years to see if these enhanced infection control procedures were actually helping to keep our people healthier.

Since overtime to cover illness is a major budgetary expense, theoretically less sick time would result in less overtime expense.

In the spirit of full disclosure, we recognize that there are a number of factors that prevent a direct “cause and effect” use of departmental sick time as the sole indicator of AeroClave cost-effectiveness. For example, we track unscheduled time off which is a combination of sick time and personal time off. Also, because many departmental personnel have spouses and children who also get sick, not all departmental personnel illness can be attributed to work. Additionally, many departmental personnel work second jobs in the healthcare field where they may be exposed to infectious diseases. And lastly, even though the recent Ebola outbreak has heightened everyone’s awareness of infection control procedures, we as a department had not instituted any new additional departmental infection control procedures other than implementing the AeroClave system. There are so many variables involved that our conclusions would probably never stand up to a rigorous peer review process. However, we were really just looking for a trend; something that might at least tell us we were heading in the right direction.

Note: Because our departmental roster has not changed significantly in size over the last 6-7 years, we believe a yearly comparison of unscheduled leave data is fairly representative of the average health of the Department.

Prior to 2009 our equipment cleaning policies mirrored those of most modern departments, i.e., daily truck check and cleaning with approved hospital grade disinfectants using the standard spray and wipe techniques, a process that has been shown in a number of recent studies to be ineffective or actually **worsen** the problem by spreading the disease-causing organisms<sup>7,8</sup>.

Previously we had been witnessing a gradual but definite increase in unscheduled time off (UTO). We began monthly use of the AeroClave process in 2009 and noticed a moderate improvement in 2010, despite the fact that there was an H1N1 avian influenza epidemic that year. According to CDC statistics<sup>9</sup>, this H1N1 epidemic peaked in the southeastern United States during the 2010-2011 flu seasons, perhaps explaining the rebound in UTO hours that year. In late 2010 we began using the AeroClave vehicle decon on a much more regular basis. In 2012 we began using the RDS 3110 system to decontaminate both the vehicles and the stations. In 2014 we began using the built-in ADS system for more frequent ambulance decontamination while still using the RDS 3110 system for station decon as well as decontamination of other non-ADS equipped departmental vehicles and equipment.

Our analysis shows that since the introduction of regular, enhanced infection control procedures utilizing the AeroClave system, we have witnessed an approximate 34% decrease in UTO from previous years (Table 1). This equates to substantial fiscal savings for the department. Perhaps equally important to the fiscal savings is the widespread sense of departmental pride and well-being that has permeated the department.

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<sup>7</sup> Ramm L, Siani H. Pathogen transfer and high variability in pathogen removal by detergent wipes. Am J of Inf Control 2015

<sup>8</sup> Sattar, S, Maillard, J. The crucial role of wiping in disinfection of high-touch environmental surfaces: Review of current status and directions for the future. Am J of Inf Control 2013; 41: S97-S104.

<sup>9</sup> <http://www.cdc.gov/flu/weekly/pastreports.htm>

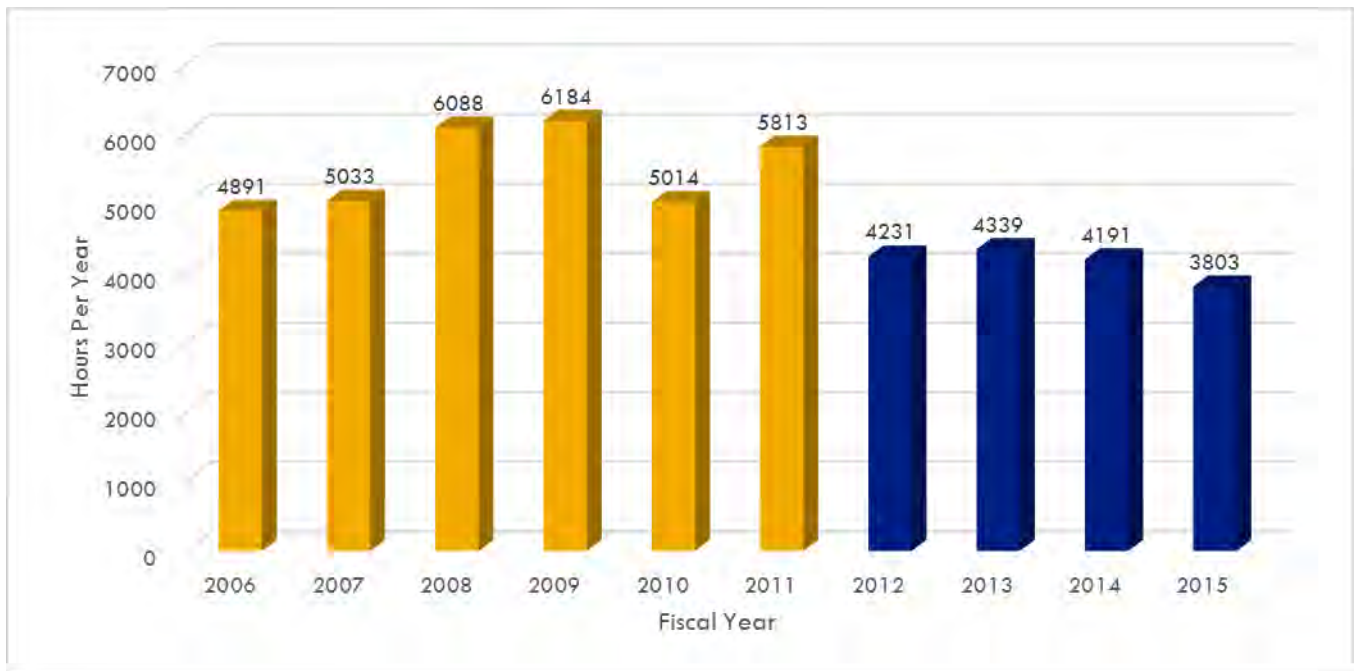


TABLE 1 ANNUAL UNSCHEDULED LEAVE HOURS

In 2006, our department took on the challenge to redesign the patient compartment work area to create a safer and more productive work environment, a project we called the Action Safe Ambulance. Working with leading health and safety experts and national ambulance manufacturers, the Action Safe program redefined industry safety standards which have been incorporated into NIOSH safety standards for all new ambulance construction. I remember the department-wide sense of pride and satisfaction.

Because the AeroClave equipment and process has been adopted as SOP by a number of other fire departments around the country, our personnel take great pride once again in the fact that they were instrumental in helping to develop and refine equipment and procedures that could have a very positive impact to their health and well-being as well as that of their families, patients and fellow public service professionals. As Chief, it's also a nice feeling to report to the City Commissioners that in addition to a healthier and safer work environment, we also saved a few bucks!

## About Winter Park Fire Rescue Department

The Winter Park Fire Rescue Department, established in 1900, provides fire protection and EMS services to the citizens of Winter Park, Florida, a northern suburb of Orlando with a population of approximately 29,000. It services the roughly 10 square mile area from three stations manned by a 70 person staff. The department provides ALS service from two transport rescues, three engines and one aerial (plus reserves). Annual call volume is approximately 5,000 alarms with about 85% being EMS. In addition to its ISO Class 1 rating, the Department has also maintained international accreditation from the Commission on Fire Accreditation International (CFAI) and the Center for Public Safety Excellence continuously since 2001. WPFDR is also accredited by the Commission for the Accreditation of Ambulance Services (CAAS).

## About the Author

James “Jim” White, EFO, has served as Fire Chief of the Winter Park Fire Department since 2002. He has over 35 years of fire service operations, training and executive experience. Chief White holds a degree in fire science technology and is a graduate of the National Fire Academy’s Executive Fire Officer Program. In addition to his numerous other state and local awards, he was recently voted 2015 Fire Chief of the Year by his peers from the Florida Fire Chiefs Association. Jim lives in Winter Park with his wife and two daughters.

## About AeroClave, LLC

AeroClave, LLC is a privately held company located in Winter Park, Florida. Its mission is to develop cost-effective methods of decontamination to prevent the global spread of infectious diseases via aircraft, vehicles, and other equipment. AeroClave’s founder, Ronald D. Brown, MD, is an emergency physician and past EMS Medical Director with over 35 years of clinical experience. For more information please visit [www.aeroclave.com](http://www.aeroclave.com)



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