

## Infection Control, Ambulance Cleaning & Contamination Literature Resources

**OSHA Bloodborne Pathogens standard (29 CFR 1910.1030)**

[https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10051&p\\_table=STANDARDS](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10051&p_table=STANDARDS)

**OSHA Personal Protective Equipment (29 CFR 1910.132)**

[https://www.osha.gov/dte/grant\\_materials/fy07/sh-16625-07/ppehandout.pdf](https://www.osha.gov/dte/grant_materials/fy07/sh-16625-07/ppehandout.pdf)

**System Assessment and Validation for Emergency Responders (SAVER), Portable Ambulance Decontamination Systems Market Survey Report.**

US Department of Homeland Security, September, 2015

**EMS Infectious Disease Playbook**

HHS ASPR, the Technical Resources, Assistance Center, and Information,

<https://asprtracie.hhs.gov>

**Spread of infectious microbes during emergency medical response**

Melissa K. Valdez MS\*, Jonathan D. Sexton PhD, MS, Eric A. Lutz PhD, CMSP, Kelly A. Reynolds PhD

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Background: To our knowledge, no studies to date demonstrate potential spread of microbes during actual emergency medical service (EMS) activities. Our study introduces a novel approach to identification of contributors to EMS environment contamination and development of infection control strategies, using a bacteriophage surrogate for pathogenic organisms.

Methods: Bacteriophage FX174 was used to trace cross-contamination and evaluate current disinfection practices and a hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) wipe intervention within emergency response vehicles. Prior to EMS calls, 2 surfaces were seeded with FX174. On call completion, EMS vehicle and equipment surfaces were sampled before decontamination, after decontamination per current practices, and after implementation of the intervention.

Results: **Current decontamination practices did not significantly reduce viral loads on surfaces (P ¼ .3113), but H<sub>2</sub>O<sub>2</sub> wipe intervention did (P ¼ .0065).** Bacteriophage spread to 56% (27/48) of sites and was reduced to 54% (26/48) and 40% (19/48) with current decontamination practices and intervention practices, respectively.

Conclusion: Results suggest firefighters' hands were the main vehicles of microbial transfer.

Current practices were not consistently applied or standardized and minimally reduced prevalence and quantity of microbial contamination on EMS surfaces. Although use of a consistent protocol of H<sub>2</sub>O<sub>2</sub> wipes significantly reduced percent prevalence and concentration of viruses, training and promotion of surface disinfection should be provided.

**Risk of Transmission of MRSA on Contact Surfaces in Ambulance**

Lukas, R., Keppler, P., Brinkrolf, P., Friedrich, A. W., Van Aken, H. & Bohn, A. Oct-2015 In : Der Notarzt. 31, 5, p. 234-238 5 p.

The gram-positive bacterium methicillin-resistant Staphylococcus aureus (MRSA) is one of the most frequent causes of treatment-associated nosocomial infections.

The incidence of MRSA among the population and in hospitalized patients is growing worldwide. Ambulance service is an interface between the environment, outpatient treatment and inpatient treatment of patients. What is the probability that MRSA is applied by the patient on contact surfaces in ambulance vehicles in compliance with an infection control concept and what are risk contact surfaces in the ambulance vehicle? We studied defined contact surfaces in 30 ambulances after

transport of a MRSA positive patients. In the control group 15 ambulances were examined after transport with unknown MRSA status. The sampling was carried out before the final disinfection, genotyping of MRSA strains were carried out within the Euregio MRSA-net project. ***In three transports with known MRSA status of the patient we found on four contact surfaces in the vehicles a nosocomial MRSA strain with the same genotype of previously transported patient.*** In the control group, we detected an incidental finding of a nosocomial MRSA strain on the disinfectant dispenser. The risk areas identified were all close to the patient and all hand-related areas of the staff. All sampling was carried out before the final disinfection. In 10% MRSA is transmitted from patient to near patient and all hand contact surfaces in the ambulance vehicle. A targeted disinfection, as well as an infection control concept are sufficient to eliminate MRSA transmission on contact surfaces in the ambulance vehicle.

### **PREVALENCE OF METHICILLIN-RESISTANT *Staphylococcus aureus* ON THE STETHOSCOPES OF EMERGENCY MEDICAL SERVICES PROVIDERS**

Mark A. Merlin, DO, Matthew L. Wong, MPH, PeterW. Pryor, MD, MPH, Kevin Rynn, Andreia Marques-Baptista, MD, Rachael Perritt, PharmD, Catherine G. Stanescu, MD, Timothy Fallon, BS

#### **ABSTRACT**

**Objective.** The investigation seeks to determine the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) on the stethoscopes of emergency medical services (EMS) providers. While stethoscopes are known fomites for MRSA, the prevalence of MRSA in the prehospital setting is not well documented in the literature.

**Methods.** This was a prospective, observational cohort study of 50 stethoscopes provided by consecutive, consenting EMS providers at our academic emergency department (ED). Stethoscopes were swabbed with saline culture applicators and samples were cultured on a commercial MRSA test kit containing mannitol salt agar with oxacillin. After 72 hours of incubation at 37°C, two emergency physicians and one microbiologist analyzed the plates independently. MRSA colonization was recorded as positive if all three reviewers agreed that colonization had occurred.

**Results.** ***Of 50 stethoscopes, 16 had MRSA colonization, and 16 (32%) EMS professionals had no recollection of when their stethoscopes had been cleaned last.*** Reported length of time

since last cleaning was grouped into six categories: one to seven days, eight to 14 days, 15 to 30 days, 31 to 180 days, 181 days to 365 days, and unknown. The median time frame reported since the last cleaning was one to seven days. In the model, an increase from one time category to the next increased the odds of MRSA colonization by 1.86 (odds ratio =1.86, p = 0.038).

**Conclusions.** In this ED setting, MRSA was found on approximately one in three stethoscopes of EMS professionals. A longer length of time since the last stethoscope cleaning increased the odds of MRSA colonization.

### **A DESCRIPTIVE ANALYSIS OF OCCUPATIONAL HEALTH EXPOSURES IN AN URBAN EMERGENCY MEDICAL SERVICES SYSTEM: 2007–2009**

Mazen El Sayed, MD, MPH, Ricky Kue, MD, MPH, FACEP, Claire McNeil, RN, EMT-P, K. Sophia Dyer, MD, FACEP

**Introduction.** Prehospital providers are exposed to various infectious disease hazards. Examining specific infectious exposures would be useful in describing their current trends as well as guidance with appropriate protective measures an emergency medical services (EMS) system should consider.

**Objective.** To describe the types of infectious occupational health exposures and associated outcomes reported at an urban EMS system.

**Methods.** A retrospective review of all reported exposures was performed for a three-year period from January 1, 2007, to December 31, 2009. Descriptive analysis was performed on data such as provider demographics, types of exposures reported, confirmation of exposure based on patient follow-up information, and outcomes.

**Results.** Three hundred ninety-seven exposure reports were filed with the designated infection control officer (ICO), resulting in an overall exposure rate of 1.2 per 1,000 EMS incidents. The most common exposure was to possible meningitis (n = 131, 32.9%), followed by tuberculosis (TB) (n = 68, 17.1%), viral respiratory infections (VRIs) such as influenza or H1N1 (n = 61, 15.4%), and body fluid splashes to skin or mucous membranes (n = 56, 14.1%).

Body fluid splashes involving the eyes accounted for 41 cases (10.3%). Only six cases (1.5%) of needlestick injuries were reported. Three hundred thirty-two of all cases (83.6%) were considered true exposures to an infectious hazard, of which

177 (53.3%) were actually confirmed. Half of all exposures required only follow-up with the ICO (52.6%). One hundred twenty-seven cases (31.9%) required follow-up at a designated occupational health services or emergency department. Of these, only 23 cases (18.1%) required treatment. ***There was a significant trend of increasing incidence of VRI exposures from 2008 to 2009 (6.3% vs. 26.8%,  $p < 0.001$ ), while a significant decrease in TB exposures was experienced during the same year (22.9% vs. 8.2%,  $p = 0.002$ ).***

**Conclusions.** Trends in our data suggest increasing exposures to viral respiratory illnesses, whereas exposures to needlestick injuries were relatively infrequent. Efforts should continue to focus on proper respiratory protection to include eye protection in order to mitigate these exposure risks.

### **Isolation and characterization of methicillin-resistant *Staphylococcus aureus* from fire stations in two northwest fire districts**

Marilyn C. Roberts, PhD, Olusegun O. Soge, PhD, David No, BS, Nicola K. Beck, MS, and John S. Meschke, PhD

Seattle, Washington

**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) strains were isolated and characterized from environmental surfaces of two fire stations from two independent districts in the northwestern United States. After the first sampling and before the second sampling, education was provided, additional signage was added, and changes in disinfection protocols were put in place. Nasal carriage of MRSA was determined at the second sampling.

**Methods:** Environmental samples were collected using SANICULT swabs and RODAC plates. Biochemical tests and 16S rRNA sequencing confirmed MRSA isolates. Antimicrobial susceptibility testing was performed, and the *mecA* gene, multilocus sequence typing, and SCCmec typing were determined by polymerase chain reaction, sequencing, and pulsed-field gel electrophoresis analysis.

**Results:** MRSA was isolated from 44 of 1,064 samples examined (4.1%) and included USA300 isolates. The same strains of MRSA were found in both the garage (ie, medic and fire trucks and protective clothing) and the living quarters. ***Nasal carriage of MRSA from one fire district was 22.5%.***

**Conclusion:** Community-like and hospital-like MRSA were isolated from the environmental samples. The majority of the nasal MRSA/*S aureus* isolates were genetically related to the environmental MRSA strains, suggesting possible transmission between personnel and the environmental surfaces. Further research is needed to verify this hypothesis.

### **Environmental Surface Sampling for MRSA in Washington State Fire Stations final report**

Prepared by Nancy J. Simcox, Janice Camp, and Marilyn C. Roberts

*A Collaborative Effort*

University of Washington School of Public Health

Department of Environmental and Occupational Health Sciences

Field Research and Consultation Group

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Executive Summary

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium that is resistant to common antibiotics. MRSA can cause minor or severe skin infections, surgical wound infections, bloodstream

infections, and pneumonia. It can live for weeks or months on surfaces that are not kept clean. MRSA is spread by direct skin-to-skin contact with an active infection or by contact with contaminated shared items and surfaces. Fire service professionals may have a higher likelihood of exposure to MRSA when they come in contact with patients during emergency medical situations. However, for this population, the risk of developing a MRSA-related disease is not known.

The risk of MRSA infections has become an increasingly important concern for firefighters; recent studies have found MRSA on surfaces in fire stations. This service project was coordinated by the University of Washington Field Research and Consultation Group, working in collaboration with Dr. Marilyn C. Roberts, Professor in the Department of Environmental and Occupational Health Sciences (DEOHS).

The goal of the project was to collect environmental surface samples from 30 different fire stations across Washington state to better understand the presence and distribution of MRSA and to help reduce exposure risk factors in fire stations.

Thirty-three fire stations with career-based staff participated in this study. Sampling kits containing all supplies needed to conduct environmental surface sampling were mailed to each station. Fire station personnel collected 653 samples. Eight percent of the field samples (52/653) were positive for MRSA, and **19 of 33 stations (58%) had at least one positive MRSA sample. The percentage of MRSA positive samples per station ranged from 5%–35%**. Forty-two percent of the stations had two or more positive MRSA samples. Nine stations (27%) had three to seven samples with MRSA. Sixty-two percent of the positive MRSA samples were collected from the living quarters. MRSA was also found on turnout gear, items in aid cars (work benches, seat belts, and medical bag handles), and fire engines/ladders (steering wheels, door handles, mobile data computers, and arm rests). MRSA was not found in samples from 14 stations.

The average fire station call volume was 151 per week, ranging from 5 to 1800. Seventy-six percent of the stations transported patients for medical services.

Stations were classified into two groups according to the presence or absence of MRSA. In general, policies, practices, and cleaning and disinfecting items did not significantly differ between the two groups.

Many factors appear to contribute to the presence of MRSA on a surface. This project was designed to give general guidance and strategies to fire stations for reducing the spread of MRSA and other infectious diseases.

Each fire station was provided the results of its sampling, educational materials on how to maintain a clean zone in the fire station, and a fact sheet on tools for improving an infection control program. Special attention to infection control policies, work practices, and cleaning techniques are necessary to reduce the risk potential of MRSA transmission.

# **AN ASSESSMENT OF AMBULANCE INFECTION CONTROL IN AN EMERGENCY MEDICAL SERVICE IN THE ILEMBE DISTRICT OF KWAZULU-NATAL**

By SAGESHIN NAGURAN

STUDENT NUMBER: 18651193

A dissertation submitted in fulfillment of the requirement for the degree of Master in Technology:  
Emergency Medical Care

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Department of Emergency Medical Care and Rescue

## **ABSTRACT**

### **Purpose**

The purpose of the study was to assess ambulance infection control in an emergency medical service in the Ilembe District of KwaZulu-Natal, by determining the prevalence of bacteria and fungi in ambulances, including those that are potentially pathogenic, and evaluating the knowledge and practices of staff in infection control.

### **Methodology**

This quantitative, non experimental study used a cross-sectional, descriptive design to investigate aspects of ambulance infection control (IC). A laboratory analysis determined micro-organism contamination of ambulances, and a questionnaire was used to assess the ambulance IC knowledge and practices of 122 staff. All 15 ambulances in the district were checked.

### **Findings**

***Contamination of ambulances was widespread throughout the district under study, with 13 species of micro-organisms being identified, 10 of which were potentially pathogenic.***

Many respondents were unaware of policies and procedures. IC knowledge, cleaning practices and procedures were generally poor, personal protective equipment was frequently unavailable and staff immunization was inadequate. Challenges were, insufficient time and cleaning resources. Patient body fluid exposures had occurred in 67 (54.9%) of the respondents.

### **Conclusions**

Ambulances have an unacceptable level of pathogenic micro-organism contamination, and may be a reservoir in the transmission of potentially serious infections to patients and staff. There is a need for the development and implementation of evidence-based ambulance IC guidelines. These findings should be carefully considered and all attempts must be made to tackle the problem of ambulance cleanliness and infection control.

## **“MRSA Colonization in EMS Personnel and Equipment as a Risk Factor for Secondary Injury in Ohio Trauma Patients”**

Prepared by

Kurt B. Stevenson, MD MPH

### **Executive Summary**

This study represents the first large statewide analysis of MRSA colonization among EMS personnel and contamination of ambulances. It is unique in that randomly selected agencies in all 10 regions with equal representation of urban and rural sites are included. Thus, the results are

representative of the entire state. The most significant findings are that 50.6% of all agencies had an ambulance that was contaminated with MRSA. This rate is consistent with other studies cited but represents the estimated status across all of Ohio rather than one agency or region.

***The MRSA colonization rate of EMS workers is 4.6%, higher than the rate published for the general population but in the range reported for other healthcare settings. EMS personnel with MRSA colonization are more likely to have open wounds, have received antibiotics in the last year, and may have worked longer as an EMS worker.*** These data provide support for additional studies such as efforts to increase training in infection control and

environmental cleaning. Molecular epidemiology methods can be applied to determine the actual risk of a patient acquiring MRSA from EMS personnel and equipment and further support interventions to prevent such transmission.

### **Decontamination of rooms, medical equipment and ambulances using an aerosol of hydrogen peroxide disinfectant.**

Andersen BM1, Rasch M, Hochlin K, Jensen FH, Wismar P, Fredriksen JE.

#### **Author information**

#### **Abstract**

A programmable device (Sterinis, Gloster Sante Europe) providing a dry fume of 5% hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) disinfectant was tested for decontamination of rooms, ambulances and different types of medical equipment. Pre-set concentrations were used according to the volumes of the rooms and garages. Three cycles were performed with increasing contact times. Repetitive experiments were performed using *Bacillus atrophaeus* (formerly *Bacillus subtilis*) Raven 1162282 spores to control the effect of decontamination; after a sampling plan, spore strips were placed in various positions in rooms, ambulances, and inside and outside the items of medical equipment. Decontamination was effective in 87% of 146 spore tests in closed test rooms and in 100% of 48 tests in a surgical department when using three cycles. One or two cycles had no effect. The sporicidal effect on internal parts of the medical equipment was only 62.3% (220 tests). When the devices were run and ventilated during decontamination, 100% (57/57) of spore strips placed inside were decontaminated. *In the ambulances, the penetration of H<sub>2</sub>O<sub>2</sub> into equipment, devices, glove boxes, under mattresses, and the drivers' cabins was 100% (60/60 tests) when using three cycles, but was less effective when using one or two cycles. In conclusion, an H<sub>2</sub>O<sub>2</sub> dry fumigation system, run in three cycles, seemed to have a good sporicidal effect when used in rooms, ambulances, and external and internal parts of ventilated equipment.* Further studies need to be performed concerning concentration, contact time and the number of cycles of H<sub>2</sub>O<sub>2</sub>. This is especially important for inner parts of medical equipment that cannot be ventilated during the decontamination process.

PMID: 16337307 DOI: 10.1016/j.jhin.2005.07.020

J Hosp Infect. 2006 Feb;62(2):149-55. Epub 2005 Dec 6.

### **A preliminary investigation into bacterial contamination of Welsh emergency ambulances.**

Nigam Y1, Cutter J.

#### **Author information**

#### **Abstract**

#### **OBJECTIVES:**

The objective of this regional study across Wales was to perform a preliminary examination of Welsh emergency vehicles to determine levels of bacterial contamination.

#### **METHODS:**

Specific sites within emergency vehicles were swabbed, before and after vehicle cleaning, over a 12 month period, on a monthly basis. All swabs were sent to pathology laboratories for culturing and analysis.

#### **RESULTS:**

*Results showed that most sites within emergency vehicles across Wales were contaminated with a range of bacterial species before vehicle cleaning. After vehicle cleaning, many sites in vehicles were still contaminated, and some sites that were previously uncontaminated, became freshly contaminated as a result of cleaning methods used.*

#### **CONCLUSIONS:**

The authors conclude that the Welsh emergency vehicles examined exhibited an unacceptable level of bacterial contamination. This finding should be carefully considered and all attempts must be made to tackle the problem of vehicle cleanliness and infection control.

Comment in

Steering wheel spin? [Emerg Med J. 2004]

PMID: 12954699 PMCID: PMC1726203

Emerg Med J. 2003 Sep;20(5):479-82.

Evaluation of ambulance decontamination using gaseous chlorine dioxide.

Lowe JJ1, Hewlett AL, Iwen PC, Smith PW, Gibbs SG.

Author information

Abstract

**OBJECTIVE:**

We evaluated gaseous chlorine dioxide (ClO<sub>2</sub>) decontamination of an ambulance using a variety of bacterial biological agents.

**METHODS:**

Spores of attenuated *Bacillus anthracis* and *Bacillus atrophaeus* as well as vegetative cells of *Acinetobacter baumannii*, *Mycobacterium smegmatis*, and *Staphylococcus aureus* were exposed to ClO<sub>2</sub> gas inside an ambulance. Log reduction in viability was assessed following decontamination using organism plate counts.

**RESULTS:**

Ambulance decontamination with ClO<sub>2</sub> gas concentrations of 362 to 695 ppm maintained to exposures of 756 ppm-hours with 65% relative humidity (RH) achieved inactivation of all the bacterial agents tested. Decreasing exposure (ppm-hours) and RH (<65%) or restricting air flow reduced inactivation but still achieved greater than 6-log reductions in organism viability.

**CONCLUSION:**

*Up to 10-log reductions were achieved in an ambulance interior following exposure to ClO<sub>2</sub>, indicating that gas concentrations needed to mitigate biological agent contamination can be achieved and maintained safely in an ambulance. Future studies are ongoing to evaluate gaseous ClO<sub>2</sub> in other environments contaminated with biological agents of health care concern.*

PMID: 23734992 DOI: 10.3109/10903127.2013.792889

Prehosp Emerg Care. 2013 Jul-Sep;17(3):401-8. doi: 10.3109/10903127.2013.792889.

**Methicillin-Resistant *Staphylococcus Aureus* Nasal Colonization Prevalence among Emergency Medical Services Personnel**

DOI: 10.1017/S1049023X13003476 · Source: PubMed

Alaa Al Amiry, Ajman University of Science and Technology

Richard A Bissell, University of Maryland, Baltimore County

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Abstract

**Introduction:** The prevalence of Methicillin-resistant *Staphylococcus aureus* (MRSA) nasal colonization among Emergency Medical Services (EMS) personnel is not well studied.

Methicillin-resistant *Staphylococcus aureus* colonization can be a health hazard for both EMS personnel and patients. The aim of this study was to quantify the prevalence of MRSA colonization among EMS personnel. This study will help the scientific community understand the extent of this condition so that further protocols and policies can be developed to support the health and wellbeing of EMS personnel. Hypothesis/ Problem The hypothesis of this study was that the prevalence of MRSA colonization among EMS personnel is significantly higher than among the general population. Methods: This was a cross-sectional study. A total of 110

subjects were selected from two major US Mid-Atlantic fire departments. Methicillin-resistant *Staphylococcus aureus* colonization was detected by nasal swabbing. Nasal swabs were inoculated onto a special agar medium (C-MRSA Agar) with polymerase chain reaction testing performed. One-sided binomial distribution at the Study Size 2.0 Web calculator was used. Using the Web calculator,  $p$  ( $H_0$  proportion) = 1.5%; a difference ( $H_1-H_0$ ) ' $\Delta$ ' = 4.53% can be detected at  $\alpha$  = 5% and power = 80% with  $N$  = 110. Results: ***Samples were collected from 110 volunteers. Seven samples were positive for MRSA, resulting in a prevalence of 7/110 or 6.4% (95% CI, 1.8%-11%;  $P < .0003$ ) compared with a 1.5% prevalence of MRSA colonization among the general population.***

Conclusion: There is evidence that EMS personnel have a higher prevalence of MRSA colonization than the general population. This can be a risk to patients and can be recognized as an occupational hazard.

Article in Prehospital and disaster medicine: the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation 28(4):1-5 · April 2013 with 38 Reads

Use of a forensic technique to identify blood contamination of emergency department and ambulance trauma equipment.

Lee JB1, Levy M, Walker A.

Author information

Erratum in

Emerg Med J. 2005 Nov;22(11):836.

Abstract

Using a Kastle-Meyer (KM) technique, the following equipment from the emergency departments of six UK hospitals (four trusts) and three regional ambulance services was tested for blood contamination: extrication ("spinal") boards, cervical collars, straps, box splints, head blocks, and headboards. Only equipment ready for patient use was tested. ***Over half of trauma equipment (57%) tested positive for blood***, including 15% of equipment that was visibly stained with blood. There have been no recorded cases of infection from contaminated trauma equipment but our study has identified the potential risk. Disposable covers for boards, disposable straps, and disposable radiolucent head blocks which are currently available provide a solution but have resource implications.

PMID: 16373813 [PubMed - indexed for MEDLINE] PMCID: PMC2564139

Emerg Med J. 2006 Jan;23(1):73-5.

Can methicillin-resistant *Staphylococcus aureus* be found in an ambulance fleet?

Roline CE1, Crumpecker C, Dunn TM.

Author information

Abstract

OBJECTIVE:

To perform an initial screening study of methicillin-resistant *Staphylococcus aureus* (MRSA) contamination in an ambulance fleet.

METHODS:

This was a cross-sectional study of MRSA contamination in an ambulance fleet operating in the western United States in June 2006. Five specific areas within each of 21 ambulances ( $n = 105$ ) were tested for MRSA contamination using dacron swabs moistened with a 0.85% sterile saline solution. These samples were then plated onto a screening media of mannitol salt agar containing 6.5% NaCl and 4 mcg/mL oxacillin.

RESULTS:

***Thirteen samples isolated from 10 of the 21 ambulances (47.6%) in the sample group tested positive for MRSA.***

## CONCLUSIONS:

The results of this preliminary study suggest that ambulances operating in the emergency medical services (EMS) system may have a significant degree of MRSA contamination and may represent an important reservoir in the transmission of potentially serious infections to patients.

Comment in

Prevalence of methicillin-resistant *Staphylococcus aureus* colonization in emergency medical service providers. [Am J Emerg Med. 2011]

PMID: 17454817 [PubMed - indexed for MEDLINE]

Prehosp Emerg Care. 2007 Apr-Jun;11(2):241-4.

The prevalence of methicillin-resistant *Staphylococcus aureus* among out-of-hospital care providers and emergency medical technician students.

Miramonti C1, Rinkle JA, Iden S, Lincoln J, Huffman G, Riddell E, Kozak MA.

Author information

Abstract

### OBJECTIVE:

We compared the methicillin-resistant *Staphylococcus aureus* (MRSA) carrier rate among out-of-hospital care providers with greater than six months' experience in emergency medical services (EMS) care with that of emergency medical technician (EMT) students with two months or less of observation time as part of their clinical training.

### METHODS:

We conducted a prospective study utilizing a convenience sample of out-of-hospital care providers and EMT students in an urban EMS system operating in the Midwest during October and November 2006. One hundred thirty-four out-of-hospital care providers and 152 EMT students were tested for MRSA susceptibility using the cefoxitin disk diffusion method.

### RESULTS:

Contrary to our hypothesis, we did not find a statistically significant difference in MRSA nasal colonization between out-of-hospital care providers (4.5%; 95% confidence interval [CI] 1.0, 8.0) and EMT students (5.3%; 95% CI 1.7, 8.8). A subgroup analysis showed that among out-of-hospital

care providers, paramedics had a higher rate of nasal colonization than EMTs (5.6% vs. 2.2%).

### CONCLUSION:

*We found that out-of-hospital care providers and EMT students had higher nasal colonization rates than the reported rate for the U.S. population (0.084% at the time the study was conducted and 1.5% currently). It is imperative that both groups adhere to infection control practices.*

PMID: 23098136 DOI: 10.3109/10903127.2012.717169

Prehosp Emerg Care. 2013 Jan-Mar;17(1):73-7. doi: 10.3109/10903127.2012.717169. Epub 2012 Oct 25.

Bacterial pathogens in ambulances: results of unannounced sample collection.

Alves DW1, Bissell RA.

Author information

Abstract

The concern that the health care environment may harbor a substantial reservoir of infectious agents has been vigorously examined by microbiology and infectious disease experts. Although universal precautions and disposable equipment reduces risks to patients and providers, the ambulance remains vulnerable to bacterial contamination from biological secretions.

Additionally, the nature of emergency medical services creates pressures on prehospital care providers.

**OBJECTIVE:**

We hypothesized that a discrepancy exists between the expectation of disinfection of reusable equipment in emergency medical services (EMS) and the cleaning that actually occurs.

**METHODS:**

We chose five areas within the ambulance for specimen collection for their reasoned propensity to yield a large spectrum of bacteria. Four first-due ambulances were selected for culturing. The crews did not have advance knowledge of the study or sample collection. Specific identifications with antibiotic susceptibility were completed, identifying three multidrug resistant organisms.

**RESULTS:**

*Specimens from all four ambulances grew moderate-to-large quantities of environmental and skin flora.* Newer, automated microbiological techniques and concerns regarding multipledrug-resistant organism prevalence as well as the potential for biological warfare make complete identification more important.

**CONCLUSIONS:**

This study examined the bacterial pathogens found in EMS vehicles. Four of the seven species isolated were substantial nosocomial pathogens, and three of these four possess formidable antibiotic resistance patterns. All of the organisms detected are susceptible to the disinfectant agents currently in common use by EMS agencies.

PMID: 18379921 [PubMed - indexed for MEDLINE]

Prehosp Emerg Care. 2008 Apr-Jun;12(2):218-24. doi: 10.1080/10903120801906721.

**POSAiDA: presence of Staphylococcus aureus/MRSA and Enterococcus/VRE in Danish ambulances. A cross-sectional study.**

Vikke HS1, Giebner M2.

Author information

Abstract

**BACKGROUND:**

Every year approximately one out of ten Danish patients contracts a healthcare associated infection (HAI). Staphylococcus aureus and Enterococcus are prominent in the group of pathogenic bacteria that underlie HAIs, causing unnecessary inconvenience and prolonging hospitalization. Bacterial colonization often occurs due to indirect patient-to-patient transmission, caused by poor hygiene compliance. This study aims to determine the level of contamination with S. aureus/MRSA and Enterococcus/VRE on presumed clean blood pressure cuffs in the Danish ambulances.

**METHOD:**

Blood pressure cuffs were tested for contamination with S. aureus and Enterococcus when being cleaned according to everyday guidelines in this cross-sectional study. Imprints were performed with specific agar plates after cleaning with ethanol wipes. Positive imprints were typed and antibiotic susceptibility was determined.

**RESULTS:**

Both S. aureus and Enterococcus were found on blood pressure cuffs thought to be clean, however, to a limited extent. The average level of contamination by S. aureus was 0.54 CFU per 25 cm(2) (SD 1.98). Minimum and maximum values ranged from 0 to 12 CFU per 25 cm(2) and 10% of the 50 samples were positive. The average level of contamination by Enterococcus was 0.06 CFU per 25 cm(2) (SD 0.42). Minimum and maximum values ranged from 0 to 3 CFU per 25 cm(2) and 2% of the 50 samples were positive. All S. aureus isolates were found to be methicillin susceptible S. aureus (MSSA) and the one Enterococcus isolate was identified as Enterococcus faecalis, negative for vancomycin resistance genes.

**CONCLUSION:**

*Staphylococcus aureus and Enterococcus were detectable on equipment thought to be clean.* However, all detected bacteria showed susceptibility towards methicillin or vancomycin.

Findings of pathogens after cleaning may be due to cross-contamination, improper cleaning and limited effect of the currently used cleaning procedure and are thought to affect the risk of infection. Therefore, we recommend a thorough evaluation of current cleaning procedures as well as increased focus on and further research into hygiene challenges in a prehospital setting. Future studies should be performed in order to demonstrate the level of bacterial contamination in all areas of the medical service, e.g., the ambulance environment, medical equipment, staff uniform and hand hygiene. Furthermore, in order to establish evidence for different cleaning procedures in situ we recommend testing the effect of different cleaning interventions by interventional designs.

**KEYWORDS:**

Cleaning procedures; Contamination; Emergency care; Hygiene; Infection control; Prehospital  
BMC Res Notes. 2016 Mar 30;9:194. doi: 10.1186/s13104-016-1982-x.

Prevalence of nosocomial pathogens in German ambulances: the SEKURE study.  
Wepler M1, Stahl W1, von Baum H2, Wildermuth S2, Dirks B1, Georgieff M1, Hafner S1.  
Author information

**Abstract**

**OBJECTIVE:**

The increasing prevalence of multidrug resistant bacteria is a problem in the inpatient care setting, and in the emergency care system. The aim of this observational, cross-sectional study was to evaluate the prevalence of pathogens on well-defined surfaces in German ambulances that have been designated as 'ready for service'.

**METHODS:**

After informed consent was obtained, ambulance surfaces were sampled with agar plates for microbiological examination during an unannounced visit. A standardised questionnaire was used to obtain information regarding the disinfection protocols used at each rescue station.

**RESULTS:**

*Methicillin resistant staphylococcus aureus contamination was present in 18 sampling surfaces from 11 out of 150 ambulance vehicles (7%) that were designated as ready for service. Contact surfaces directly surrounding patients or staff were most frequently contaminated with pathogens. However, bacterial contamination was not related to annual missions, methods or frequency of disinfection.*

**CONCLUSIONS:**

In accordance with previous studies, disinfection and cleaning of areas with direct contact to patients or staff seem to be the most challenging. This should also be reflected in disinfection guidelines and the related continuing education.

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**KEYWORDS:**

bacterial; infectious diseases; management, emergency department management; prehospital care; risk management

PMID: 25714107 DOI: 10.1136/emmermed-2013-202551

Emerg Med J. 2015 May;32(5):409-11. doi: 10.1136/emmermed-2013-202551. Epub 2015 Feb 24.

Prevalence of positive carriage of tuberculosis, methicillin-resistant *Staphylococcus aureus*, and vancomycin-resistant *Enterococci* in patients transported by ambulance: a single center observational study.

Ro YS1, Shin SD, Noh H, Cho SI.

**Author information**

**Abstract**

**OBJECTIVES:**

An ambulance can be a potential source of contagious or droplet infection of a community. We estimated the prevalence of positive carriage of tuberculosis (TB), methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant Enterococci (VRE) in patients transported by ambulance.

**METHODS:**

This was a retrospective observational study. We enrolled all patients who visited a tertiary teaching hospital emergency department (ED). Blood, sputum, urine, body fluid, and rectal swab samples were taken from patients when they were suspected of TB, MRSA, or VRE in the ED. The patients were categorized into three groups: pre-hospital ambulance (PA) group; interfacility ambulance (IA) group; and non-ambulance (NA) group. Adjusted odds ratio (OR) and 95% confidence intervals (CI) were calculated using a multivariable logistic regression model for the prevalence of each infection.

**RESULTS:**

The total number of patients was 89206. Of these, 9378 (10.5%) and 4799 (5.4%) were in the PA and IA group, respectively. The prevalence of TB, MRSA, and VRE infection were 0.3%, 1.1%, and 0.3%, respectively. In the PA group, the prevalence of TB, MRSA, and VRE were 0.3%, 1.8%, and 0.4%. In the IA group, the prevalence of TB, MRSA, and VRE were 0.7%, 4.6%, and 1.5%, respectively. The adjusted ORs (95% CI) of the PA and IA compared to the NA group were 1.02 (0.69 to 1.53) and 1.83 (1.24 to 2.71) for TB, 2.24 (1.87 to 2.69) and 5.47 (4.63 to 6.46) for MRSA, 2.59 (1.78 to 3.77) and 8.90 (6.52 to 12.14) for VRE, respectively.

**CONCLUSIONS:**

*A high prevalence of positive carriage of TB, MRSA, and VRE in patients transported by metropolitan ambulances was found.*

**KEYWORDS:**

Emergency medical services; Infection; Prevalence; Resistance; Tuberculosis  
J Prev Med Public Health. 2012 May;45(3):174-80. doi: 10.3961/jpmph.2012.45.3.174. Epub 2012 May 31.

Detection and analysis of *Staphylococcus aureus* isolates found in ambulances in the Chicago metropolitan area.

Rago JV1, Buhs LK, Makarovaite V, Patel E, Pomeroy M, Yasmine C.

Author information

Abstract

**BACKGROUND:**

Given the frequency with which many different strains of *Staphylococcus aureus* are found in various prehospital settings, this study sought to characterize *S aureus* isolates taken from one such environment. The objectives were to determine the frequency of *S aureus* in front-line, advanced life support (ALS) ambulances throughout the Chicago metropolitan area, and to generate antibiograms (antibiotic resistance profiles) for each *S aureus* isolate using 8 clinically relevant antibiotics.

**METHODS:**

Samples were obtained from 26 sites in 71 ambulances from 34 different Chicago-area municipalities. Selected colonies that demonstrated a growth pattern consistent with that of *S aureus* were subjected to a latex agglutination test specific for *S aureus*. Antibiograms and genetic analyses were performed on all latex agglutination test-positive isolates.

**RESULTS:**

*At least one S aureus isolate was found in approximately 69% of all ambulances in the study. Of all isolates detected, 77% showed resistance to at least one antibiotic, and 34% displayed resistance to 2 or more antibiotics. Some level of oxacillin resistance was found in 21% of isolates; however, only slightly more than half of these oxacillin-resistant isolates were*

found to carry the methicillin-resistant *S aureus*-specific SCCmec cassette. Some 12% of all isolates were ultimately determined to be methicillin-resistant *S aureus*, whereas the remaining 88% were methicillin-sensitive *S aureus* with varying antibiograms.

#### CONCLUSIONS:

*Antibiotic resistance appears to be prevalent in S aureus isolates detected in Chicago area ALS ambulances.* Given the ease with which *S aureus* can survive on inanimate surfaces and exchange antibiotic resistance elements, a conscientious approach to the application of existing cleaning techniques, especially in key ambulance sites, is needed. Future work will include further characterizing isolates using multiple techniques, as well as follow-up studies with interested municipalities.

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PMID: 22440671 DOI: 10.1016/j.ajic.2011.08.021

Am J Infect Control. 2012 Apr;40(3):201-5. doi: 10.1016/j.ajic.2011.08.021.

Meticillin-resistant *Staphylococcus aureus* (MRSA) contamination of ambulance cars after short term transport of MRSA-colonised patients is restricted to the stretcher.

Eibicht SJ1, Vogel U.

Author information

#### Abstract

Cabin surfaces of ambulance cars transporting hospitalised patients are at risk of methicillinresistant

*Staphylococcus aureus* (MRSA) contamination. In this study ambulance cars were analysed for the presence of MRSA immediately after transport of MRSA-colonised or -infected patients (two sites at the stretcher, three sites at the interior walls). Eighty-nine of 100 transport events, which fulfilled the inclusion criterion of transport time less than 20 min, were further analysed. Eight ambulance cars (9%) were contaminated (90% confidence interval: 4-14%). Transport time of 11-20 min did not result in a higher contamination rate than shorter transport time of 1-10 min. MRSA was detected only on the stretcher, i.e. the headrest and the handles. Cabin walls were not contaminated. *In conclusion, ambulance cars were contaminated with eMRSA even at short transport times.* Disinfection after short-term transport of MRSApositive patients should be restricted to surfaces in close vicinity to the patient's position. Consecutive investigation of 60 transport events in the absence of MRSA notification did not reveal any MRSA, but methicillin-susceptible *S. aureus* was detected in 12 cars, predominantly at handles and headrests. This finding highlights the importance of disinfection of surfaces in the vicinity of patients irrespective of the MRSA status.

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PMID: 21440330 DOI: 10.1016/j.jhin.2011.01.015

J Hosp Infect. 2011 Jul;78(3):221-5. doi: 10.1016/j.jhin.2011.01.015. Epub 2011 Mar 25.

Bacterial contamination of ambulance oxygen humidifier water reservoirs: a potential source of pulmonary infection.

Cameron JL, Reese WA, Tayal VS, Clark RF, Kelso D, Gonzalez ER, Garnett AR, Ornato JP.

#### Abstract

The risk and benefit of oxygen humidification during ambulance transport is unknown. *We cultured the water in plastic multiple-use bottles of humidifiers on 30 randomly selected area ambulances during November 1985. There were 22 positive cultures.* Potentially pathogenic bacteria (four *Pseudomonas maltophilia*, three *Pseudomonas aeruginosa*, one *Klebsiella pneumoniae*, and one *Staphylococcus epidermidis*) were found in nine samples. Assuming that the water in ambulance humidifiers should have been sterile, the findings are

statistically significant ( $P$  less than .01). Because there is no evidence that humidification is of benefit for nonintubated patients receiving oxygen at flow rates of 4 L/min or less when environmental humidity is adequate, we suggest that such patients should receive oxygen without humidification during ambulance transport. All other patients requiring oxygen during ambulance transport should continue to receive humidified oxygen. If a multiple-use humidifier reservoir is to be used, a written policy for its use must be developed and there must be appropriate documentation of compliance with the policy. An alternative is to replace the multiple-use humidifier reservoir with single-use sterile disposable devices, which cost approximately \$2.00 per unit.

PMID: 3535586

Ann Emerg Med. 1986 Nov;15(11):1300-2.

**Risk stratification-based surveillance of bacterial contamination in metropolitan ambulances.**

Noh H1, Shin SD, Kim NJ, Ro YS, Oh HS, Joo SI, Kim JI, Ong ME.

Author information

Abstract

We aimed to know the risk-stratification-based prevalence of bacterial contamination of ambulance vehicle surfaces, equipment, and materials. This study was performed in a metropolitan area with fire-based single-tiered Basic Life Support ambulances. Total 13 out of 117 ambulances (11.1%) were sampled and 33 sites per each ambulance were sampled using a

soft rayon swab and aseptic containers. These samples were then plated onto a screening media of blood agar and MacConkey agar. Specific identification with antibiotic susceptibility was performed. We categorized sampling sites into risk stratification-based groups (Critical, Semi-critical, and Non-critical equipment) related to the likelihood of direct contact with patients' mucosa. *Total 214 of 429 samples showed positive results (49.9%) for any bacteria. Four of these were pathogenic (0.9%) (MRSA, MRCoNS, and K. pneumoniae), and 210 of these were environmental flora (49.0%). However, the prevalence (positive/number of sample) of bacterial contamination in critical, semi-critical airway, semi-critical breathing apparatus group was as high as 15.4% (4/26), 30.7% (16/52), and 46.2% (48/104), respectively.* Despite current formal guidelines, critical and semi-critical equipments were contaminated with pathogens and normal flora. This study suggests the need for strict infection control and prevention for ambulance services.

KEYWORDS:

Ambulances; Bacterial Infections; Contamination

PMID: 21218040 PMCID: PMC3012836 DOI: 10.3346/jkms.2011.26.1.124

J Korean Med Sci. 2011 Jan;26(1):124-30. doi: 10.3346/jkms.2011.26.1.124. Epub 2010 Dec 22.

**Prevalence of methicillin-resistant Staphylococcus aureus in ambulances in southern Maine.**

Brown R1, Minnon J, Schneider S, Vaughn J.

Author information

Abstract

OBJECTIVE:

To determine whether methicillin-resistant Staphylococcus aureus (MRSA) could be found in ambulances in a predominantly rural state.

METHODS:

Samples were obtained from specified areas in 51 ambulances in southern Maine. These samples were tested on mannitol salt agar containing 4 microg/mL oxacillin. Resulting colonies

were gram-stained and tested for the presence of catalase and coagulase.

**RESULTS:**

*Of the 51 ambulances tested, 25 (49%) had at least one area positive for MRSA contamination.*

**CONCLUSIONS:**

A significant number of ambulances operating in southern Maine have MRSA contamination, and ambulances may represent an important reservoir for the transmission of potentially serious infections to patients and EMS personnel. There was no statistical difference between the service types (fire-based vs. non-fire-based) or annual call volume. There was, however, a statistically significant lower rate of contamination in services that provided paid, 24-hour coverage versus those that did not.

PMID: 20199231 DOI: 10.3109/10903120903564480

Prehosp Emerg Care. 2010 Apr-Jun;14(2):176-81. doi: 10.3109/10903120903564480.

Detection and characterization of surface microbial contamination in emergency ambulances.

Varona-Barquin A1, Ballesteros-Peña S2, Lorrio-Palomino S3, Ezpeleta G4, Zamanillo V1, Eraso E1, Quindós G5.

Author information

**Abstract**

A cross-sectional study was performed in 10 emergency basic life support ambulances operating in Bilbao, Spain, to assess surface bacterial contamination. *Presence of clinically relevant bacterial contamination suggests that disinfection of the studied basic life support ambulances was not optimal and represents a potential risk of infection for the patients transferred in them.* It is critical to implement existing infection control and prevention protocols to resolve this issue.

**KEYWORDS:**

Bacteria; Emergency medical services; Environmental microbial contamination; Infection; Infection control procedures; Staphylococcus aureus

PMID: 27566871 DOI: 10.1016/j.ajic.2016.05.024

Am J Infect Control. 2017 Jan 1;45(1):69-71. doi: 10.1016/j.ajic.2016.05.024. Epub 2016 Aug 24

Microbial air quality and bacterial surface contamination in ambulances during patient services.

Luksamijarulkul P1, Pipitsangjan S2.

Author information

**Abstract**

**OBJECTIVES:**

We sought to assess microbial air quality and bacterial surface contamination on medical instruments and the surrounding areas among 30 ambulance runs during service.

**METHODS:**

We performed a cross-sectional study of 106 air samples collected from 30 ambulances before patient services and 212 air samples collected during patient services to assess the bacterial and fungal counts at the two time points. Additionally, 226 surface swab samples were collected from medical instrument surfaces and the surrounding areas before and after ambulance runs. Groups or genus of isolated bacteria and fungi were preliminarily identified by Gram's stain and lactophenol cotton blue. Data were analyzed using descriptive statistics, t-test, and Pearson's correlation coefficient with a p-value of less than 0.050 considered significant.

**RESULTS:**

The mean and standard deviation of bacterial and fungal counts at the start of ambulance runs were  $318 \pm 485$  cfu/m(3) and  $522 \pm 581$  cfu/m(3), respectively. Bacterial counts during patient

services were  $468 \pm 607$  cfu/m<sup>3</sup>) and fungal counts were  $656 \pm 612$  cfu/m<sup>3</sup>). Mean bacterial and fungal counts during patient services were significantly higher than those at the start of ambulance runs,  $p=0.005$  and  $p=0.030$ , respectively. For surface contamination, the overall bacterial counts before and after patient services were  $0.8 \pm 0.7$  cfu/cm<sup>2</sup>) and  $1.3 \pm 1.1$  cfu/cm<sup>2</sup>), respectively ( $p < 0.001$ ). The predominant isolated bacteria and fungi were *Staphylococcus* spp. and *Aspergillus* spp., respectively. Additionally, there was a significantly positive correlation between bacterial ( $r=0.3$ ,  $p < 0.010$ ) and fungal counts ( $r=0.2$ ,  $p=0.020$ ) in air samples and bacterial counts on medical instruments and allocated areas.

#### CONCLUSIONS:

*This study revealed high microbial contamination (bacterial and fungal) in ambulance air during services and higher bacterial contamination on medical instrument surfaces and allocated areas after ambulance services compared to the start of ambulance runs.*

Additionally, bacterial and fungal counts in ambulance air showed a significantly positive correlation with the bacterial surface contamination on medical instruments and allocated areas. Further studies should be conducted to determine the optimal intervention to reduce microbial contamination in the ambulance environment.

#### KEYWORDS:

Ambulances; Bacterial Counts; Microbiology Air

PMID: 25960835 PMCID: PMC4412456 DOI: 10.5001/omj.2015.23

Oman Med J. 2015 Mar;30(2):104-10. doi: 10.5001/omj.2015.23.

UniStatus - a cross-sectional study on the contamination of uniforms in the Danish ambulance service.

Vikke HS1, Giebner M2.

Author information

Abstract

#### BACKGROUND:

Patients are at risk of contracting infections due to the presence of disease-causing microorganisms that can be transmitted from the medical staff's uniforms to the patient. The dual purpose of this study was to examine the contamination level of the uniforms worn by ambulance staff after a shift and to test the effect of washing of the uniform with and without a detergent containing acetic peroxide.

#### METHODS:

This was a cross-sectional study in which 30 ambulance staff uniforms were randomly selected for inclusion and divided into two groups. Before washing, 90 prints were performed with specific agar plates to determine bacterial contamination and to establish the prevalence of a variety of microorganisms. Group A uniforms were washed with a detergent without acetic peroxide; Group B uniforms were washed with a detergent containing acetic peroxide.

#### RESULTS:

Before washing, the 90 prints had an average colony-forming units (CFU) of potentially pathogenic bacteria of 68.89 per 25 cm<sup>2</sup>) and a prevalence of: *E. coli* and *Pseudomonas* 0%, *Bacillus cereus* 27.78% (CI 95%  $\pm$  9.80), *Clostridium* and *Enterococcus* 2.22% (CI 95%  $\pm$  1.96), *Staphylococcus aureus* 21.11% (CI 95%  $\pm$  7.80). After washing, CFU was reduced to 3.09 (CI 95%  $\pm$  5.04) per 25 cm<sup>2</sup>) in Group A and to 1.47 (CI 95%  $\pm$  4.77) per 25 cm<sup>2</sup>) in Group B. The prevalence of specific bacteria in either group was 0%, except for *S. aureus* which had a prevalence rate of 4.40% (CI 95%  $\pm$  6.10) in Group A. The difference between the contamination

degrees of the two groups was not significant in either test ( $p > 0.05$ ).

#### CONCLUSION:

*Potentially pathogenic bacteria are detectable on ambulance staff uniforms when a shift ends. Optimal prevention of bacterial infection may be achieved by daily changing, washing at a*

minimum of 60 degrees Celsius and use of a detergent containing acetic peroxide.  
PMID: 25889860 PMCID: PMC4376367 DOI: 10.1186/s13104-015-1057-4  
BMC Res Notes. 2015 Mar 25;8:95. doi: 10.1186/s13104-015-1057-4.

**Exposure of emergency medical responders to methicillin-resistant Staphylococcus aureus.**

Sexton JD1, Reynolds KA.

Author information

Abstract

**BACKGROUND:**

Methicillin-resistant Staphylococcus aureus (MRSA) infections result in 19,000 deaths a year in the United States. Epidemiologic studies have shown that community-acquired infections are increasing dramatically, and strains typical of community infections are increasingly detected in hospital populations. Emergency medical responders (EMR) are exposed to both community and hospital MRSA patients, which, combined with their communal lifestyles in fire stations, results in higher risk of exposure. This study determined the occurrence and frequency of MRSA

and other bacterial indicators on environmental surfaces in fire stations, training sites, and offices of EMR.

**METHODS:**

Handled sponges were used for collection of targeted bacteria from commonly contacted environmental surfaces at EMR facilities. Biochemical tests confirmed isolates as S aureus, and MRSA was confirmed by growth on selective and differential media. An initial set of 500 samples

was collected at 9 fire-related facilities to identify areas of increased exposure. Subsequent studies targeted sites (n = 160) for repeat sampling that were MRSA positive.

**RESULTS:**

*S aureus was isolated from 10.6% (17/160) of the sampled sites. The couch and the classroom desks were the most contaminated at 20% (4/20 and 2/10, respectively). Of the S aureus isolated, 64.7% (11/17) were confirmed as MRSA.*

**CONCLUSION:**

EMR have a high potential for exposure to MRSA, not only through patient and hospital contacts but also in the fire station environment. MRSA was isolated with the highest frequency on the couches and the class desks. Although the true health significance of these exposures is unknown, improved infection control practices, such as routine handwashing and surface disinfection, are warranted to reduce MRSA exposures.

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PMID: 20381195 DOI: 10.1016/j.ajic.2010.01.004

Am J Infect Control. 2010 Jun;38(5):368-73. doi: 10.1016/j.ajic.2010.01.004. Epub 2010 Apr 8.

**Nosocomial infections in ambulances and effectiveness of ambulance fumigation techniques in Saudi Arabia. Phase I study.**

Alrazeeni D1, Al Sufi MS.

Author information

Abstract

**OBJECTIVES:**

To evaluate infection control and the incidence of bacterial pathogens in Emergency Medical Service (EMS) ambulances in Riyadh, Saudi Arabia. The effectiveness of fumigation techniques used for these ambulances to minimize the spread of infection to transported patients and prehospital

care providers was also assessed.

#### **METHODS:**

Based on previous literature review indicating a higher propensity of microbial load, 3 areas within the ambulance, such as, stretcher handle, oxygen flow meter knob, and interior handle of the rear door were selected for specimen collection. Swab samples were collected both in the day and night shift, after the intended disinfection and cleaning (before and after fumigation). Micro-organisms were identified using standard procedures. This phase-I study was conducted at the Emergency Medical Services Department, Prince Sultan Bin AbdulAziz College of Emergency Medical Services, Al Malaz, King Saud University, Riyadh, Saudi Arabia between October and November 2013, wherein a total of 10 ambulances from the Saudi Red Crescent Authority in Riyadh were selected for inclusion in the study.

#### **RESULTS:**

The specimens from all 10 ambulances showed similar results. *In post disinfection and before fumigation, swab samples showed positive cultures that grew moderate to large quantities of environmental and skin flora. However, almost all organisms were susceptible to the fumigation technique.*

#### **CONCLUSION:**

This study confirms the importance of evaluating the frequency and efficiency of various fumigation techniques as an ambulance is a potential reservoir for microbial transmission to patients and staff.

PMID: 25399212 PMCID: PMC4362147

Saudi Med J. 2014 Nov;35(11):1354-60.

[Knowledge of aseptics and antisepsis and following their rules as elements of infection prevention in the work of paramedics].

[Article in Polish]

Szarpak Ł1.

Author information

Abstract

#### **BACKGROUND:**

The health-care professionals, particularly paramedics are exposed to bloodborne infections during medical rescue operations. The aim of this study was to assess knowledge of bloodborne infections, their prevention and interrupted routes of infection transmission among paramedics.

#### **MATERIALS AND METHODS:**

The study comprised 220 paramedics employed in emergency departments and ambulance services. Material was collected using an anonymous questionnaire, developed for the purpose of this study.

#### **RESULTS:**

As many as 80% of the surveyed people reported frequent contact with patients' blood; 65% of the paramedics before establishing the intravenous access palpates the conduct of the vein; 81% introduce peripheral venous catheter directly after disinfection of the skin; and 98% apply personal protection measures.

#### **CONCLUSIONS:**

The analysis of knowledge of asepsis and antisepsis of bloodborne infections among paramedics points to a series of shortcomings in their adequate preparation to reduce the effects of exposure to infectious material. However, it should be emphasized that people with higher education presented a higher level of knowledge than those with postsecondary vocational education. In the opinion of the study group mandatory training in the discussed area would prove to be the most effective method for reducing the number of bloodborne infections.

PMID: 23829068

Med Pr. 2013;64(2):239-43.

**Ambulance personnel adherence to hygiene routines: still protecting ourselves but not the patient.**

**Emanuelsson L1, Karlsson L, Castrèn M, Lindström V.**

**Author information**

**Abstract**

**OBJECTIVES:**

**It is well known that adherence to hygiene routines leads to increased quality of care and safety for patients and personnel in hospitals. However, there have been few studies describing hygiene in ambulances, despite the fact that many patients receive advanced medical care and treatment from ambulance services before arriving at an emergency department. Therefore, the purpose of this study was to describe the adherence of ambulance personnel to hygiene routines in the ambulances.**

**METHODS:**

**A participant observation study in the County of Värmland (Sweden) was conducted over 1 day in November 2010. Seven hygiene-related variables were collected during the observations: disinfection of hands before and after patient contact; correct use of gloves, gowns and shortsleeved uniforms; no rings, watches, or bracelets; and short or tied back hair during patient care.**

**RESULT:**

**A total of 68 observed ambulance assignments were analyzed in terms of the adherence of personnel to hygiene routines. *In 34% of the observed cases, hand rub was used before patient care and, in 72% of the observed cases, the ambulance personnel used hand rub after patient care. Correct adherence to the rule requiring use of a short-sleeved uniform was found in 28% of the observations. Correct adherence to the rule regarding short or tied back hair was found in 91% of the observations.***

**CONCLUSION:**

**The ambulance personnel were found to have relatively good adherence to some hygiene routines, but not all. The adherence by ambulance personnel to all of the seven observed variables was correct in only 3% of the assignments.**

**PMID: 22850089 DOI: 10.1097/MEJ.0b013e328357938e**

**Eur J Emerg Med. 2013 Aug;20(4):281-5. doi: 10.1097/MEJ.0b013e328357938e.**

**Hand Washing Practices Among Emergency Medical Services Providers.**

**Bucher J1, Donovan C1, Ohman-Strickland P2, McCoy J1.**

**Author information**

**Abstract**

**INTRODUCTION:**

**Hand hygiene is an important component of infection control efforts. Our primary and secondary goals were to determine the reported rates of hand washing and stethoscope cleaning in emergency medical services (EMS) workers, respectively.**

**METHODS:**

**We designed a survey about hand hygiene practices. The survey was distributed to various national EMS organizations through e-mail. Descriptive statistics were calculated for survey items (responses on a Likert scale) and subpopulations of survey respondents to identify relationships between variables. We used analysis of variance to test differences in means between the subgroups.**

**RESULTS:**

**There were 1,494 responses. Overall, reported hand hygiene practices were poor among prehospital**

providers in all clinical situations. Women reported that they washed their hands more frequently than men overall, although the differences were unlikely to be clinically significant. Hygiene after invasive procedures was reported to be poor. The presence of available hand sanitizer in the ambulance did not improve reported hygiene rates but improved reported rates of cleaning the stethoscope (absolute difference 0.4,  $p=0.0003$ ). Providers who brought their own sanitizer were more likely to clean their hands.

**CONCLUSION:**

*Reported hand hygiene is poor amongst pre-hospital providers. There is a need for future intervention to improve reported performance in pre-hospital provider hand washing.*

PMID: 26587098 PMCID: PMC4644042 DOI: 10.5811/westjem.2015.7.25917

West J Emerg Med. 2015 Sep;16(5):727-35. doi: 10.5811/westjem.2015.7.25917. Epub 2015 Oct 20.

**Hand hygiene in emergency medical services.**

Teter J, Millin MG, Bissell R.

**Abstract**

**BACKGROUND:**

Hospital-acquired infections (HAIs) affect millions of patients annually (World Health Organization. Guidelines on Hand Hygiene in Healthcare. Geneva: WHO Press; 2009). Hand hygiene compliance of clinical staff has been identified by numerous studies as a major contributing factor to HAIs around the world. Infection control and hand hygiene in the prehospital environment can also contribute to patient harm and spread of infections. Emergency medical services (EMS) practitioners are not monitored as closely as hospital personnel in terms of hand hygiene training and compliance. Their ever-changing work environment is less favorable to traditional hospital-based aseptic techniques and education.

**METHODS:**

This study aimed to determine the current state of hand hygiene practices among EMS providers and to provide recommendations for improving practices in the emergency health services environment. This study was a prospective, observational prevalence study and survey, conducted over a 2-month period. We selected participants from visits to three selected hospital emergency departments in the mid-Atlantic region. There were two data components to the study: a participant survey and hand swabs for pathogenic cultures.

**RESULTS:**

This study recruited a total sample of 62 participants. *Overall, the study revealed that a significant number of EMS providers (77%) have a heavy bacterial load on their hands after patient care. All levels of providers had a similar distribution of bacterial load. Survey results revealed that few providers perform hand hygiene before (34%) or in between patients (24%), as recommended by the Centers for Disease Control and Prevention guidelines.*

**CONCLUSION:**

This study demonstrates that EMS providers are potential vectors of microorganisms if proper hand hygiene is not performed properly. Since EMS providers treat a variety of patients and operate in a variety of environments, providers may be exposed to potentially pathogenic organisms, serving as vectors for the exposure of their patients to these same organisms. Proper application of accepted standards for hand hygiene can help reduce the presence of microbes on provider hands and subsequent transmission to patients and the environment.

**KEYWORDS:**

hand hygiene; hand washing; infection; infection control; patient safety

PMID: 25415186 DOI: 10.3109/10903127.2014.967427

Prehosp Emerg Care. 2015 Apr-Jun;19(2):313-9. doi: 10.3109/10903127.2014.967427. Epub

2014 Nov 21.

Hand sanitization rates in an urban emergency medical services system.

Ho JD1, Ansari RK2, Page D3.

Author information

Abstract

**BACKGROUND:**

Hand sanitizing, although often a "forgotten" practice, has been demonstrated to be a leading factor in preventing infectious disease transmission in health care environments. Previous studies have looked at hand-sanitization rates in hospital settings, but we are aware of very few describing this in the prehospital setting. Because emergency medical services (EMS) providers are potential vectors of infectious disease spread, it is important to know if their handsanitization practices are sufficient.

**OBJECTIVE:**

The objective of this study was to describe the hand-sanitization rates for a convenience sample of an urban EMS system.

**METHODS:**

A convenience sampling of paramedics employed by an urban paramedic ambulance service (55,000+ runs/year) underwent prospective, blinded observation during a 6-month period. Observations were conducted by paramedic students during 8-h and 12-h shifts. Recorded data points included any modality of hand sanitizing (e.g., soap/water, anti-germicide gels or foams, anti-germicide wipes) immediately surrounding all patient contacts and meals. Glove use during patient contact was also recorded. Trips to the restroom were not directly observed and hand sanitizing after this event was assumed. Duration of any sanitizing event was not recorded. Data points were analyzed using simple and descriptive statistics.

**RESULTS:**

Fifty-three paramedics (of 108 paramedic employees) were observed during 258 patient contacts. Paramedics were observed to sanitize their hands after 162 of these (62.8%). If hand sanitizing is assumed in the 16 immediate trips to the restroom after patient contact, the compliance rate increased to 68.9%. Hands were sanitized immediately before patient contact only three times (1.1%) and nine times during patient contact (3.5%). Gloves were not worn during 32 of the patient contacts (12.4%). Hand sanitizing occurred before 8 of 42 meals (19%) and after 25 of 42 meals (59.5%).

**CONCLUSIONS:**

Hand-sanitization events were noted in this convenience sample group a majority of times in association with patient contact. However, there appears to be substantial room for improvement. This suggests that EMS services should work to improve hand-sanitization compliance. Increased instruction, education, or access to hygiene equipment should be investigated as avenues to improve future compliance.

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**KEYWORDS:**

EMS; hand hygiene; hand sanitization; hand washing; nosocomial infection; paramedic

PMID: 24680100 DOI: 10.1016/j.jemermed.2013.08.070

J Emerg Med. 2014 Aug;47(2):163-8. doi: 10.1016/j.jemermed.2013.08.070. Epub 2014 Mar 27.

Compliance with recommendations for universal precautions among prehospital providers.

Eustis TC1, Wright SW, Wrenn KD, Fowle EJ, Slovis CM.

Author information

Abstract

**STUDY OBJECTIVE:**

To evaluate the compliance of emergency medical responders with local employer and Centers for Disease Control and Prevention recommendations for disposal of sharps and use of personal protective equipment in the prehospital environment.

**DESIGN:**

Prospective, single-blinded observational study of 297 ambulance runs conducted for 3 months.

**SETTING:**

A metropolitan emergency medical service system.

**PARTICIPANTS:**

Sixty-nine emergency medical technicians and paramedics.

**INTERVENTIONS:**

None.

**RESULTS:**

Observers recorded the handling of sharps and the use of personal protective equipment in four situations: i.v. line placement, endotracheal intubation, large-wound management, and body fluid hazard. Emergency medical workers properly handled sharps in 24 of 65 situations (37%). They were usually compliant with glove use during the observed procedures. However, compliance with the use of other personal protective equipment was poor.

**CONCLUSION:**

Sharps were often improperly handled. Most workers complied with recommendations for the use of gloves but often underused goggles, masks, and gowns. Although education and restructuring of the environment and equipment may improve compliance, strong consideration should be given to developing standardized and more practical recommendations for the prehospital environment.

PMID: 7710158

Ann Emerg Med. 1995 Apr;25(4):512-5.

[Hygiene status of ambulances and equipment in rescue services].

[Article in German]

Kober P1, Labes H, Möller H, Hülse C, Kramer A.

Author information

Abstract

**PURPOSE:**

Focus on hygienic management in ambulances is presented based on findings from hygienic microbiological sampling.

**METHODS:**

In 44 ambulances, the handwashing area, equipment for artificial respiration, insufflation, intubation, aspiration, intravascular catheterisation, blood-pressure measurement, and sterile materials storage were examined hygienically and microbiologically using the following methods: water sampling, imprint technique, and swab technique with subsequent cultivation on blood-, endo-, and Sabouraud agar.

**RESULTS:**

*The highest contamination was found in the hand-washing area and on insufflation equipment (up to > or = 100,000 cfu/ml), where proof of the potential pathogens Pseudomonas, Acinetobacter, and Alcaligenes spp. was found. The second highest contamination level was found on the sphygmomanometer cuffs, stethoscopes, and respirator masks (e.g., Enterococci and S. aureus were identified). Apparently, the germs chiefly originate from the drinking water at the handwashing station, from the environment and mucous membranes from the skin, and intestines of the ambulance personnel. The predominant hygienic deficiencies were found in the equipment of the handwashing areas, and in the storage of resuscitation equipment and sterile materials.*

**CONCLUSIONS:**

Based on the results of hygienic microbiological analysis, the main focus of hygienic measures--besides hand disinfection--should be on spray disinfection of the sphygmomanometer cuffs and stethoscopes as well as disinfection of ambulance equipment and storage areas for sterile devices, supplemented by dust protection of ready-to-use materials and devices. Stationary dispensers for hand disinfection possessing at least midlength levers must become the standard in ambulances, and conventional handwashing basins with plastic drinking-water containers and pump must be eliminated entirely.

PMID: 11227305 DOI: 10.1055/s-2001-10237

Anesthesiol Intensivmed Notfallmed Schmerzther. 2001 Jan;36(1):25-30.

EMS provider compliance with infection control recommendations is suboptimal.

Bledsoe BE, Sweeney RJ, Berkeley RP, Cole KT, Forred WJ, Johnson LD.

Abstract

**INTRODUCTION:**

Standard precautions are disease transmission prevention strategies recommended by both the World Health Organization (WHO) and by the Centers for Disease Control and Prevention (CDC). Emergency medical services (EMS) personnel are expected to utilize standard precautions.

**METHODS:**

This was a prospective observational study of the use of standard precautions by EMS providers arriving at a large urban emergency department (ED). Research assistants (RAs) observed EMS crews throughout their arrival and delivery of patients and recorded data related to the use of gloves, hand hygiene, and equipment disinfection.

**RESULTS:**

*A total of 423 EMS deliveries were observed, allowing for observation of 899 EMS providers. Only 512 (56.9%) EMS providers arrived wearing gloves. Hand washing was observed in 250 (27.8%) of providers. Reusable equipment disinfection was noted in only 31.6% of opportunities. The most commonly disinfected item was the stretcher (55%).*

**CONCLUSION:**

EMS provider compliance with standard precautions and equipment disinfection recommendations is suboptimal. Strategies must be developed to improve EMS provider compliance with internationally recognized infection control guidelines. Key words: Emergency medical services, hand washing, hygiene, disinfection, disease prevention.

PMID: 24401023 DOI: 10.3109/10903127.2013.851311

Prehosp Emerg Care. 2014 Apr-Jun;18(2):290-4. doi: 10.3109/10903127.2013.851311. Epub 2014 Jan 8.

An assessment of the prevalence of pathogenic microorganisms in the rotor wing air ambulance: one program's findings.

Galtelli M1, Deschamp C, Rogers J.

Author information

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