Risk of Environmental Exposure to Methicillin Resistant *Staphylococcus aureus* in Healthcare Programs

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ABSTRACT

The opportunity for disease transmission increases with potential pathogen exposure. Environmental exposure provides an avenue for not only active infection, but also for bacterial colonization. Of the various bacteria that exhibit regular colonization in humans, methicillin resistant *Staphylococcus aureus* (MRSA) is of particular interest in healthcare. To determine the potential for MRSA transmission from public restrooms we cultured 72 sites within nine buildings on the University of Alaska Anchorage (UAA) campus. *Staphylococcus aureus* was isolated in six of the nine buildings but was not significant for exposure risk (p= 0.07). However, MRSA was isolated in the Health Science Building and was determined to be an independent risk factor for pathogen transmission ($p < 0.05$). The discovery of MRSA in a building dedicated to health care professional education and absent from all other public restrooms on the UAA campus suggests a subpopulation of colonized students and faculty. Because students and faculty in healthcare-related programs have close proximity to patients, a screening process for MRSA carrier status should be implemented to determine potential transmission risk during clinical rotations.

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INTRODUCTION

The opportunity of disease transmission increases with potential pathogen exposure especially in public facilities, such as restrooms, which are not sterile sites.

Bacteria are known to survive for several weeks on bathroom surfaces and often originate from our skin.[1] Microorganisms found in restrooms therefore represent not only the cleanliness of the facility, but also the user population microbiome.

Because microorganisms exist in our environment good hygiene dictates that we control the impact bacteria has on our health, however some facilities may place individuals at greater risk.

To determine potential environmental microbial exposure and risk for pathogenic transfer, we conducted a systematic evaluation of public access restrooms on the University of Alaska Anchorage (UAA) campus.

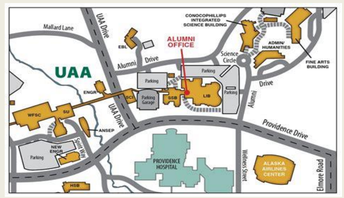

Image 1. Map of UAA campus

SAMPLE COLLECTION METHOD

Same day microbial culture samples were collected from male and female restrooms on the first floor of each building.

Four discrete sites were targeted for culture: faucet handle, interior door handle, interior stall lock and toilet handle. Flocked swabs were rolled over a 2x2inch area and placed in liquid transport media.

Nine buildings were surveyed:
Health Sciences Building (HSB), Edward & Cathryn Rasmuson Hall (RH), Natural Sciences Building (NSB), Administrative/Humanities Building (ADM), ConocoPhillips Integrated Science Building (CPISB), Social Sciences Building (SSB), Engineering and Computation Building (ECB), Eugene Short Hall (ESH), and Student Union (SU).

CULTURE AND IDENTIFICATION

Sample transport vials were vortex for 5 seconds. Direct plating of sample liquid was quantitatively inoculated onto Tryptic Soy Agar (TSA), chromID MRSA/SAID™ (Biomerieux) and Potato Dextrose Agar (PDA).

500 ul of tryptic soy broth was added to the sample vial as an enrichment culture and plated onto MacConkey/Sheep Blood Agar plates after 48 hours incubation.

Catalase positive, gram positive cocci isolated on all culture media were identified as *Staphylococcus aureus* by positive coagulase test using rabbit plasma (BD BBL™ Coagulase Plasma, Rabbit with EDTA). Coagulase negative bacteria were further identified as either Coagulase Negative *Staphylococcus* (CoNS) or *Micrococcus species* by colony morphology. All *Staphylococcus aureus* identified colonies were sub-cultured to MRSA/SAID™ plates. All positive chromagar MRSA isolates were verified for methicillin resistance using Alere™ PBP2a kit.

Gram negative lactose non-fermenting bacteria were identified using Remel™ Rapid NF System and gram negative lactose fermenting bacteria were identified using MicroScan System™.

Gram positive bacilli (GPB) were identified by typical colony morphology and gram stain.

Fungal isolates were identified by lactophenol microscopic evaluation and colony morphology.

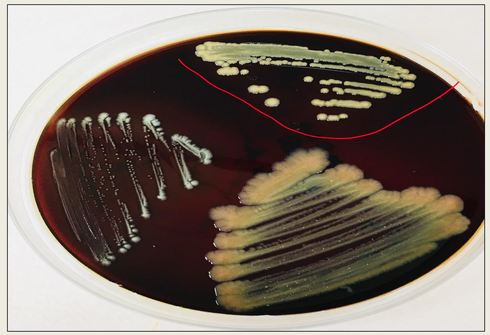

Image 2. Isolated bacteria. MRSA circled in red

RESULTS

In direct bacterial cultures *Staphylococcus aureus* was the predominate organism isolated with methicillin resistant *Staphylococcus aureus* having the highest concentration. Other organism isolated included CoNS, *Micrococcus*, *Corynebacterium*, *Pseudomonas*, and *Klebsiella* species. Fungal cultures isolated *Penicillium* and *Mucor* species. Enrichment broth isolated CoNS.

Bacterial growth was found to be evenly distributed between both male and female bathrooms with no statistical difference in gender or culture site. Statistical significance was found in culture positive buildings for *Staphylococcus aureus* and presence of MRSA.

	M/F	Culture site	Staph aureus
Bacterial growth	0.71	0.08	0.45 E-05
	Staph aureus	**MRSA**	**Other organisms**
Colony count	0.79	1.25 E-08	0.17
	Staph aureus	**MRSA**	
Building Health vs non-health	0.07	3.6 E -06	

Table 1. Linear regression analysis p values. Significance $p < 0.05$.

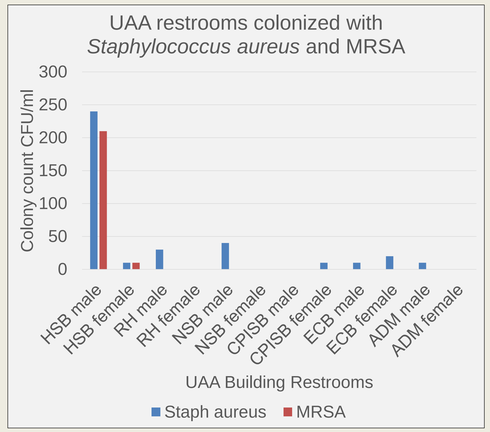

Chart 1. Comparison of bathrooms colonized with Staph aureus and MRSA

DISCUSSION

Studies of bacterial growth in public spaces identified similar organisms, including *Staphylococcus aureus* and MRSA.[2] Facilities, such as showers and whirlpools utilized by individuals with high risk of MRSA colonization, showed an increase of MRSA contamination.[3] Household presence of *Staphylococcus aureus* and MRSA has been related to colonization of its inhabitants.[4]

Staphylococcus aureus was cultured in a number of our UAA bathrooms, but it was not significant for concentration or building type. However, MRSA colonization was present only in the UAA Health Science Building where the majority of students and faculty are in the medical field, including students in hospital clinical rotations. If this represents the user population, individual colonization of MRSA found in the HSB restroom could be considered either community acquired or hospital acquired.[5,6] Studies following *Staphylococcus aureus* and MRSA in medical students found an increase in colonization after clinical rotations.[7] Our study suggests that individuals in health care education, whether student or faculty, could potentially have high rates of MRSA colonization. Incoming students to the health profession exposed to MRSA either by teaching faculty or clinical rotations places them at a higher risk for colonization

CONCLUSIONS

Healthcare workers are screened for *Mycobacterium tuberculosis* to reduce the potential spread of disease.[8] The same could be considered for MRSA, where the potential for transmission exists.[9] Increased MRSA colonization in the healthcare worker, including students in clinical rotations, has the potential to increase MRSA exposure to patients. Infection control measures, such as handwashing, prevent transfer of MRSA, yet compliance is often inadequate unless there is a measured outcome.[10] Knowledge of MRSA carriage in healthcare students could promote effective standard hygiene protocols, reducing potential of MRSA transfer during clinical rotations.

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