Copper Surfaces Reduce the Microbial Burden in an Out-Patient Infectious Disease Practice

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Abstract

Background: Copper alloy (Cu) surfaces are known to kill bacteria and decrease the environmental microbial bio-burden (MB) in ICUs. Out-patients share risk factors including co-morbidities, antibiotic exposure plus recent hospitalization. The transient and high volume of potentially infectious and vulnerable subjects renders the out-patient clinic a significant locus of transmission that is often overlooked. This study shows the benefit of Cu surfaces for their ability to reduce the MB in an Infectious Disease (ID) out-patient practice (OPP).

Methods: The environmental MB was characterized from 3 therapy chairs in an ID OPP comparing twice weekly MB assessments between standard chairs and those fitted out with Cu. Cu was applied to the side tray and the chair arm tops but not its sides. MB was taken from the surfaces of the chair arms utilizing a pre-moistened sterile rayon/polyester wipe. Samples were sent within 12 hrs in cooled insulated packages and processed within 30 hrs of collection. Quantitative microbiological assessment was conducted using various selective and differential media.

Results: Data from the first 3 weeks of a 9 week study were available for analysis. Average MB per 100 cm2 on the Cu arm-top was reduced from 3668 to 364 (p= 0.01). The side tray demonstrated a similar reduction in MB from 1973 to 79 (p<0.01). The MB on the arm-sides, where no Cu was applied, was reduced from 2400 to 1028 (p = 0.06). A statistically significant reduction (Krushak-Wallis Test for two groups) of staphylococci on the arm- sides from 2080 to 394 (p= 0.02) suggested a halo effect from the Cu extending to adjacent surfaces.

Conclusions: Cu reduced the overall MB on the objects covered in Cu. Additionally, the antimicrobial effects of Cu reduced the MB on the adjacent non-Cu surfaces. Cu surfaces may decrease the transfer of pathogenic bacteria in the OPP.

Introduction

Nosocomial acquisition of organisms and subsequent development of a healthcare-acquired infection continues to challenge healthcare facilities.

Organisms are capable of surviving on inanimate surfaces for extended periods in the patients' environment; however the roles of neither the environment for transmission of microbes in the outpatient setting, nor the effectiveness of measures to reduce the MB in the patient care environment have been adequately described.

Objective

We conducted a pilot study to assess the ability of copper to reduce the MB associated with objects in an out-patient care environment.

Methods

Study Site

Samples were obtained from phlebotomy chairs located in the out-patient practice of the Division of Infectious Diseases North Shore-Long Island Jewish Health System for a period of 15 weeks. A total of 446 patients used the study chairs. Approximately 2/3 of out-patients were HIV+; the remainder were general infectious disease patients. Chairs were wiped down at the end of each working day with a cleanser wipe (*PDI Sani-Cloth HB Germicidal Disposable Wipes™*). There was no alteration to the environmental protocol over the course of the study. All environmental cultures were performed by a single individual (RN.) This study was approved by the Institutional Review Board of North Shore-Long Island Jewish Health System.

Phlebotomy Chairs

The wooden arms and plastic tray on two of the three phlebotomy chairs used in the study site were refitted using copper alloys. Solid, copper alloy sheet metal (90% copper, 10% nickel) was inlayed across the arm tops while the sides were unchanged. The trays were fabricated entirely from the same copper alloy. The copper alloy used was one of those identified and registered with the US-EPA as having antimicrobial properties.

Sampling Methodology

Three surfaces from three phlebotomy chairs located at the study site were cultured twice each week for a period of 15 weeks. Wearing a sterile glove, a 4 cm x 25 cm sterile template was placed over the appropriately shaped surface. Applying even pressure for each stroke, the surfaces were wiped with pre-moistened sterile rayon/polyester wipes in a vigorous side to side motion using five strokes both ways (ten total). The samples were sent within 12 hours in cooled, insulated packages for processing. Viable bacteria were liberated from each wipe by adding three mL of sterile PBS/LT to a tube containing a wipe where upon the tube was vortexed at high speed for 1 minute. Each sample was allowed to settle for 5 minutes at which time the sample and various dilutions, as necessary, were plated (100 µl) onto: TSA+ sheep blood plates (for Total Microbes), Mannitol Salt Agar (for Total Staphylococci), MacConkey Agar (for Total Gram negative), ChromAgar (BD) MRSA (MRSA), Bile Esculin Azide + vancomycin Agar (VRE). Plates were incubated inverted, between 35° - 37° C for 24 to 48 hours and colony counts were performed.

Calculations and Statistical Analysis

The MB associated with each object (copper and non-copper) was determined as colony forming units (cfu) per 100cm2.

The efficacy of copper was calculated as the difference in median MB between the copper and non-copper objects associated with the chairs in the phlebotomy center. The Kruskall-Wallis Test was used to compare median burden values. (EpiInfo, CDC, Atlanta GA). A P-value of <0.05 was considered to be statistically significant.

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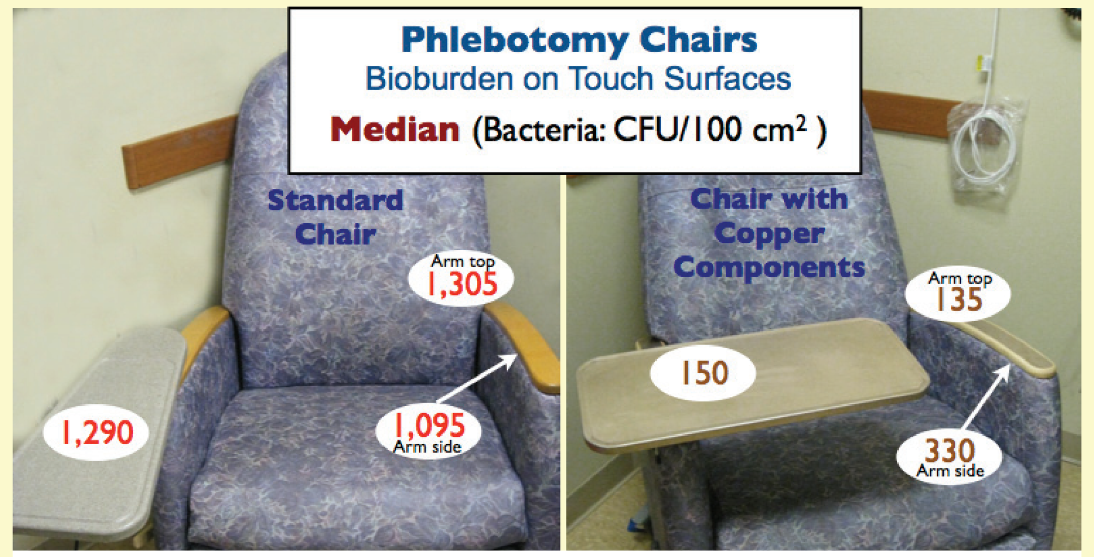
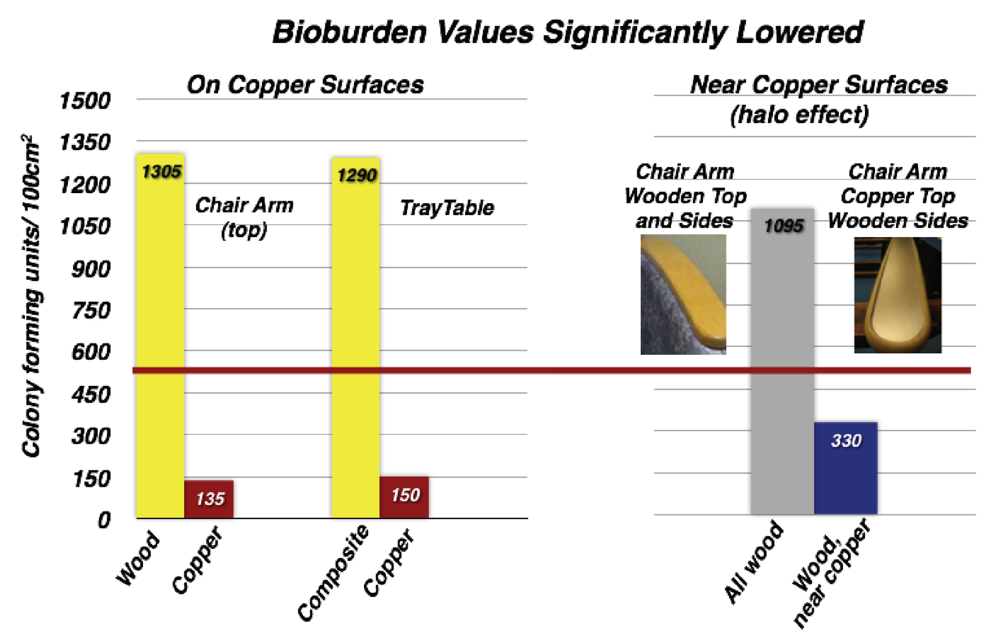


Copper Significantly lowered the Median Bioburden Values Observed

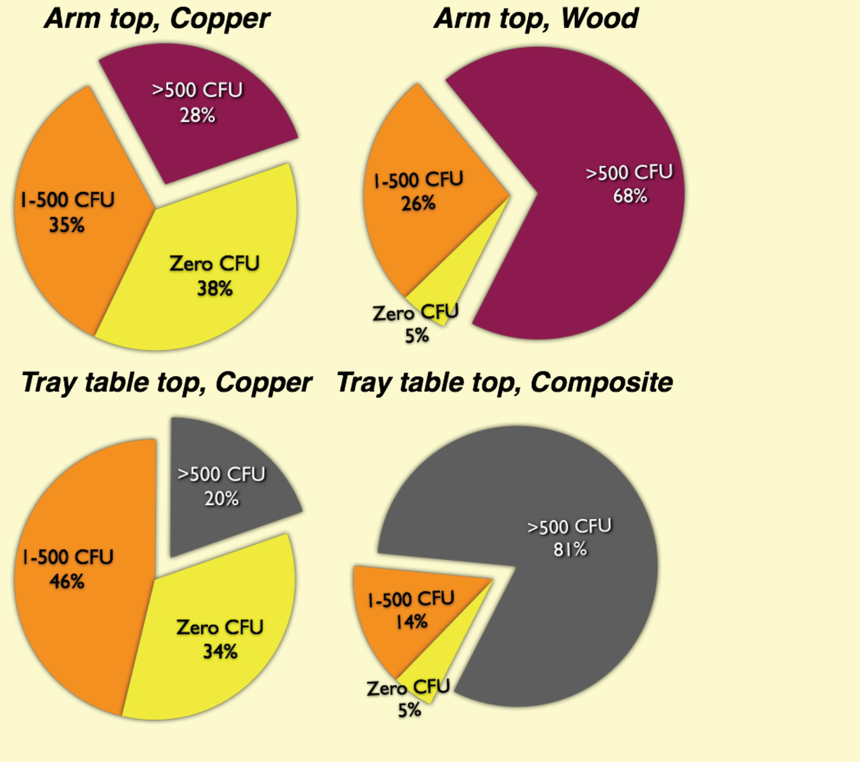
Median	Arm Top (wood)	Arm Top (copper)	TrayTop (composite)	TrayTop (copper)
Total Bacteria (CFU/100cm²)	1,305	135	1,290	150
Percent reduction	-90%		-88%	
Staph (CFU/100cm²)	480	30	390	60
Percent reduction	-94%		-85%	

Bioburden Also Significantly Reduced on areas Near Copper

Median	Arm Top (All wood)	Arm Top (Wood, near copper)
Total Bacteria (CFU/100cm²)	1,095	330
Percent reduction	-70%	
Staph (CFU/100cm²)	795	270
Percent reduction	-66%	



Percent Samples Greater than 500 CFU/100cm²



CFU/100cm²

Results

1. Copper significantly lowered the microbial burden found on the trays and arm surfaces. The median reduction for total bacteria found on the common touch surface of the trays was 88% (p< 0.0000) while that found on the top of the chairs' arms was 90% (p< 0.0001). Such a significant and consistent reduction approached the microbiocidal activities observed under ideal laboratory conditions where rates > 99.9% are the norm for claims asserting microbiocidal activity.
2. The majority of the microorganisms identified were Staphylococci (mannitol,±); the remaining unidentified microbes grew well on TSA Blood Agar at 37° C; MRSA and VRE were not recovered during the study.
3. The majority of the samples from the chairs with copper components were below a level thought to represent a risk to the patient (500 CFU/ cm²)[1-2] while the majority of the samples collected from the non-copper chairs were above this level (red line on the graph in the figure to left).
4. The microbiocidal properties of copper were able to confer an '*antimicrobial halo'* within the general vicinity of the arm top in that the microbial burden associated with the wooden side arms of the copper covered chair arms was significantly *lower*, 70%, than the control.
5. Given that the environmental microbial burden is a component of the risk associated with clinical care, median burden data were normalized based on the number of patients using the respective standard phlebotomy chairs (n=156 patients), against the median microbial burden data observed from the chairs outfitted with copper trays and arms for the study period (n=281patients). The calculated ratio of patients to the median burden enabled us to conclude use of the chair with the copper arm tops resulted in a *17-fold LOWER RISK* of exposure to environmental microbes than when patients used the standard chair. Similarly, the patients & health care workers who used the chairs with copper trays were predisposed to a *15-fold LOWER RISK* than the patients using chairs with composite trays. Whether or not the use of antimicrobial copper translates into better outcomes requires further study.

Conclusions

- The surfaces of regularly cleaned chairs within the phlebotomy area serve as a reservoir for the spread of bacteria, particularly staphylococci, to patients, healthcare workers, and visitors.
- Patient acquisition of organisms associated with the surface may lead to healthcare-acquired infections resulting in substantial morbidity and mortality.
- The continuous microbiocidal activity of copper was apparent and effective in significantly reducing the total median burden by 90% on the top surface of the arms and by 88% on the trays associated with the chairs.
- Indications are that copper surfaces can impart a '*microbiocidal halo*' effect that reduces the relative microbial burden on adjacent, non-copper, touch surfaces.
- Further study regarding the effectiveness of the microbiocidal activity of copper objects within high use out-patient environments is warranted in order to assess the ability of copper to reduce the acquisition of epidemiologically important organisms and healthcare-acquired infections.

References

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