A Pilot Study to Determine the Effectiveness of Copper in Reducing the Microbial Burden (MB) of Objects in Rooms of Intensive Care Unit (ICU) Patients

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Abstract

Background: The roles of the neither the environment for transmission of microbes in hospitals, 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 the patient care environment.
Methods: Copperized (Cu) objects (bed rails (99.99% Cu alloy), tray tables (90% Cu alloy), chair arms (90% Cu alloy), call buttons (70-95% Cu alloy), monitors (90% Cu alloy), and IV poles (75-95% Cu alloy)) were placed into three randomly selected ICU rooms. These objects were sampled by the sterile wipe technique weekly for 9 weeks from 7/27/09-9/28/09 and the MB for each object and each room (sum of MB of all objects) determined as colony forming units (cfu)/100cm2. The mean (m) MB associated with each room and each Cu object was compared to the mMB measured by sampling the same non-copperized (non-Cu) objects in three randomly selected control ICU rooms. The efficacy of copper was calculated as the difference in mMB between the Cu and non-Cu objects and rooms. Environmental cleaning regimens did not change over the study period. The Kruskall-Wallis Test was used to compare means.
Results: 282 Cu objects in 32 rooms and 288 non-Cu objects in 27 rooms were sampled. Copper was effective in significantly reducing the total mMB of the patient ICU room by 87.4% (mMB 26,927 cfu/100cm2 in non-Cu rooms vs. 3,391cfu/100cm2 in Cu rooms, p=0.003). Copper was also effective in reducing the mMB on 4 of the 6 objects (bed rails by 99% mMB 18,417 cfu/100cm2 vs. 240 cfu/100cm2, p=0.0003; chair arms by 38% mMB 3,164 cfu/100cm2 vs. 1,962 cfu/100cm2, p=0.11; call buttons by 90% mMB 4,548 cfu/100cm2 vs. 463 cfu/100cm2, p=0.003; and IV poles by 67% mMB 418 cfu/100cm2 vs. 139 cfu/100cm2, p=0.11). Copper showed no reduction in the mMB on tray tables (mMB 323 cfu/100cm2 vs. 509 cfu/100cm2) or monitors (mMB 57 cfu/100cm2 vs. 78 cfu/100cm2). *Staphylococcus* was the predominant organism isolated from each individual object whether it was Cu or non-Cu and comprised 78.7% of the mMB of Cu rooms and 55.5% of non-Cu rooms. Of note, although MRSA and VRE were frequently isolated from non-Cu objects, they were never isolated from Cu objects.
Conclusions: Copper was effective in significantly reducing the total mMB by 87.4% in ICU patient care rooms and on many individual objects within those rooms. Significant reduction was seen when bed rails and call buttons were Cu and these items accounted for 85.3% of the total mMB of the non-Cu rooms. Further study regarding the effectiveness of placing Cu objects, particularly Cu bed rails and call buttons, into patient care environments in reducing the MB as well as acquisition of epidemiologically important organisms and healthcare acquired infections is needed.

Introduction

Nosocomial acquisition of organisms and subsequent development of nosocomial 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 the neither the environment for transmission of microbes in hospitals, 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 the patient care environment.

Methods

Study Center

The Medical University of South Carolina is a 660 bed academic facility with 17 MICU beds. The hospital is a referral center for all of South Carolina and offers treatment for all medical and surgical subspecialties including solid organ and bone marrow transplantation.

Sampling Method

Copper objects (bed rails, tray tables, chair arms, call buttons, monitors, & IV poles) were placed into 3 randomly selected MICU rooms and were sampled weekly for 9 weeks (7/27/09-9/28/09) [figure 1]. Similarly, these same non-copper objects were sampled in 3 other randomly selected control MICU rooms over the same time period.

A 10cm x 10cm area was vigorously wiped (side to side using 5 strokes) with a pre-moistened rayon/polyester sterile wipe. The wipe was placed in a sterile tube with 3ml of sterile PBS/LT. This was vortexed for 1 minute and allowed to settle for 5 minutes. The sample was plated onto TSA plus sheep blood agar (total microbes), mannitol salt agar (staphylococci), MacConkey agar (gram negatives), ChromAger MRSA (MRSA), and bile esculin azide plus vancomycin agar (VRE). Plates were incubated between 35°to 37℃ for 24 to 48 hours.

Calculations and Statistical Analysis

The MB associated with each object (copper and non-copper) was determined as colony forming units (cfu) per 100cm^2. The MB of each room (copper and non-copper) was calculated as the sum of the MB of the objects within that room.

The efficacy of copper was calculated as the difference in mean MB between the copper and non-copper objects and rooms. Environmental cleaning regimens did not change over the study period. The Kruskall-Wallis Test was used to compare means. (EpiInfo, CDC, Atlanta GA). A P-value of $\leq$0.05 was considered to be statistically significant.

Figure 1. Schematic of Objects in Patient ICU Room

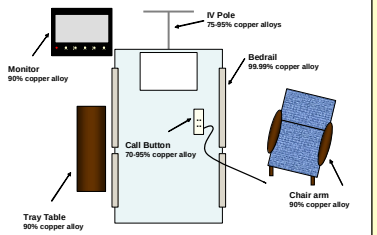


Figure 2. Mean Microbial Burden of Objects in MICU Control Rooms

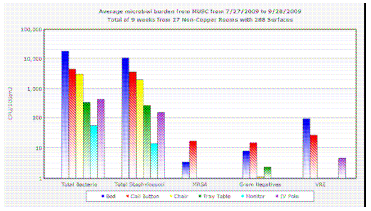
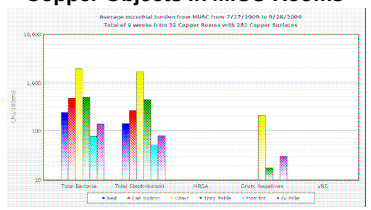


Figure 3. Mean Microbial Burden of Copper Objects in MICU Rooms



Results

- 282 copper objects in 32 rooms and 288 non-copper objects in 27 rooms were sampled
- Copper was effective in significantly reducing the total mean MB of the patient ICU room by 87.4% (mean MB 26,927 cfu/100cm2 in non-copper rooms vs. 3,391cfu/100cm2 in copper rooms, p=0.003) [figures 2 and 3]
- Copper was also effective in reducing the mean MB on 4 of the 6 objects
  - Bed rails by 99%, mean MB 18,417 cfu/100cm2 vs. 240 cfu/100cm2, p=0.0003
  - Chair arms by 38%, mean MB 3,164 cfu/100cm2 vs. 1,962 cfu/100cm2, p=0.11
  - Call buttons by 90%, mean MB 4,548 cfu/100cm2 vs. 463 cfu/100cm2, p=0.003
  - IV poles by 67%, mMB 418 cfu/100cm2 vs. 139 cfu/100cm2, p=0.11
- Copper showed no reduction in the mean MB on tray tables (mean MB 323 cfu/100cm2 vs. 509 cfu/100cm2) or monitors (mean MB 57 cfu/100cm2 vs. 78 cfu/100cm2)
- *Staphylococcus* was the predominant organism isolated from each individual object whether it was copper or non-copper and comprised 78.7% of the mean MB of copper rooms and 55.5% of non-copper rooms
- Of note, although MRSA and VRE were frequently isolated from non-copper objects, they were never isolated from copper objects over the study period

Conclusions

- Objects found in ICU rooms can serve as a reservoir for the spread of bacteria, particularly staphylococci, to patients, healthcare workers, and visitors.
- Patient acquisition of organisms that we recovered from ICU rooms may lead to healthcare-acquired infections resulting in substantial morbidity and mortality.
- The continuous antimicrobial activity of copper was apparent and effective in significantly reducing the total mean MB by 87.4% in ICU patient care rooms as well on many individual objects within those rooms. Significant reduction was seen when bed rails and call buttons were copper and these items accounted for 85.3% of the total mean MB of the non-copper rooms.
- Further study regarding the effectiveness of placing copper objects, particularly copper bed rails and call buttons, into patient care environments in reducing the MB as well as acquisition of epidemiologically important organisms and healthcare acquired infections is needed.

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