



Effectiveness of copper contact surfaces in reducing the microbial burden (MB) in the intensive care unit (ICU) of hospital del Cobre, Calama, Chile.

V. Prado¹, C. Durán¹, M. Cresto², A. Gutierrez², P. Sapiain², G. Flores², H. Fabres², C. Tardito³, M. Schmidt⁴

¹Faculty of Medicine, University of Chile, Santiago, Chile, ²Hospital del Cobre de Calama, Calama, Chile, ³CODELCO Chile, ⁴Medical University of South Carolina, Charleston, SC, USA.

BACKGROUND

Nosocomial infections are associated with increased morbidity, mortality and costs of medical care. In Chilean patients the most common nosocomial pathogens are *S.aureus*, *P.aeruginosa* and *A.baumannii*. The incidence rate of hospital-acquired pneumonia is 4-9 per 1000 ventilator days, and nosocomial urinary tract infections range between 5-6 per 1000 catheter days. In Chile 70,000 nosocomial infections are reported every year, being responsible for an average of 10 additional days of hospitalization resulting in between 2 to 4 times higher usage of antimicrobials. The environment serves a role as reservoir and vehicle for transmission of microbes in hospital settings. In vitro studies have demonstrated the microbicidal activity of copper (Cu). This study evaluated whether or not the continuous antimicrobial properties of copper were sufficient to reduce the microbial burden (MB) associated with commonly contacted surfaces within the hospital setting.

HYPOTHESIS: The introduction of copper touch surfaces in the hospital environment will reduce the levels of potential harmful microbes that could be transmitted to patients and/or healthcare workers.

OBJECTIVE: To assess the effect of copper and its alloys to reduce the total microbial burden associated with critical touch surfaces within ICU rooms at Hospital del Cobre de Calama, located in a semi-desert area in the north of Chile.

METHODS

- Selected copperized (Cu) surfaces (bed rails, bed lever, tray tables, chair arms, touch screen monitor pen, and IV poles) were placed into 3 randomly selected ICU rooms.
- Three paired rooms were compared by measuring the MB for a period of 30 weeks.
- The mean microbial burden (mMB) for each copper object, determined as colony forming units (cfu)/100cm² was compared to the values obtained from equivalent un-copperized objects from the control, non-copper rooms.
- Antimicrobial efficacy of copper was calculated as the difference in mMB between the copper and non-copper objects.
- The environmental cleaning procedures were equivalent for copper and non-copper rooms during the study period.
- Protocol was reviewed and approved by the Ethics Committee of Faculty of Medicine, University of Chile
- The Kruskal-Wallis test for two groups was used to determine statistical significance (XLSTAT).

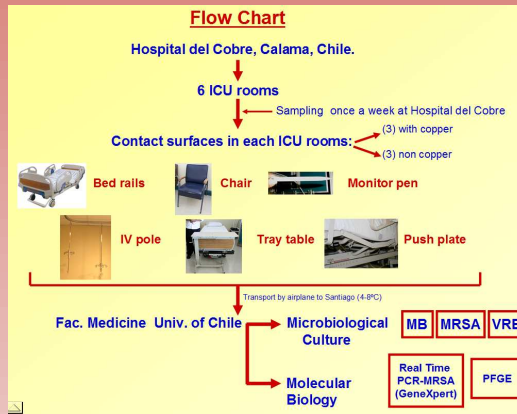


Fig. 1 Sampling chair contact surface



Fig. 2 ICU room with copperized surfaces

RESULTS

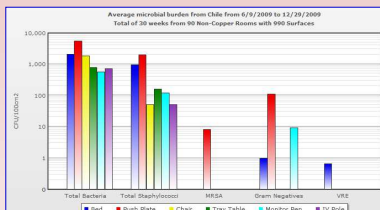


Fig. 3. During 30 weeks of study in rooms without copper objects the average of total MB was approximately 2000cfu/100cm²; majority of the microbes recovered were *Staphylococcus spp*; pathogens such as MRSA and VRE were present at lower concentrations as was the concentration of Gram negative microbes.

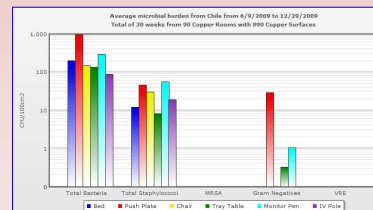


Fig. 4. During the same 30 week period in the rooms with equivalent copper objects the average total MB was approximately 300 cfu/100cm²; MRSA and VRE were not recovered from any of the copper objects.

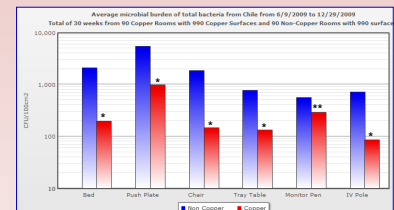


Fig. 5. Copper significantly and substantially reduced the average MB for all of the selected contact surfaces in all cases. *p <0.0001 **p= 0.006

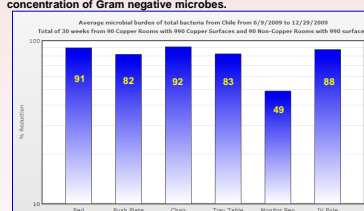


Fig. 6. The percentage with which copper surfaces reduced the total MB ranged between 49% - 92%.

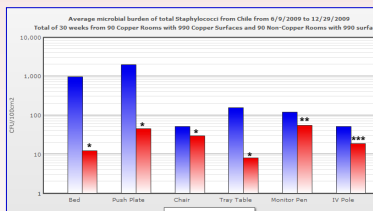


Fig. 7 Average of *Staphylococcus* burden (cfu/100cm²) in 990 copper surfaces was significantly lower than in 990 non copper surfaces in ICU rooms during the study period, in all cases. *p<0.0001; ** p 0.001; *** p 0.026

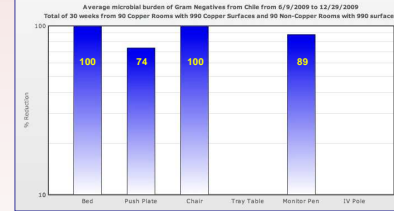


Fig. 8 Copper substantially reduced the inherent Gram negative burden (cfu/100cm²) on all of the objects. The absence of values for the IV pole and Tray Table surface are a consequence of failing to recover Gram negative microbes from the copper objects.

The mMB associated with 990 copper surfaces from 90 rooms containing 6 copper objects was compared against the mMB from an equivalent number of surfaces from 90 rooms containing an equivalent number of non-copper objects from an ICU with humidity levels ranging between 7.2 to 19.7%. Copper was effective in reducing mMB on all 6 surfaces tested (bed rails by 91%, bed lever by 82%, tray tables by 83%, chair arms by 83%, monitor pen by 49%, and IV poles by 88%). Average mMB count in rooms with copper objects (1,851cfu/100cm²) was significantly lower than in rooms without copper (11,620 cfu/100cm²) p<0.00001. *Staphylococci* were the most predominant microorganism isolated. Copper was equivalently effective and significant in reducing the staphylococcal burden associated with the objects, p<0.0001. MRSA and VRE were never isolated in copperized rooms. Gram negative microbes were infrequently isolated from some surfaces, and copper reduced the Gram negative burden between 74% - 100%.

Conclusions

The antimicrobial effects of copper on critical contact surfaces within ICU rooms was evident and significant in this hospital located in this arid region of Chile throughout the 30 week trial. The antimicrobial properties of copper were of a broad spectrum in that a reduction in the total microbial burden was seen for each class of microbe characterized in ICU rooms containing copper. The continuous antimicrobial activity of copper persisted throughout the study. Some variations in percentage of reduction in MB were observed and might be attributed to the proportion of copper present within the alloy covering the object or may be reflective of the frequency with which the object is handled. Further studies regarding the clinical implications of reducing the mMB by copper objects within the environment of hospitals is warranted.