Benefits of Copper Products in Prevention of HAIs

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Background

Hospital Acquired Infections (HAI) cost hospitals large amount of dollars per year.

- According to "Copper surfaces…" in America Journal of Infection Control, HAI's increase length of stay.

-To combat this cost, Sentara recently implemented the use of copper linen with intent to further utilize copper-infused products such as bedside tables and counter tops.

This project purpose is to assess the literature regarding the benefits of copper products on reducing HAI versus non-copper products in the acute care setting.

Methodology/Discussion

Steps: 1. Identify PICOT.
2. Literature review/research
3. Evaluate
4. Conclusion/recommendation

PICOT:

- P- Medical/Surgical, Surgical , ICU, Oncology
- I- Copper Products
- C- Non-copper Products
- O- Prevention of HAIs
- T- Duration of hospital stay

Methodology/Discussion Continued

Literature review was performed using scholarly databases and searching following keywords: copper, linens, surfaces, hospital, infections, HAI, non-copper, prevention.

Only peer reviewed articles published within last five years were included. A total of 5 articles met the search criteria.

Discussion:

Author/Year	Study Design/Purpose	Outcome Measurements	Results	Study Limitations	Implications
Michael G. Schmidt PhD, Bettina von Dessauer MD, Carmen Benavente MD, Donna Benadof MD, Paulina Cifuentes RN, Alicia Elguenta RN Claudia Duran MS, Maria S. Navarrete D, MPH 2016	Design: Level2 Quantitative survey 1012 patients from two high acuity care units in pediatric hospital for 12 months. 16 rooms were used, 8 of which were supplied with copper linens and 8 rooms were left with regular linens	The surfaces were bed rails, bed rail levers, IV poles, faucet handles, and the surface of the healthcare workstation were used to determine if copper infused linens would decrease bacterial concentrations in certain surfaces.	Results show that the antimicrobial copper on the bed rails decreased bacteria by 99%. Copper introduced to the rooms showed a suppression of the microbial burden from objects assessed in the controlled rooms.	Control items were brought into copper intervention areas (beds/cradles) due to surges in occupancy and clinical need, resulting in a 12% deviation in results over a 2-month period	Copper infused materials should be considered in facilities going to a no-touch disinfection technology to limit HAI's.
Jiaqi Luo, Christina Hein, Frank Mucklich, Marc Solioz 2017	Design: Level 5 Descriptive Study The purpose of this study was to determine how bacteria are decreased by contact killing and what the special antimicrobial properties of copper are as compared to other alloy metals (cadmium and silver)	Participants: Wet plating using 20 of washed, resuspended cells applied to coupons, incubated for0-9 hours in water-saturated atmosphere at room temperature. Repeated pipetting to resuspend bacteria clone in intervals.10 serially diluted with normal saline. After 24 hours of growth at 37 degrees Celsius, colony counted, and cell numbers calculated relative to the 20 samples.	Varying kill times were recorded due to variances in plating methods and media used. It was found that Cu2O (made via tarnishing) had most killing effect over 9hr compared to silver, cadmium (kills at 1/3 rate of copper), and stainless steel.	Non- growing bacterium were used, thus susceptible to toxic metal ions, inhibitory concentrations of silver can widely vary. Japanese testing protocol J1SZ2801 used, which favors ion oxidations and/ or ion release.	Copper kills bacteria better than silver or Cadmium. When used properly, copper can be beneficial in reducing HAI causing bacteria
Nanako Niiyama, Takeshi Sasahara, Hiroshi Mase, Michiko Abe, Haruo Saito, and Kensei Katsuoka 2013	Design: Level 3 Controlled trial without randomization Purpose to determine whether a bed sheet made of copper coated film will reduce the spread of MRSA contamination in the environment of a heavily colonized patient	Subject was a 47-year-old female with cutaneous malignant lymphoma, MRSA positive. Bed sheets, floor, over bed table, gloves, wash stand, mobile phone, and top panel of AC unit were examined to determine disinfectant performance of Copper film	Cell counts of MRSA and Staph on copper coated areas were "considerably" lower than non-coated areas. Trace amounts of P. aeruginosa was found on copper film. The bactericidal effect of copper was eliminated by mannitol, SOD, and catalase	Small sample size, no repeated trials. Other variables, such as administration of drugs LZD and DRPM were also used to combat the infection during the hospital stay	Copper infused linen may aide in reducing the amount of bacteria
A. Lazary, I. Weinberg, J.-J. Vatine, A. Jefidolff, R. Bardenstein, G. Borkow, N. Ohana 2014	Design: Level 4 Cohort Study Purpose: to determine effectiveness of copper linens in reducing HAIs in long term brain injury ward where ll pts confined to either a bed or wheelchair with the most common medical modality being infection.	There were two test periods divided into A (control) and B (copper linens used) groups within a 35-bed head injury ward, each 6 months long. Number of abx treatments, fever days, steroid treatments, inhalations and infections were collected	There was a 24% reduction in HAI events with copper linen use 23% decrease in events antibiotics used, 32% decrease in total days of antibiotics administered	6 month trial periods only, with only one ward being used (could use more similar wards and have a controlled study). Noted in study that antipyretic therapy used when fever detected in pt (98% of fevers did not last more than a day)	Copper oxide impregnated linens may help decrease HAI's, antibiotic use, and other infection related treatments.
C. Grobe, G. Schleuder, C. Schmole, D. Nies 2014	Design: Level 1 Systematic Review Purpose: To determine the survival of E. coli cells on solid copper surfaces	E. Coli cell survival counts in aerobic and anaerobic environments were determined based on a number of studies including: dose-response growth, time-dependent growth, gene deletion techniques, RNA isolation, DNA degradation	Under direct contact with copper alloys, 99.9% of E. coli strands could not be cultivated. Glutathione (naturally occurs in human body) increased E. coli survival on copper surfaces. E. coli in NaCl had prolonged survival on copper surfaces because copper fights with sodium for reuptake into cell	Experimental conditions of study would be difficult to reproduce in the hospital setting.	Copper, when in direct contact with E. Coli, can be helpful in killing said bacteria. Due to factors discussed in "results" copper may not be utilized effectively (NaCl use in hospitals and glutathione presence). The article also introduces the obstacle of evolution of bacteria to resist copper antimicrobial properties

Conclusion

- Based on the articles researched:
- Copper could be utilized when facilities consider going to a no-touch disinfection technology to lessen the microbial burden to limit HAI's.
- Of the bactericidal metals examined by these articles, Copper and Cadmium best 2/3 antibacterial metal alloys, silver being the third.
- Of the multiple chemical compounds, a specific ion of copper (Copper Oxide) was shown to be most effective in the healthcare setting. This ion thrives under specific conditions and maintenance procedures, some of which may be difficult to achieve in the hospital setting.

Recommendation

Based on the evidence found through research, we do not recommend Sentara further convert to these copper infused products due to limited sample size, inability to replicate specific conditions, and infantile stage of relevant research. There is currently only one study to support the use of copper linens.