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LETTERS TO THE EDITOR

Antimicrobial efficacy of copper touch surfaces in reducing environmental bioburden in a South African community healthcare facility

Madam,

The applied potential of copper's antimicrobial properties has recently been extended to reducing nosocomial and environmental bioburden on touch surfaces in healthcare facilities.[1] Laboratory-based studies have demonstrated the bactericidal activity of copper against food, nosocomial and communicable disease pathogens.[1–4] It was therefore proposed that in addition to the existing infection control armamentarium, the incorporation of copper surfaces could effectively reduce environmental contamination, thus rendering healthcare facility surfaces safer. A comparative controlled study was conducted at a busy walk-in primary healthcare clinic (PHC) in Grabouw, a rural region of the Western Cape, South Africa, to demonstrate antimicrobial efficacy of copper touch surfaces in reducing bioburden in a community healthcare facility.

Two similar consulting rooms were chosen next to each other in the same PHC. The study room was fitted with copper sheets (BS 2870, Alloy C101: 99.9% pure copper) on touch surfaces (desk and trolleys) which were in constant contact with staff and patients and surfaces (top of cupboard and windowsill) where contact was less frequent. The control room remained with its original surfaces (desk: varnished wood; trolleys: stainless steel; cupboard: wood; and windowsill: tiles). The room temperature at each sampling point, patient numbers and type of consultations were recorded. Separate buckets and new cloths (beginning of each sampling series) were allocated to each room and surfaces wiped with a cloth rinsed in warm water containing diluted dishwashing liquid at 07:00. No disinfectants were used in the environment. Residual micro-organisms present on the copper and control surfaces after cleaning did not exceed a 2-fold difference in total counts.

Sampling sites were allocated across five touch surfaces: two trolleys ($N = 4$), desk ($N = 4$), cupboard ($N = 1$), windowsill ($N = 3$), with an identical template for both rooms. Sampling was undertaken every six weeks by the same person. During each series, samples from both rooms were collected for four and a half days (clinic timings: Monday 08:00 to Friday 12:00). Samples were taken: (1) 07:00 (pre cleaning) to establish a baseline on day 1 and overnight bioburden on subsequent days; (2) 08:00 (post cleaning but pre consultation) to reflect bioburden following cleaning; and (3) 16:00 (post consultation). Each surface sampling site covered an area of 23.76 cm^2, equivalent to the size of the Compact Dry TC plate (HyServe, Uffing, Germany) used to conduct the total counts. Rediswab™ (3M, Minneapolis, MN, USA) containing 1 mL Letheen broth was used to take the sample. Data analysis was performed by M. Kidd, Department of Statistics, University of Stellenbosch, using repeat measures analysis of variance over time with a 5% significance level as guideline for determining significant differences. All analyses were performed using Statistica 8.0. Approval for the study was granted by the Ethics Committee of the University of Stellenbosch and the Western Cape Department of Health, Cape Town.

The number of consultations at the PHC during the six-month study period was evenly matched with an average of 65 study and 68 control room patients seen during every sampling series. The presumptive clinical diagnoses were also similar, from skin disease to respiratory illness. Room temperatures at each sampling point were comparable and ranged between 15 °C in winter to 33 °C in summer, with similar mean room temperatures of 21.05 °C in the study and 21 °C in the control room. An in vitro effect of temperature on the antimicrobial activity of copper has been reported.[1–4] It was suggested that moisture was required for copper to demonstrate antimicrobial activity and that in a dry climate activity would decline. The study period of six months was planned to cover winter, spring and summer to examine this effect. The climate and temperature

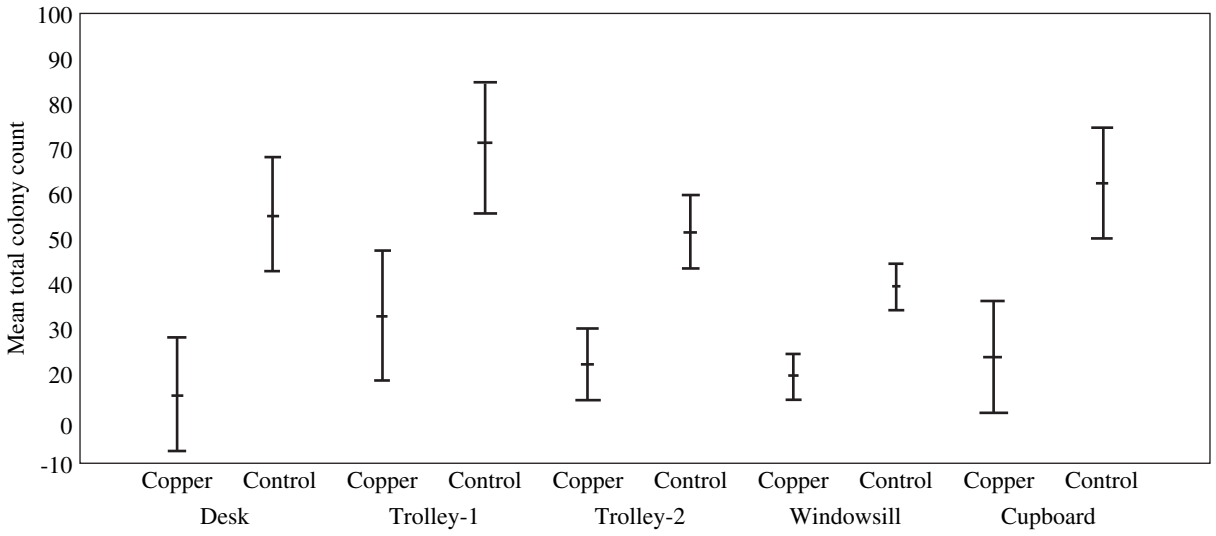

Figure 1 Mean total colony counts for copper and control touch surfaces.

had no significant effect on the antimicrobial activity of copper.

The overall mean total colony count was 5.9×10^4 cfu/dm^2 for copper compared with 2.0×10^5 cfu/dm^2 for control surfaces, which marked a 71% reduction. Significantly lower mean total colony counts ($P < 0.001$) for all copper surfaces were evident (Figure 1). Copper surfaces were seen to exhibit lower total counts than control surfaces during the working day and overnight, it was only over weekend periods (71 h) when the clinic was closed and microbial loading markedly reduced that persister survival was comparable.

In the clinical environment, surfaces would be contaminated with both pathogenic and non-pathogenic bacteria and fungi. The study showed that the antimicrobial activity of copper touch surfaces reduced environmental bioburden to a far greater extent than standard materials and would be beneficial in the healthcare environment. It must be stated that the importance of regular environmental cleaning programmes and good hand hygiene should not be abandoned in favour of copper surfaces. The encouraging beneficial antimicrobial effect of copper touch surfaces, and potential application for high patient–staff interaction and specimen areas in healthcare facilities, require further studies for microbiological assurances.

Conflict of interest statement
Support from the Copper Development Association Africa, but study methodology was developed, executed and controlled by the University of Stellenbosch.

Funding sources
Copper Development Association Africa.

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Response to: Griffith CJ, Dancer SJ. 'Hospital cleaning: problems with steam cleaning and microfibre'

Madam,

We read the recent Letter to the Editor from Griffith and Dancer with great interest, and agree that the logistics of steam cleaning continue to present challenges.[1] However, we believe that we have some solutions to the issues raised concerning the use of microfibre (MF).

We have previously reported on three novel copper-based biocides and demonstrated that ultramicrofibre (UMF) cloths impregnated with these at 150 mg/L will kill meticillin-resistant *Staphylococcus aureus*, *Acinetobacter calcoaceticus baumannii* and either the spores of *Clostridium difficile* or their emerging vegetative forms during a 16 h incubation at room temperature — a practical test of used UMF cloths stored overnight before laundering.[2]

We also reported the results of a hospital cleaning study using UMF mops and cloths either wetted with water or impregnated with the copper-based biocide CuWB50 at 300 mg/L in this Journal.[3] We showed that whereas UMF and water alone reduced median total viable (bacterial) counts (TVCs) by 31% between 1 h pre-cleaning and 1 h post-cleaning, with UMF and CuWB50 the reduction was 57% — a clearly significant difference ($P < 0.0001$). We also found evidence of what we believe to be a 'residual effect', whereby TVCs before the next cleaning cycle (23 h after cleaning) were significantly lower. We presume that this reflects residual biocidal activity on surfaces relating to the presence of CuWB50, and have further shown that this does not relate to CuWB50 carry-over onto the Rodac plates used to detect TVCs.[3]

The well-established efficacy of UMF at removing soil (and bacteria) from surfaces, combined with application of CuWB50 to surfaces seems therefore to create a cleaner, nutrient-poor, and hostile environment for bacterial survival and growth.[4–6] This would seem of particular benefit in view of some bacteria's ability to survive for extended periods of time in such an environment.[7]

In two subsequent hospital cleaning studies (manuscripts in preparation) we have confirmed the residual effect of CuWB50 on bacterial levels on surfaces, and also showed the cleaning efficacy of UMF as assessed by the 3 M Clean-Trace ATP assay, which was only modestly enhanced by the presence of CuWB50.

These studies defined and then refined the entire cleaning process to make it easier and less unpleasant and onerous to clean. First, UMF mops and cloths were provided already impregnated with CuWB50, saving time otherwise lost by filling or emptying buckets and wringing mops and cloths with unpleasant and malodorous chlorine-based solutions — something much appreciated by cleaning staff. Second, because UMF are damp rather than wet, the floors dry almost immediately and consequently pose less of a risk for slipping to staff, patients and visitors. Third, the individual mops when used correctly will clean a larger area than the standard wet loop mop, which also requires wringing.

The hospital cleaning study at UCLH also investigated the essential elements of cost-effectiveness and acceptability with CuWB50-impregnated UMF with structured cleaning staff interviews. Staff preferred UMF, as they only had to use a single mop or cloth once per bed-space, with no wringing and rinsing (unpublished data). They argued that following infection control training, the awareness of the potential for contamination and transmission was raised and that UMF offered greater assurance. Tasks such as high dusting and glass cleaning were easier and produced a better finish with UMF. Cleaning staff and their managers concluded that once UMF systems were embedded and functioning well they saved time; but this was at the cost of a learning period.

Finally, Griffith and Dancer mention the incompatibility of MF with chlorine-based disinfectants. Although this seems an accepted fact and acknowledged by most producers of MF products, we have been unable to find any published evidence relating to this. Accordingly, we contracted independent studies comparing the effects on UMF cloths of Chlor-Clean, a widely used sodium dichloroisocyanurate-containing disinfectant, and CuWB50. UMF cloths (Ecolab UK Ltd, Swindon, UK) were soaked at room temperature in working