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Reply to Abbas et al. "Infection prevention: Is copper the new gold?"

Sir,

I am grateful for the opportunity to respond to the letter by Abbas et al. *Infection Prevention: Is copper the new gold?* [1] concerning my original paper [2].

First, Abbas et al. [1] comment that they are surprised to see a single author reporting a multi-centre study. In fact, the Acknowledgement section of the paper thanks the entire Sentara Healthcare Infection Prevention Team for their contribution to the study. However, preparation of the manuscript was solely this author's responsibility.

Second, it is my opinion that Abbas et al. have taken out of context the single term 'partnered' from a Sentara Healthcare 2016 press release [3] to imply a lack of disclosure. The term 'partnered' was used in the press release to describe a commercial relationship between Sentara Healthcare and a vendor company Cupron. To avoid any doubt, this author and Sentara Healthcare have no disclosures of interest.

Some of the other points raised by Abbas et al. are already addressed in the original paper [2], but this letter can provide some further clarification. The reason why this study did not include all 12 Sentara Healthcare facilities was purely that the study was focused on a subset of the hospitals that were geographically co-located, had similar patient populations, and most importantly implemented the intervention at the same time-point. As such, the inference that the selection of units was inappropriate or biased is refuted. It is agreed that longer time periods for almost any study are better, but pragmatically studies have to be performed over a defined time period. The timeframes chosen for analysis in the study were from the date of deployment of the intervention to the end of the calendar year, and the same period in the preceding year; these times were chosen to minimize seasonal impacts and any impacts of NHSN definition changes. The choice of outcomes was also based upon the National Healthcare Safety Network standardized reporting, [4] which at this time does not include susceptible organism reporting.

The additional IPC measures that Abbas et al. were unclear about, including an educational effort, were all executed as referenced in the paper at the same time as the intervention. Further the hand hygiene figures disclosed in the paper and questioned by Abbas et al. did not form part of the main study, and were provided to the reader to simply demonstrate that no

changes in hand hygiene during the study period would contribute to the results.

Abbas et al. also suggested that other interventions during the trial may not have been disclosed. Whilst it is correct that Sentara Healthcare system did decide to deploy both the Cupron Medical linens and Cupron Enhanced EOS Surfaces, this study was of the Medical Textile products only and was performed prior to the deployment of any of the hard surface biocidal composite surfaces.

The terminology for patient mix, as questioned by Abbas et al., is widely used and adopted in the US; the Case Mix Index, an indicator of patient wellness, is a relative value assigned to a diagnosis-related group (DRG/MSDRG) of patients in a medical care environment. As much infection data by microorganism type as were available under the NHSN reporting guidelines were included in the Results section. Demographic and infection type data were not available, because this information does not form part of the standardized US healthcare NHSN definitions.

Abbas and colleagues also request the economic data of the copper linens, however the economic analysis of this intervention cannot be presented as the linens are owned, supplied and cleaned by an independent laundry. The price of the contract for the linen supplied to the building cannot be separated from additional linens including healthcare worker apparel, cleaning textiles and other textiles. Therefore the economic pricing for a comparison to the cost of the infection is not available, and cost-effectiveness was not assessed in this study; the author recognizes that future trials should include a robust cost—effect analysis.

Abbas et al. were disappointed with the before-after design. However, the practical realities of deploying an intervention across multiple facilities in a healthcare system without interrupting patient flow meant that this trial design was the most pragmatic. For statistical analysis the primary comparison of interest in the manuscript was the 240 day analysis comparing infection rates over the 240 days to the infection rates during the same calendar months from the previous year. The alpha of 0.05 was applied to the analysis of the 240 day data. If the 240 day analysis was significant then the 90 day and 180 day subsets were also analyzed. As such, no adjustment was made for multiple testing since the subsets were analyzed after determining significance on the 240 day data. Whilst alternative analytical models could have been used, it is contended that the method used in the study was robust.

Whilst the interest of Abbas et al. in the research is appreciated, this author, whilst acknowledging the practical limitations of studies of this kind, considers that Sentara Healthcare's experience of implementing medical linens in an effort to deliver the best patient care and safety, delivered valid findings that are worthy of reporting.

Conflict of interest statement
None declared.

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The unknown role of disinfectant-detergents for failure of effective endoscope reprocessing

Sir,

Bourigault *et al.* recently reported an outbreak of carbapenemase-producing *Klebsiella pneumoniae* (OXA-48) via duodenoscopes in France [1]. Several possible explanations for persistence of the pathogen and its transmission were discussed, such as the possible viable but non-culturable state of the pathogen, a delay between the endoscopic procedure and the detection of *K. pneumoniae* carriage, the partially complex design of the endoscope, and the partial non-compliance with the manufacturer's reprocessing protocol during reprocessing. I would like to add another aspect which may be relevant in this context. In 2004, the French Ministry for Health published a guideline for manual reprocessing of medical devices including flexible endoscopes [2]. This guideline recommends a first cleaning of at least 10 min, followed by a rinse and a second cleaning for another 5 min. Recommended cleaning solutions include detergents and disinfectant-detergents without aldehydes. Based on the latest positive list for disinfectants published by the French Society for Hospital Hygiene in 2009, disinfectant-detergents are often based on quaternary ammonium compounds such as benzalkonium chloride (BAC) [3]. It may well be that disinfectant-detergents are still used for the pre-cleaning or cleaning step, which may have relevant implications. It has been shown recently that BAC binds to metals and plastic compounds, leading to its detection on surfaces based on these materials [4]. Remaining BAC at low levels has the potential, especially in Gram-negative species, to lead to increased tolerance to BAC (e.g. an increased minimum inhibitory concentration of 2500 mg/L in *Pseudomonas aeruginosa*); increased tolerance to other biocidal agents such as didecyldimethylammonium bromide, didecyldimethylammonium chloride, triclosan and chlorhexidine; and increased tolerance to selected antibiotics such as