TABLE 1. Primary and Composite Outcomes for Patients in Rooms with and without Copper-Coated Surfaces

Outcome[a]	No. of patients, by type of room			*P*	
	Copper-coated surfaces (n = 294)	Without copper-coated surfaces (n = 320)	Total (n = 614)	χ^2 test[g]	Fisher exact test
Any HAI event (a)	17[f]	29[f]	46	.12	.13
Any MRSA or VRE colonization event (b)	11[f]	15[f]	26	.56	.69
Both HAI and colonization (c)[b]	7[f]	3[f]	10	.16	.21
HAI and/or colonization (d)[c]	21	41	62	.020	.023
HAI only (e)[d]	10	26	36	.013	.015
Colonization only (f)[e]	4	12	16	.063	.077

NOTE. HAI, healthcare-acquired infection; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci.

[a] Letters in parentheses correspond to those in the text.

[b] Both events occurring in the same patient.

[c] Either HAI or colonization or both (ie, any event).

[d] No. of patients with HAI minus those who had both HAI and colonization.

[e] No. of patients with colonization minus those who had both HAI and colonization.

[f] These numbers were not provided in the original article by Salgado et al[1] and instead were extracted and calculated from the other reported data.

[g] Without Yates correction.

than answers, and we would appeal for additional work on linking antimicrobial surfaces with HAI transmission in ICUs.

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Portions of this letter were previously presented online at the Controversies in Hospital Infection Prevention website, April 25, 2013 (http://www.haicontroversies.blogspot.com).

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Reply to Harbarth et al

To the Editor—We thank Harbarth et al[1] for their characterization of our work as laudable, but offer the following perspective on their critique of the design and interpretation of data from our study.[2] It is firmly established that hospital-

associated infections (HAIs) represent substantial risk to all patients in the developed world and that, although hand-hygiene and effective cleaning and disinfection of the patient environment are paramount for infection control, they cannot completely eliminate nosocomial transmission of microbes nor subsequent infections.[3-5] In our study, we added a passive, continuously active microbiocidal material to commonly touched surfaces in close proximity to the patient to reduce viable bacteria, and we investigated whether this reduced burden would alter the rate of HAI or hospital-acquired colonization (HAC).

Concerns with our approach to reporting study outcomes and lack of information concerning end points raised by Harbarth et al[1] are unfounded. They state that we created a complex system of 2 single and 4 prespecified composite outcomes and further suggest that we dubiously used selective reporting of only unnecessarily complex and artificially constructed outcomes.[1] This is simply not true. Our primary outcome was defined as part of the last phase of our peer-reviewed and government-sponsored 3-phase protocol. In the first phase, we determined resident microbial burden on commonly touched objects within the intensive care unit (ICU) environment; in the second, we performed an evaluation of the effect of copper-surfaced objects on microbial burden; and finally, we assessed the clinical impact of such objects.[2,6] Given the known time frame and funding available for the clinical portion of the study, as well as our baseline rates of HAI and HAC, we decided, a priori, to have a clinically relevant primary composite outcome of HAI and/or HAC to have sufficient power to detect a significant difference if one existed. The secondary outcomes of HAI alone and HAC alone were chosen because of their clinical relevance, but the study was not powered for these. We did not report on "any HAI" (which would have included some patients with HAC), "any HAC" (which would have included some patients with HAI), or "both HAI and HAC" for the very same reason that the authors point to in their letter; development of HAI and acquisition of colonization may be biologically different. This was documented in our protocol and vetted by our respective institutional review boards, the US Army Office of Risk Protection, and an independent expert study panel.

Our definitions of HAI and HAC were thoughtfully provided in the article and reflected current NHSN criteria. We chose to report our κ statistic and discuss it with regard to difficulty in defining HAI. It is not reflective of limitations in the methodology of our study. We included data on specific HAIs, but we clearly state that our study was not powered to assess which HAI would be most impacted by our intervention.

The authors also question the biological plausibility of our findings. Results from well over 75 studies have established that solid copper surfaces and alloys containing greater than 60% by weight of the element are significantly microbiocidal to a large number of bacteria, fungi, and viruses in the absence of water. As part of our 3-phase study, we confirmed this observation and established that, during active patient care in the ICU, commonly touched copper-surfaced objects had continuously and significantly fewer viable bacteria.[6,7] We respectfully bring to the attention of the authors that, although the average difference between the copper-surfaced objects and the control objects was $\log_{10}$ 1.92 lower for copper items, when characterized from the perspective of an infectious risk to the patient, 80% of control bed rails were observed to have concentrations greater than 250 colony-forming units per 100 cm^2, whereas 83% of copper rails were below this threshold. Following the logic that viable bacteria from the environment can contribute to risk of infection, particularly objects considered high risk as suggested by Dr. Dancer in her review of the role of environmental cleaning and control of HAI,[8] it is certainly biologically plausible that reduction in exposure may reduce risk of infection. In point of fact, the authors questioning the biological plausibility of our hypothesis have made the very arguments that the environment does indeed represent a clear source of microbes responsible for infections, specifically from lack of compliance with hand hygiene or failure to properly clean between patient encounters. We agree that our study challenges the current notion of the source of pathogen acquisition and suggests that the environment may play a greater direct, and potentially indirect (via cross transmission), role.

With regard to insufficient data on compliance with hand hygiene, it is true that we did not make an attempt to specifically measure the impact of all potential opportunities, and this could be considered a limitation to be addressed in future studies. However, each site conducted direct observations for hand hygiene, which included upon entry and exit from patient rooms, and there was no association between overall hand hygiene compliance and HAI and/or HAC collectively or at any single site.

Finally, Harbarth and colleagues commented that "this study ... provides more questions than answers, and we would appeal for additional work on linking antimicrobial surfaces with HAI transmission in ICUs."[1] We agree! This is, to our knowledge, the first study to present evidence to support causality in this setting. However, we recognize that there are other principles of causality that need to be addressed, including repeated epidemiologic studies that result in similar findings. The introduction of a continuously active antimicrobial surface approach for the control of HAI represented a substantial challenge and appears to offer great promise for healthcare. The movement of microbes and the rhythms of healthcare are each subject to different and distinct stochastic forces. We attempted to ask a direct and focused question and learned that, when the bacterial burden was controlled in the vicinity of the patient, infection rates were lower.[2]

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H.T.M., and M.G.S. report that they received salary support from the US Army Materiel Command, US Department of Defense (DOD), to conduct the study. P.A.S. reports that he acquired and purchased materials from vendors using funds from the US Army Materiel Command, US DOD, and reports that he provided expertise on issues relevant to technology transfer and application of antimicrobial copper equipment and furnishings for the Copper Development Association and Olin Brass. K.A.S., H.H.A., and M.G.S. report that they have received grant support from the Copper Development Association to study the placement of copper surfaces in other non–patient care environments. C.D.S. reports that she received grant support from the Agency for Healthcare Research and Quality to study healthcare-acquired infections and served as an educational consultant for continuing medical education activities for Outcomes. K.D.F. reports that she served as a consultant for Ortho-McNeil-Janssen. H.T.M. reports being employed by the Copper Development Association. M.G.S. reports serving as a consultant for Olin Brass and Coldelco; receiving funding from the Ministry of Health of Chile to serve as an external consultant for a clinical trial investigating the consequences of placement of antimicrobial copper on the rate of healthcare-acquired infections; and receiving travel support from the Copper Development Association. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

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Impact of the 2013 Revised Centers for Disease Control and Prevention Central Line–Associated Bloodstream Infection (CLABSI) Surveillance Definition on Inpatient Hospital CLABSI Rates: Is It Enough?

To the Editor—It is with great interest that we read the article entitled "Distribution of Pathogens in Central Line–Associated Bloodstream Infections among Patients with and without Neutropenia following Chemotherapy: Evidence for a Proposed Modification to the Current Surveillance Definition" by Steinberg et al.[1] This study found that common microbial residents of the gastrointestinal tract were overrepresented in neutropenic patients, suggesting that central line–associated bloodstream infections (CLABSIs) in neutropenic patients may primarily represent bacterial translocation of gut organisms rather than infections related to the central line catheter. Steinberg and colleagues state that their findings support the efforts by the National Healthcare Safety Network to refine the CLABSI surveillance definition. We present a comparison of the pre-2013 CLABSI surveillance definition with the revised CLABSI surveillance definition in a large tertiary hospital, utilizing 4 years of surveillance data. These data provide additional evidence of the increased validity of the current definition and suggest areas for further refinement.

In January 2013, the Centers for Disease Control and Prevention (CDC) released a revised CLABSI surveillance definition that included a mucosal barrier injury–laboratory-confirmed bloodstream infection (MBI-LCBI) component. MBI-LCBI eliminated the following 2 groups of patients: (i) allogeneic hematopoietic stem cell transplant recipients within the past year with either grade III or IV gastrointestinal graft versus host disease or 1 or more liters of diarrhea in 24 hours within 7 days of the blood cultures and (ii) patients with neutropenia on or within 3 days of the positive blood culture.[2] This new exclusion criterion aimed to reduce the number of cases due to bacterial translocation in immunocompromised patients that were counted as CLABSIs. This is an important effort by the CDC, which acknowledges that not all reported CLABSIs are a result of gaps in infection control practices.

To determine the impact of the recent change in the CL-