izontal surfaces in the rooms of patients with *C. difficile* infection.

It would be obtuse to assume that in vitro experiments precisely simulate in vivo conditions. Similarly, relying solely on an antimicrobial agent's minimum inhibitory concentration to predict its clinical efficacy against a particular infecting pathogen is ill-advised. Thus, it is standard practice to employ in vitro models of infection to simulate, among other factors, waning concentrations of an antimicrobial agent after each dose is administered. The impact of cleaning and disinfecting agents should be viewed no differently. Initial working strength concentrations applied to surfaces do, in fact, wane over time. Subsequently, in germicides and/or cleaning agents, the residual active components are exposed to organic material (eg, feces containing *C. difficile* in both vegetative and spore forms). If working strength concentrations were universally delivered after their initial application, it would be surprising if the environment was ever implicated in the spread of infection. We caution against assuming that use of a germicide or a cleaning agent guarantees effective environmental decontamination; it does not. Thus, it has been shown that as the level of environmental contamination with *C. difficile* increases, so does the magnitude of healthcare worker hand contamination.[3]

In our article,[2] we acknowledged that the clinical significance of results showing an increased rate of sporulation associated with use of some cleaning agents and/or germicides is unknown. However, as pointed out by Holtschlag,[1] the US Enironmental Protection Agency does not currently recognize a test method for inactivation of *C. difficile* spores. It is logical, therefore, to use different test methodologies and to base any conclusions concerning the potential efficacy of agents against *C. difficile* on all of the results obtained. This is what we did. It would be unwise to pick and choose which results appear more favorable, particularly, as in Holtschlag's case, if there is a potential conflict of interest. Hence, we concluded our report by stating that "the combined body of evidence suggests that dichloroisocyanurate (ie, chlorine-release) germicides currently represent the optimum choice for the removal of *C. difficile* from healthcare environments."[2(p924)] We went on to say that our results "suggest that compounds that do not kill *C. difficile* spores at working concentrations, such as general-purpose detergents and hydrogen peroxide, may promote the persistence and accumulation of spores in healthcare environments."[2(p924)] We stand by these comments.

ACKNOWLEDGMENTS

Potential conflicts of interest. The authors report no conflicts of interest relevant to this article.

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Infect Control Hosp Epidemiol 2008; 29:191-192

 0899-823X/2008/2902-0021$15.00. DOI: 10.1086/527450

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Should Test Methods for Disinfectants Use Vertebrate Viruses Dried on Carriers to Advance Virucidal Claims?

TO THE EDITOR—The advancements made in microbicidal science in the past decade have raised questions about the appropriateness of the test methods still being used to substantiate microbicidal and virucidal claims globally. The test methods currently being used to evaluate the virucidal activity of disinfectants employ challenge virus that is either dried on prototypical hard surfaces or is in suspension. The latter approach presents a weaker challenge to the formulation that is being tested.[1,2] Regulatory agencies such as the US Environmental Protection Agency, Canadian General Standard Board, and Australian Therapeutic Goods Administration require that data for virucidal activity be based on carrier test methods that use vertebrate viruses.[3-6] In contrast, European Norms for claims about virucidal activity (both BS EN 14476:2005 and EN 13610) require suspension tests, although EN 13610 specifies bacteriophages, as opposed to vertebrate viruses.[7,8] We believe that the requirements of both of these European Norms are unrealistic and do not represent field situations where disinfectants are used for decontamination of pathogens dried on hard surfaces in domestic, health care, or extended care settings.

In this letter, we comment on the irrelevance of both these standards (BS EN 14476:2005 and EN 13610:1999) on the basis of our 20 years of experience as manufacturers of microbicidal products and also as developers of methods to test the virucidal activity of disinfectants. A number of our carrier test methods have been approved by the US Environmental Protection Agency to generate virucidal data for product registration.[3] Such virucidal data are also accepted by the Canadian General Standard Board, the Australian Therapeutic Goods Administration, and jurisdictions in Asian countries.[5,6]

Vertebrate viruses (*not* bacteriophages) on naturally contaminated environmental surfaces pose a danger to public health. Disinfectants with demonstrated virucidal activity against these pathogenic viruses play a pivotal role in the interruption of viral dissemination through such vehicles. Experts believe that the ideal disinfectant should be effective against both gram-positive and gram-negative bacteria, as well as pathogenic viruses, when tested using carrier-based methods.[1,2,9,10]

The scientific literature strongly supports the idea that data generated using relevant vertebrate viruses, such as enteric viruses (coronavirus and rotavirus) or respiratory viruses (influenzaviruses and rhinovirus), are relevant to real-life situations and should be considered when relevant virucidal claims are issued. It is, therefore, of paramount importance to consider the following factors in the evaluation of a product registration that includes claims about virucidal activity: (1) Vertebrate viruses (not bacteriophages) are emerging and/or reemerging pathogens of public health concern. (2) Vertebrate viruses survive on contaminated environmental surfaces, which may play a role in the dissemination of an infectious virus. (3) Virucidal test methods employing viruses dried on prototypical environmental surfaces are more challenging to disinfectants than those employing viruses in suspension, as required by EN 13610:1999 and BS EN 14476:2005. (4) Organizations that develop antimicrobial test methodologies, such as ASTM International, have developed virucidal testing parameters that include vertebrate viruses (enveloped and naked or nonenveloped viruses). (5) Testing that conforms to European Norms EN 13610:1999 and/or BS EN 14476:2005, which both require virucidal testing against only bacteriophages or nonenveloped vertebrate viruses, will eliminate many disinfectants otherwise effective against emerging and reemerging viruses. (6) Regulatory agencies worldwide (in the United States, Canada, Australia, and Asian countries) accept data on the efficacy of virucidal agents that are generated using vertebrate viruses (enveloped and naked or nonenveloped viruses). This is in line with the demand by both consumers and the infection control community to know the virucidal efficacy of the products that are being used against emerging and/or reemerging pathogens, such as severe acute respiratory syndrome–associated human coronavirus, avian influenza virus, and, more recently, rabies in China and bat-borne Melaka virus, a type of reovirus, in Malaysia. (7) Public health agencies, such as the Centers for Disease Control and Prevention and the World Health Organization, issue public advisories on emerging pathogens based on the claims of virucidal activity against vertebrate viruses that are being made for registered products.

Therefore, it is scientifically justifiable to use vertebrate viruses (enveloped or nonenveloped viruses) to generate data on the efficacy of virucidal agents for the purpose of making relevant virucidal claims, given that these data add weight to a virucidal claim and generate greater confidence about that claim in the minds of the infection control community and the public at large (Figure). Use of only the naked or nonenveloped bacteriophages or viruses for virucidal testing in suspension, as required by EN 13610:1999 or BS EN 14476:

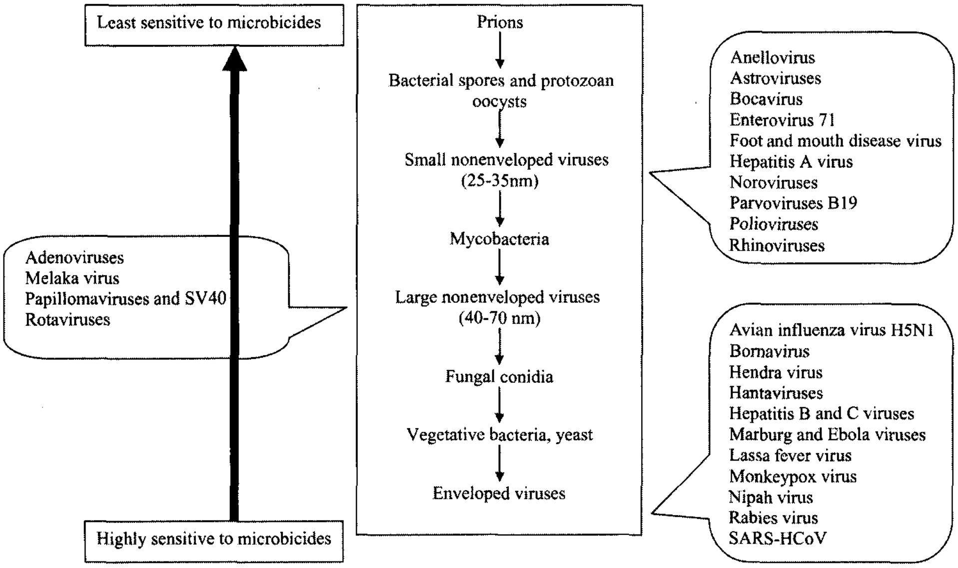

FIGURE. Emerging and reemerging viruses and their sensitivities to microbicides. SARS-HCoV, severe acute respiratory syndrome–associated human coronavirus; SV40, simian virus 40.

https://doi.org/10.1086/526441 Published online by Cambridge University Press

2005, is irrelevant to field situations and will force the manufacturers of disinfectants to overformulate or use more potentially toxic ingredients because of the challenging virucidal hierarchy of naked viruses (nonenveloped vertebrate viruses or bacteriophages).

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Infect Control Hosp Epidemiol 2008; 29:192-194

 0899-823X/2008/2902-0022$15.00. DOI: 10.1086/526441

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Staphylococcus aureus: What Are the Levels of Contamination of Common-Access Environmental Surfaces?

TO THE EDITOR—Outbreaks of community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) infection have increased public concern about the risks of infection, especially from contamination of the environment.[1] MRSA can survive on plastic surfaces[2] and stainless steel.[3] Clusters of community-associated MRSA infection in athletes indicated that transmission occurred through the use of shared items rather than through physical contact.[4] Tabloid press reports of sampling of public area surfaces may lack validity, as further investigation has questioned their methodology and interpretation.[5]

S. aureus, which is carried by approximately 25% of humans, may be transferred to the fingers by nose picking or touching the nasal area. Although nasal MRSA colonization rates remain low in Hong Kong,[6] there is concern about environmental reservoirs of the organism. We investigated levels of *S. aureus* contamination and characterized isolates from commonly contacted surfaces.

Over a 5-week period, 100 samples were collected on the same weekday from a range of publicly accessed surfaces in a densely populated area of Hong Kong, with each of the 25 sites being sampled 4 times daily. Temperature and humidity were also recorded. The sampling sites were chosen as a convenience sample within walking distance of an underground railway station. Samples were collected by swabbing the entire surface of a keyboard or elevator button or a 2.5 cm^2 area of larger surfaces with a saline-moistened transport swab. Swab samples were cultured within 2 hours of collection on blood agar, mannitol salt agar, and oxacillin-resistant screening agar and then enriched in brain-heart infusion broth (all media; Oxoid). Colonies with staphylococcal morphology were characterized as *S. aureus* by use of the Staphaurex test (Murex Biotech). All blue-pigmented colonies on oxacillin-resistant screening agar were Gram stained, and positive cocci were subcultured to blood agar and further identified. Brain-heart infusion broth was subcultured after 24 h on blood agar and oxacillin-resistant screening agar, and any growth was identified as mentioned above. *S. aureus* isolates were tested for susceptibility to a range of antibiotics. The presence of the *mec*A gene and the genes for enterotoxins *(sea–sef)*, exfoliative toxin *(eta* and *etb)*, and toxic shock syndrome toxin *(tsst-1)* were determined by means of multiplex polymerase chain reaction.[7] Isolation rates were compared over time with the χ^2 test, and correlation with temperature and humidity was determined with the Pearson correlation test.

Of a total of 500 samples, 56 (11.2%) yielded *S. aureus.* No culture-positive samples were obtained from public telephones, but other sites were frequently contaminated (Table).