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Brief report

Surface microbial contamination in hospitals: A pilot study on methods of sampling and the use of proposed microbiologic standards

Tânia Claro PhD [a], Marese O'Reilly MB [a], Stephen Daniels PhD [b], Hilary Humphreys MD [a,c,*]

[a] Department of Clinical Microbiology, Education and Research Centre, Royal College of Surgeons in Ireland, Beaumont Hospital, Dublin, Ireland
[b] National Centre for Plasma Science and Technology, Dublin City University, Dublin, Ireland
[c] Department of Microbiology, Beaumont Hospital, Dublin, Ireland

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Contamination of hospital surfaces by bacteria is increasingly recognized. We assessed commonly touched surfaces using contact plates and Petrifilms (3M, St. Paul, MN) and compared the results against proposed microbiology standards. Toilet door handles were the most heavily contaminated (7.97 ± 0.68 colony forming units [CFU]/cm^2) and exceeded proposed standards on 74% of occasions. Petrifilms detected statistically higher CFU from bedside lockers. Further research is required on the use of standards and methods of sampling.

The role of the physical environment in the acquisition of health care–associated infections (HCAIs) is increasingly recognized. Many microbial causes can survive for weeks in the absence of decontamination.[1,2] Routine cleaning practices are often suboptimal, with an increased likelihood of the presence of pathogens.

Recent studies have investigated the benefits of better cleaning practices, including different methods to evaluate cleaning efficacy,[3,4] the microbial burden on commonly touched surfaces,[5] and the relationship with cleaning standards.[6] Although not validated, microbiologic standards for a safer hospital environment have been proposed as ≤2.5 colony forming units (CFU)/cm^2 on surfaces.[3,4] Maintaining counts below these thresholds may assist in reducing HCAIs.

The present study evaluated the microbial burden on horizontal surfaces in an acute hospital, assessed 2 methods of sampling, and compared the results with proposed standards for the microbiologic evaluation of hospital hygiene.[3,4]

METHODS

The hospital is an adult tertiary referral hospital with 700 beds. Samples were collected from 1 general medical and 1 general surgical ward over a 7-week period. Both wards have approximately 100% bed occupancy, with most patients being bedbound. Both are naturally ventilated and are representative of nonspecialist wards in our hospital. Daily visiting times were 3-4 PM and 7-9 PM.

High-touch surfaces were selected based on the proximity to the patients' environment and the contact frequency by patients, health care workers, or visitors. These included the toilet door handle, bedside locker, tray table, and call button near 24 patients on both wards. These were sampled weekly in the morning and in the afternoon on each ward. Throughout the study, the day of the week, sampling time, and precise surface area on each ward were the same.

Two different methods were used for sampling. One used 25-cm^2 tryptic soy agar contact plates with lecithin and polysorbate 80 (Remel, Oxoid, UK) designed to neutralize any residual quaternary ammonium compounds and substituted phenolic

* Address correspondence to Hilary Humphreys, MD, Department of Clinical Microbiology, Education and Research Centre, Royal College of Surgeons in Ireland, Beaumont Hospital, PO Box 9063, Dublin 9, Ireland.
E-mail address: hhumphreys@rcsi.ie (H. Humphreys).

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disinfectants, respectively. The other was 25-cm^2 aerobic count Petrifilms (3M, Bracknell, UK), which were developed for the food industry and consist of a membrane-like agar containing material that is placed on the surface to be sampled. All samples were incubated aerobically at 37°C overnight, and growth was enumerated in CFU per centimeter squared. Routine cleaning was carried out by contracted cleaning operatives to a standard protocol and occurred at 11:00 AM. Cleaners used 1,000 ppm detergent (Teepol, Kent, UK) and 1,000 ppm sodium dichloroisocyanurate (Presept, Advanced Sterilization products, Ontario, Canada) for isolation areas and terminal cleaning. Regular audits of hospital hygiene, according to national requirements, were regularly undertaken.

RESULTS

A total of 1,986 samples were taken: 112 from toilet door handles, 544 from bedside lockers, 668 from tray tables, and 662 from call buttons. Figure 1 shows the mean bacterial counts recovered from each surface in the morning and afternoon. Except for the tray table, the microbial load was generally lower in the afternoon (after cleaning) compared with the morning for all surfaces. This was statistically significant for the toilet door handle, with 10.85 CFU/cm^2 in the morning versus 5.09 CFU/cm^2 in the afternoon ($P < .0001$). As might be expected, the toilet door handles were the most heavily contaminated surfaces (7.97 CFU/cm^2) followed by the bedside lockers (7.34 CFU/cm^2), both of which exceeded the threshold of ≤2.5 CFU/cm^2 on 74% and 73% of occasions, respectively. The tray tables (2.63 CFU/cm^2) and call buttons (2.41 ± 0.15 CFU/cm^2) were the least contaminated surfaces, exceeding the threshold (<2.5 CFU/cm^2) on just 32% and 26%, respectively.

There was a heavier microbial burden on the medical compared with the surgical ward, which was statistically significant for the bedside lockers ($P < .0001$) and tray tables ($P < .0001$) (data not shown). Comparison between the 2 sampling methods (ie, contact plates, Petrifilms), showed that Petrifilms detected higher CFU from all surfaces; this was statistically significant for the bedside locker irrespective of the ward ($P < .05$) (Fig 2).

DISCUSSION

Apart from during outbreaks or as research, routine microbial monitoring of surfaces in acute hospitals is not recommended because there is no accepted and proven standard correlating environmental contamination and the risk of infection.[7] Furthermore, there is no agreed methodology for surface sampling, and some approaches yield higher counts than others.[5] However, we found that a considerable proportion of surfaces was heavily contaminated, exceeding a proposed microbial threshold for cleanliness of the hospital environment.

In this study, bacterial surface contamination was well above the threshold for the toilet door handles and bedside lockers, including during the afternoon, when cleaning earlier should have rendered these surfaces clean, notwithstanding their being regularly touched surfaces. Higher bacterial counts were found on the medical ward, and this may be caused by differences in the categories of patients (ie, more high-dependency patients with longer hospital stays, greater capacity for microbial shedding) or less effective suboptimal cleaning, but these differences and the reasons why were not assessed in this study. Wilson et al have shown that enhanced cleaning in the intensive care unit results in reduced environmental contamination, but further research is required to show an impact on reduced HCAI.[8] Our findings confirm the need for improved overall cleaning of the inanimate environment adjacent to patients outside the intensive care unit.

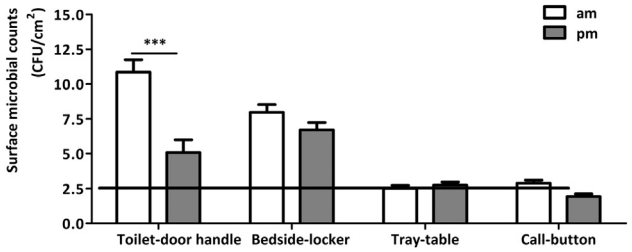

Fig 1. Mean microbial counts (colony forming units [CFU]/cm^2 ± SEM) of surfaces sampled with contact plates and Petrifilms in the morning (am) and afternoon (pm) from toilet door handles (n = 112), bedside lockers (n = 554), tray tables (n = 668), and call buttons (n = 662), with equal numbers of samples taken in the am and pm. The horizontal line is a suggested threshold of 2.5 CFU/cm^2 above which there may be an increased risk of infection.[3,4] ***$P < .001$, *t* test (am vs pm).

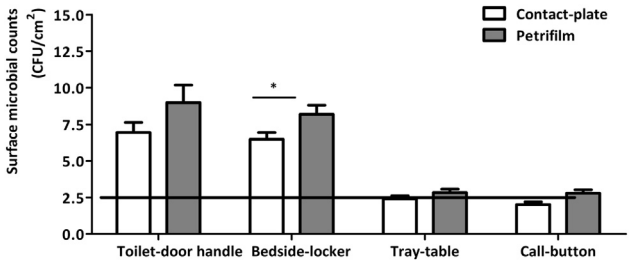

Fig 2. Mean microbial counts (colony forming units/cm^2 ± SEM) of surfaces sampled during the morning and afternoon, including toilet door handles (n = 112), bedside lockers (n = 554), tray tables (n = 668), and call buttons (n = 662) using contact plates and Petrifilms. The horizontal line is a suggested threshold of 2.5 colony forming units/cm^2 above which there may be an increased risk of infection.[3,4] *$P < .05$, *t* test (contact plate vs Petrifilm).

Carling has recently reviewed methods for the assessment of the adequacy of room decontamination, which include observed hygiene practices, fluorescent markers, adenosine triphosphate bioluminescence, and microbiologic sampling.[9] Regarding the sampling methods used in the present study, Petrifilms were more effective than contact plates, as previously confirmed in laboratory studies,[5] and should be considered during outbreaks and research.

Limitations to our study include confining the study to 2 wards only, not incorporating a thorough assessment of hygiene practices while sampling, and not assessing for the presence of marker organisms (eg, methicillin-resistant *Staphylococcus aureus*). Furthermore, we did not monitor patient activity, numbers of visitors present while sampling, and other variables that might have impacted on colony counts, such as ambient temperature and humidity. Nonetheless, we believe that further research is required on a variety of surfaces, as demonstrated in a previous study,[10] with agreed sampling methodologies, incorporating a thorough assessment of hygiene practices and allowing for patient category (eg, carriage of methicillin-resistant *S aureus*) and dependency to determine the influences these have on surface contamination.

Acknowledgments

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References

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