Routine disinfection of patients’ environmental surfaces: Myth or reality?

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Summary: We have evaluated the need for daily disinfection of environmental surfaces not contaminated by biological fluids, in patient areas of a medical unit with two wings [North (N) and South (S)] at the University Hospitals of Geneva, Switzerland. Weekly bacteriological monitoring of surfaces was carried out at random (N = 1356 samples). In the S wing (control), we used detergent/disinfectant for daily cleaning of the floors and furniture. In the N wing we began by using a detergent for floors and furniture; after four weeks the results suggested changing to a rotation of detergent, dust attracting disposable dry mops and disinfectant. During this period the furniture was cleaned with an active oxygen-based compound. The average differences in contamination before and after cleaning floors were (mean reduction in bacterial counts and 95% confidence intervals; CI 95): disposable mops: 92·7 cfu/24 cm² (CI 95; 74–112), active oxygen based compound 111·1 (90–133), and quaternary ammonium compound –0·6 (–27–26). Use of detergent alone was associated with a significant increase in bacterial colony counts: on average by 103·6 cfu (CI 95 73–134). The quaternary ammonium compound was inadequate for disinfecting bathrooms and toilets but the active oxygen based compound was satisfactory. For furniture, there was a significant reduction in bacterial counts with both the methods using disinfectants. As the detergent was contaminated, by using it alone for cleaning, we were actually seeding surfaces with bacteria.

A total of 1117 patients was studied and we observed no change in the incidence of nosocomial infections during the four months of the trial. In conclusion, uncontrolled routine disinfection of environmental surfaces does not necessarily make it safe for the patient and could seed the environment with potential pathogens.

Keywords: Surfaces; detergents; disinfectants; nosocomial infections.

Introduction

The routine use of disinfectants to clean hospital floors and other surfaces is controversial in relation to nosocomial infections.1–7 The practice varies nationally. In England, detergent alone is used widely, while in France, Switzerland and the USA, the use of a detergent/disinfectant is more common. At the University Hospitals of Geneva (HUG), Switzerland, we routinely use a detergent/disinfectant to clean floors and furniture. In a period of cost containment, care of the environment, and the possible selective pressure exerted on bacteria to become resistant to antibiotics by exposing
them to disinfectants\textsuperscript{8,9} we prospectively evaluated the necessity of daily disinfection of surfaces not contaminated by biological fluids and of isolation rooms.

Materials and methods

Setting

HUG is a large healthcare centre providing primary and tertiary medical care for Geneva, Switzerland, and the surrounding area serving a population of about 800,000. Approximately 40,000 patients are admitted annually. This study was carried out in a medical unit (106 beds), which has two wings. Wing North (N) has three wards, A, B, and C; wing South (S) has two wards, D and E. Each ward has two seven-patient rooms, two two-patient rooms and two single-patient rooms. Ward E has six additional beds. The ward floors are PVC lined and those of the bathrooms and toilets are tiled.

The infection Control Team (ICT), established in October 1992, consists of a hospital epidemiologist, one associate and six full-time infection control nurses (ICNs). Since January 1993, the ICT has conducted several hospital-wide period-prevalence studies to detect nosocomial infections using total chart surveillance.\textsuperscript{10} Collection of data was based on standard definitions.\textsuperscript{11} The ICT conducts on-going surveillance for nosocomial infections, by twice-weekly visits to general wards and daily visits (weekends excepted) to critical care units. Surveillance and measures to control methicillin-resistant \textit{S. aureus} (MRSA) transmission have already been described.\textsuperscript{12,13}

Study design

The study was conducted from 1 February to 31 May, 1997. In the S wing, the routine practice was continued, i.e., use of a quaternary ammonium compound (QA) 0·5\% ISEQUAT\textsuperscript{®} (ISE S.A. Locarno, Switzerland) daily for cleaning and disinfecting all floors. It was diluted according to manufacturer’s instructions. Furniture was cleaned with the detergent 1\% TASKI\textsuperscript{®} R50 (T) (Diversey and Lever SA, Geneva, Switzerland), then disinfected with an alcoholic solution (DOSPRAY\textsuperscript{®}; D) containing 0·028\% aldehydes (local preparation).

In the N wing, we started off by using detergent T for floors and furniture, except in bathrooms, toilets and isolation rooms, where we used an active oxygen based compound (AOB), 1\% PERFORM\textsuperscript{®} (Schulke & Mayer, Germany). Floors were cleaned with TASKI mops (Diversey & Lever SA, Geneva, Switzerland). The mops have a reservoir for cleaning or disinfecting solution and a detachable head so that the cleaning tissue can be changed when necessary. After four weeks trial of detergent, the protocol was modified in wing N due to the observed results. On Mondays, the floors were cleaned and disinfected with AOB, followed by three days cleaning with disposable dust-attracting floor mops (DM). On Fridays, the floors were cleaned with the detergent only and at the weekends with DM. The furniture was cleaned and disinfected with AOB.

Bacteriological sampling

Bacteriological sampling was carried out weekly. For all surfaces we used the Count-Tact\textsuperscript{®} plates and applicator (bioMérieux, Marcy l’Etoile, France). By using the applicator, a uniform pressure of 500 g can be applied to the plate for ten seconds. Ten surface samples of floors and ten of furniture in patients’ rooms were taken before cleaning and disinfecting. The surfaces were cleaned and/or disinfected and the same number of samples taken when the surfaces were dry (10–15 minutes later). There was very little patient movement during sampling as the floors were wet. The same procedure was carried out in bathrooms and toilets. Surface sampling was done randomly over the entire floor and furniture. Rooms sampled varied weekly, alternating between a seven-patient room and a two-patient room. The occupancy of the seven patient-rooms varied between three and five patients at time of sampling. The bed occupancy rate of the wards averaged 78\% (62–100) during the study.
Samples were incubated at 35°C for 48 h with observation of plates at 24 h. Colony counts were made at 48 h; the plates were further left at room temperature for 72 h for fungal growth. Identification of bacteria was by colonial morphology, Gram stain, coagulase test for staphylococci and API 20E (bioMérieux, Marcy l’Etoile, France) for Enterobacteriaceae.

**Statistical analysis**

ANOVA was used to compare the average differences. For each surface, a specific analysis was carried out; a priori comparisons between methods were then calculated. No Bonferroni correction or other correction approaches were used. All tests were two tailed; P-values less than 0.05 were considered statistically significant.

**Results**

In all 1356 bacteriological samples were processed. Results obtained according to the different detergent/disinfectant techniques used for regular room floors, bathroom and toilet floors and patient room furniture are shown in Figure 1. For the regular room floors, the average colony counts of 80 samples over eight weeks shows that QA did not reduce the total bacterial count (average reduction = −0.6 cfu/24 cm²; CI<sub>95</sub> −27–26) and at times they were higher than before disinfecting (Figure 1a). With the detergent T, we were introducing bacteria into the patients’ environment (average increase = 103.6 cfu/24 cm², CI<sub>95</sub> 73–134). With DM we obtained an average reduction in bacterial counts of 92.7 CFU/24 cm², (CI<sub>95</sub> 74–111) and with AOB a larger reduction of 111.1 cfu/24 cm², (CI<sub>95</sub> 87–133). Differences observed between the effects of DM vs. QA (F<sub>(1,314)</sub> = 28.02, P < 0.001) and AOB vs. QA (F<sub>(1,314)</sub> = 40.17, P < 0.001) were statistically significant; there was no statistically significant difference (F<sub>(1,314)</sub> = 1.08, P = 0.30) between the effects of DM and AOB.

At the concentration used, QA was inadequate for disinfecting bathrooms and toilets. AOB worked significantly better: bacterial colony counts decreased by an average of 186.5 cfu/24 cm² (CI<sub>95</sub> 155–218) with AOB, while they increased by 50 (CI<sub>95</sub> 10–90) with QA (F<sub>(1,157)</sub> = 84.77, P < 0.001, Figure 1b).

For furniture, there was a reduction in bacterial counts with both disinfectants (AOB, average decrease = 57.6 cfu/24 cm², CI<sub>95</sub> 36–79; T+D, average decrease = 44.6 cfu/24 cm², CI<sub>95</sub> 10–79, Figure 1c), but an increase in bacterial counts after cleaning with detergent only (average increase = 114.9 cfu/24 cm², CI<sub>95</sub> 64–166).
A total of 1117 patients were admitted during the study period, accounting for 8214 patient-days of care. Prospective surveillance for nosocomial bloodstream infection showed stable rates; in particular, the incidence of infection was similar to that of the preceding twelve months: 1.22 versus 1.36 episodes per 1000 patient-days, respectively; and did not differ between the N and the S wings during the study. Furthermore, the incidence of patients colonized or infected with MRSA remained stable during the study period compared with that observed during the 12 preceding months (2.19 versus 1.93 case patients per 1000 patient-days, respectively). Prospective surveillance for nosocomial infections (all sites) was performed during the first half of the study period over the two wings of the medical unit; infection rates were similar, and environmental culture results were not associated with concomitant identification of pathogens responsible for nosocomial infections.

Discussion

This study was undertaken with the intention of reducing routine disinfection of the patients’ environmental surfaces, and evaluating our disinfection policy. It is rather difficult to convince nursing and housekeeping staff to discard routine disinfection of all surfaces and that floor contamination has very little to do with nosocomial infections.

Despite following the manufacturer’s instructions the in-use concentration of QA was inadequate. Mops often contributed to the mechanical spread of bacteria from contaminated spots over entire surfaces; especially in bathrooms. Enterobacteriaceae, *P. aeruginosa* and other Gram-negative non-fermentative bacilli were the most frequent contaminants found on bathroom floors after disinfection with QA. The T solution was often contaminated and resulted in seeding the patients’ environment with bacteria, so that we could not really evaluate its capacity to reduce microbial load on surfaces. When uncontaminated T solution was used there was very little change in the microbial load after cleaning (sample size too small for statistical analysis).

Contamination of detergent solutions used for cleaning of surfaces was also reported by Werry et al. Detergent T had been prepared in tap water and stored before use. The contaminants were mainly Gram-negative non-fermentative bacilli, including *Acinetobacter* spp. and *P. aeruginosa*. Although we attempted to remedy this situation by preparation of fresh solutions daily, the problem persisted. Then we discovered that although the reservoirs on mops were emptied and left to dry after use, the tubing leading from the reservoir to the mop head was never thoroughly emptied. Cultures showed that the residues were always contaminated; this sometimes happened when using the mops with QA, but never with the disinfectant AOB. This could have been due to the fresh preparation of the use AOB solution from granules. The predominant organisms found after disinfecting with AOB were *Bacillus* spp. and fungi. Presumably vegetative forms of bacteria were killed within the drying time and the spores survived. Housekeeping staff could never understand why when using a disinfectant they have to take extra care in maintaining the mops in clean dry conditions. For them disinfectants are supposed to kill all bacteria!

Compliance with cleaning protocols constitutes the major problem highlighted by the bacteriological results observed. However, whatever the degree of contamination found after cleaning and/or disinfecting the floors, the bacterial counts evened out with time as shown by the samples taken just before cleaning. The recontamination rates have been shown in studies by Ayliffe and colleagues, and Palmer and Yeoman. Only on four occasions did we find Gram-negative bacilli on samples taken before cleaning of patient room floors; *Acinetobacter* spp. twice, *Enterobacter cloacae* and *E. coli* each on a single occasion. Once we found heavy contamination with *S. aureus* on a toilet floor, but after disinfection with QA we recovered only one colony on culture. On two occasions we recovered *Acinetobacter* spp. and *Enterobacter cloacae* from furniture before cleaning.
Even though we did not have good bacteriological results with T, we have decided to do away with routine disinfection of ward floors. We have introduced the use of dust attracting disposable mops, alternating with a detergent solution every other day. This is because disposable mops do not remove spill marks and a wetting agent is necessary. We have also instituted better maintenance of cleaning equipment and daily preparation of in-use dilutions of detergent. For the time being we will continue disinfecting furniture in patient rooms because compliance with handwashing practices by healthcare personal at our institution only averaged 40–50% and we hope to limit cross transmission from the environment to the patient via indirect contamination.

Over the evaluation period we did not observe any significant change in nosocomial bloodstream infection rates or in colonisation due to MRSA compared with the twelve preceding months; similarly there was no difference in the observed infection rates between the two wings. We concluded that there is no direct link between nosocomial infection rate and use of disinfectants to clean ward floors. Such a finding deserves further testing in larger trials.

We are convinced that reduction of bacterial contamination of the patient’s environment can be achieved only with frequent cleaning i.e., more than once daily, rather than using disinfectants once a day. However to introduce more cleaning is almost impossible due to the organization of work schedule in the wards and the economic climate of downsizing.

References