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Major Article

A pilot study to assess the effectiveness and cost of routine universal use of peracetic acid sporicidal wipes in a real clinical environment

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Background: Peracetic acid sporicidal wipes have been shown to be an effective disinfectant, but in controlled test environments. Their high cost may restrict use.
Aims: This pilot study investigated the efficacy and compared the costs of routine universal use of peracetic acid sporicidal wipes versus sporicidal quaternary ammonium compound and alcohol wipes in the disinfection of a hospital environment.
Methods: The routine universal use of peracetic acid wipes (Clinell Sporicidal; GAMA Healthcare Ltd, London, UK) was allocated to a study ward, whereas the control ward continued with the use of quaternary ammonium compound wipes (Tuffie 5; Vernacare, Bolton, UK) and alcohol wipes (PDI Sani-Cloth 70; PDI, Flint, UK). Twenty high-touch areas in the 2 wards were sampled for the presence of indicator organisms. The weekly detection rates of indicator organisms and weekly healthcare associated infection (HCAI) rates in the 2 wards were compared and examined for decreasing trends over the trial period.
Results: The detection rates of indicator organisms and HCAI rates were not significantly different in the 2 wards, and did not decrease significantly over the trial period. However, the peracetic acid wipes seem to be more effective against gram-negative organisms but at a significantly higher cost.
Conclusions: Further prospective studies are needed to assess the cost-effectiveness of peracetic acid wipes.

The transmission of healthcare associated infections (HCAIs) from contaminated surfaces in hospital environments, particularly frequent touch points, can be controlled with appropriate disinfection.[1,2]

Peracetic acid has rapid microbicidal action against most bacteria, *Clostridium difficile* spores, mycobacteria, and viruses.[3,4] It is nontoxic, noncorrosive, does not give rise to resistance, but is unstable.[4] This is overcome by generating synergistic peracetic acid and hydrogen peroxide from stable precursors.[5] In experiments conducted in regulated settings, these wipes have been effective in killing *C difficile* spores, and some evidence suggests that they can contribute to reducing rates of *C difficile* infection (CDI).[6-8] However, the efficacy of routine universal use of peracetic acid wipes in disinfecting a typical hospital ward in an everyday setting is yet to be evaluated. Also, their high cost at $0.47 (£0.33) per wipe may restrict their use. In comparison, the wipes containing the quaternary ammonium compound 0.5% cocoalkyldimethylbenzylammonium chloride cost $0.03 (£0.02) per wipe, and the 70% isopropyl alcohol wipes cost $0.014 (£0.01) per wipe.

The principal aim of this study was to test the use of peracetic wipes in a real clinical environment and to assess any in vivo microbiologic evidence of their superiority compared with our traditional hospital disinfection. To demonstrate this, we have compared the routine universal use of peracetic acid sporicidal wipes with sporicidal quaternary ammonium compound and alcohol wipes currently in use. A cost comparison was also performed.

METHODS

This 6-week-long prospective controlled pilot study measured the efficacy of the peracetic acid wipes in maintaining environmental cleanliness using weekly detection rates of indicator organisms and weekly HCAI rates.[8,9] Ethical clearances were obtained from the institutional review boards at the North Middlesex University Hospital and the London School of Hygiene and Tropical Medicine.

The study was conducted in two 29-bed elderly care hospital wards matched for location, layout, and profile of inpatients. The

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study ward introduced peracetic acid wipes (Clinell Sporicidal; GAMA Healthcare Ltd, London, UK) for routine universal wiping of patient and nursing station furniture, curtain rails, sphygmomanometers, infusion pumps, patient hoists, nursing station telephone, computer keyboard and mouse, toilet fittings, door handles, and light switches (completely replacing the use of any other wipes). A peracetic acid floor cleaner (GAMA Healthcare Ltd, London) was also introduced to ensure uniformity. The control ward continued as before to use quaternary ammonium compound wipes (Tuffie 5; Vernacare, Bolton, UK) for patient furniture, equipment, and toilets, and alcohol wipes (Sani-Cloth 70; PDI, Flint, UK) for nursing station furniture and equipment, whereas floors were cleaned with a chlorine solution.

The wards were cleaned at intervals of 6 hours per routine hospital cleaning schedules by the same staff each day. Manufacturers' instructions were followed by the staff in the use of all wipes. GAMA Healthcare Ltd supplied the peracetic acid wipes and floor cleaner for the study ward, and trained the ward staff in their use before the commencement of the trial by providing literature and practical demonstrations. The trial was commenced only once the staff members were familiar with the use of these wipes. Because quaternary ammonium compound and alcohol wipes are routinely used throughout the hospital, staff in the control ward were familiar with these wipes and did not require training in their use.

GAMA Healthcare Ltd was not involved in the sampling and processing, the data analysis, or the preparation of the manuscript.

To ensure that the wiping was being properly carried out, spot checks were conducted using an invisible fluorescent cream marker and an ultraviolet light. In case a surface was found to have been left out or incompletely wiped (evidenced by persistence of the fluorescent marker), the area was wiped again and rechecked using the ultraviolet light.

Twenty identical frequent touch points were sampled from the 2 wards: patient beds (heads and uppermost side rails), overbed tables (top surface), chairs (backs and armrests), lockers (top surface and drawer handles), and curtain rails; sphygmomanometers, infusion pumps (controls), and patient hoist; nursing station desk, chair (backs and armrests), telephone (keypad), computer keyboard, and mouse; toilet washbasin rims, taps, and nozzles; shower fittings (handles, heads, and taps); commodes; toilet seats and flush handles; and door handles and light switches. These areas were chosen due to their greater propensity for contamination.[9,10]

All flat surfaces were swabbed using a 10 cm × 10 cm template. Long, narrow surfaces, such as handles and rails, were swabbed over a 5-cm length, and complex surfaces, such as taps and nozzles, were swabbed in their entirety to ensure consistency in sample collection throughout the trial. Each environmental site was swabbed twice using 2 sterile swabs moistened with sterile distilled water. Swabbing was carried out by to-and-fro movements of the swab while simultaneously rolling it to ensure maximum coverage of the area by the swab tip.

Samples were collected every Monday from the pre-trial week (for baseline readings) through 5 weeks following the commencement of the use of the wipes, with swabs being collected each time within an hour after the wards had been cleaned.

Samples were processed on Columbia blood agar and Brazier's *C difficile* selective agar (Oxoid Ltd, Basingstoke, UK) as previously described, including aerobic and anaerobic incubation.[6,10] Cooked meat broth (Oxoid Ltd, Basingstoke, UK) was used for enrichment to improve sensitivity of the testing procedure.[6,10] Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry was used to identify the following indicators of environmental contamination: *C difficile*, *C perfringens*, *Staphylococcus aureus* (methicillin sensitive and resistant strains), *Enterococcus* spp, *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter* spp, *Citrobacter* spp, *Pseudomonas aeruginosa*, *Pseudomonas putida*, *Acinetobacter baumannii*, *Acinetobacter pittii*, and *Stenotrophomonas maltophilia*.[9]

Weekly HCAI data were collected from the 2 wards. Only colonizations or infections acquired by patients after 48 hours' admission into the 2 wards under study were considered.

Findings were reported as weekly detection rates of indicator organisms and HCAI rates.[8-10] Weekly detection rates of indicator organisms from each ward were calculated by dividing the number of sites from which indicator organisms were isolated by the total number of sites sampled and then multiplying this by 100 to obtain a percentage.[10] If multiple indicator organisms were isolated from a single site, the site was still counted as a single. Weekly HCAI rates were created by dividing the number of such cases per week in each ward by the number of occupied beds per week in each ward and then multiplying this by 100 to get a rate per hundred patients per week. Detection rates and HCAI rates from the 2 wards were compared by *z* tests. Linear regression analyses of the rates checked for a significant decrease over time.

GraphPad Prism 4, version 4.02 (La Jolla, CA) was used for statistical analyses. *P* values less than .05 were considered statistically significant.

RESULTS

A total of 166 indicator organisms were isolated during the trial, including the pre-trial week. Of these, 140 were gram-positive organisms (84.3%), whereas 26 were gram-negative organisms (15.7%). The spectrum of indicator organisms isolated weekly from each ward is graphically analyzed in Table 1. The percentages for each organism were calculated by dividing the number of isolates of each organism obtained in a week by the total number of all organisms isolated during that week and multiplying this by 100. *C difficile* was not isolated at any point during the trial.

1. Linear regression analysis showed no significant decrease in the detection rates of indicator organisms, returning *P* values of .06 and .08 for the study and control wards, respectively (Fig 1). The weekly detection rates from the 2 wards (with a total of 20 sampled sites in each ward) were compared and there was no statistical difference (data not shown but available on request). The detection rates of gram-negative indicator organisms from the 2 wards were similar during the preliminary week (study ward: 1 out of 20, 5%; control ward: 0 out of 20, 0%; $P = .31$), but following commencement of the use of the wipes, the rate from the study ward (4 out of 100) was significantly less ($P = .003$) than from the control ward (17 out of 100).
2. Linear regression analysis showed no significant decrease in the HCAI rates, returning *P* values of .31 and .23 for the study and control wards. The HCAI rates for each week appeared to be higher in the study ward than in the control ward, but this was not statistically significant (data not shown but available on request).

A single case of methicillin-resistant *S aureus* (MRSA) transmission occurred in the study ward during week 2. A patient who screened negative for MRSA on admission turned positive after 48 hours in the ward. *Spa* typing confirmed the isolation of the same strain (type t032) from 2 other previously admitted MRSA-colonized patients, as well as from the overbed table of a source patient. There were 3 patients with CDI with a total of 12 diarrhea days in the study ward, and 2 patients with a total of 3 diarrhea days in the control ward during the last 2 weeks of the trial. All were transferred into the wards under study after acquiring the CDI elsewhere.

Approximately 75 packs of quaternary ammonium compound (each pack contains 150 wipes) and 5 packs of alcohol wipes were