American Journal of Infection Control xxx (2012) 1-3

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief report

Environment cleaning without chemicals in clinical settings

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Key Words:
Microfiber cloth
Steam

Effective cleaning of elements in the health care environment has a crucial role in reducing the risk of health care-acquired infection. We assessed ultramicrofiber cloth and steam technology in 2 clinical settings. This new technology performed extremely well. Our pilot study supports using ultramicrofiber cloth and steam technology as an alternative to cleaning with chemicals.

Environment cleaning is of critical importance in health care settings to reduce the risk of health care-acquired infection.[1] Routine cleaning of surfaces must remove epidemiologically important pathogens with which they may have been contaminated.[2] Traditional methods involve cleaning with detergents and disinfection with chemicals.[2]

Newer technologies for environment cleaning are now becoming available. Ultra-microfiber cloths consisting of a combination of polyester and polyamide remove particles by absorption and static attraction. Dirt and bacteria are held tightly in the fibers and not transferred during cleaning. Steam technology uses very high temperatures (140°C) under pressure (97% dry steam) that loosens dirt enabling microfiber cloths to remove micro-organisms from surfaces such as laminate, steel, and vinyl. This includes the removal of *Clostridium difficile* (spores and vegetative form) from different surfaces under laboratory conditions.[3]

The aim of our pilot study was to assess the effectiveness of ultramicrofiber cloths and steam (UMF/steam) technology for cleaning in 2 separate clinical settings.

METHODS

Southern Health is a tertiary referral health service with 500 aged-care beds and 1,600 acute care beds. The health service is committed to ensuring health care-acquired infections are not associated with environment contamination and to reducing our environmental footprint.

This study commenced in May 2011 in a 60-bed residential aged-care ward and a 32-bed acute medical ward. Baseline data collection, using the existing cleaning method, was performed during the first month of the study. As well as assessment of cleaning effectiveness, data collection also included water and chemical volumes used, time to undertake specific cleaning tasks, and the type of cleans: daily, routine discharge (detergent only), or strict contact (eg, for routine followed by disinfectant). In June 2011 implementation of UMF/steam cleaning commenced.

Dampened 32 $\times$ 32 cm ultramicrofiber cloths[3] (Johnson Diversey, Racine, WI) were used for daily cleaning and a combination of UMF/steam were used whenever a patient was discharged. Steam was applied over the surface to be cleaned which was then wiped using the ultramicrofiber cloth. Dampened microfiber mops replaced traditional sling mops. Ultramicrofiber cloths and mops are sent to the laundry for reprocessing after use. They are not rinsed in a bucket of water and reused like traditional cleaning cloths and mops. During August 2011, postimplementation data was collected. During October 2011, a focus group was conducted with cleaning staff at each site to assess opinions of the new technology.

Education of the cleaning staff was paramount to the success of the new cleaning method. In addition, fluorescent marking was used for staff education to highlight the importance of thorough cleaning of high touch points. Fluorescent marker assessments were used as described elsewhere.[4] In brief, 10 high touch points were assessed as either pass or fail based on complete removal of the fluorescent marker.

Visual assessments, using Victorian Cleaning Standards,[5] were made by independent external auditors of the acute ward during

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This research was supported by a grant from Sustainability Victoria and Coviden provided a research scholarship.

Conflict of interest: None to report.

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http://dx.doi.org/10.1016/j.ajic.2012.07.003

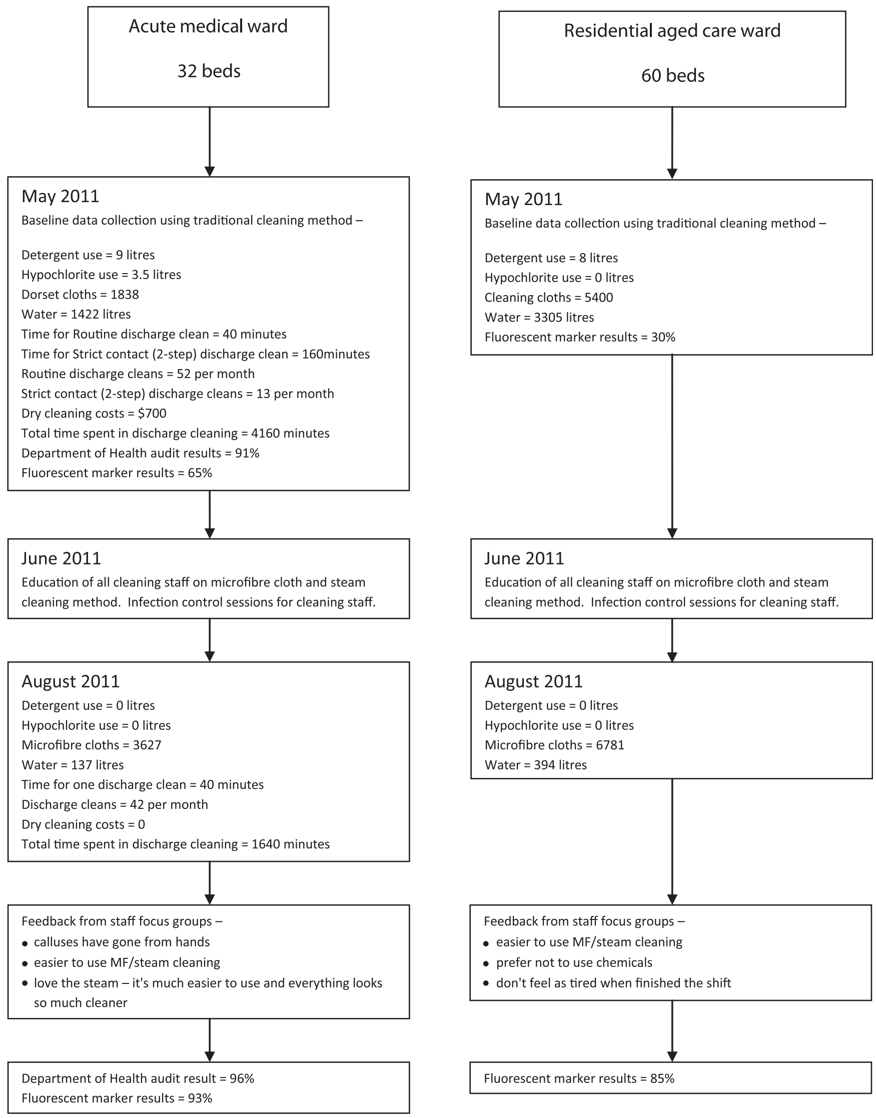

Fig 1. Chronological order of the methods and interventions.

May 2011, before the UMF/steam cleaning commenced and in November 2011, after 4 continual months of using UMF/steam.

A total of 100 adenosine triphosphate bioluminescence readings (expressed as reflective light units (RLU) were taken across 5 rooms from 10 high touch points, before and then again after UMF/steam cleaning, as described previously.[6] Summary statistics were displayed as median and interquartile ranges for the 2 cleaning methods.

Ten high touch points across 10 rooms (200 swabs) were assessed microbiologically for the presence of *C. difficile* with or without vancomycin-resistant *Enterococcus* (VRE). Standard microbiologic testing was performed (without enrichment broths) to assess the presence, before and after UMF/steam cleaning, for VRE or *C. difficile*.[7] Only rooms where patients with these pathogens were known to be isolated were included. Costs associated with dry cleaning of window drapes ($AUD 100) and their removal and reassembly were calculated using an average hourly labor rate of $AUD 25. The chronological order of the methods and interventions are summarized with the results in Figure 1.

RESULTS

The overall water use for each ward was reduced by 90%. One hundred sixty minutes for a 2-step strict contact discharge clean was reduced to 50 minutes.

Visual assessment at baseline achieved a rating of 91%, whereas after implementation of the UMF/steam protocol the result improved to 96%. Fluorescent marking results were favorable, with staff achieving a range of 80%-100%.

Measurements using bioluminescence (50 readings) before cleaning and (50 readings) following cleaning are summarized in Figure 2. Bioluminescence testing showed that UMF/steam provides a very clean surface, in 1 instance as low as 7 RLU. Of significance, the median range before cleaning was 175 RLU and after cleaning was 28 RLU; that is, a 6-fold reduction in bioburden levels ($P < .0001$).

There were 3 points where VRE was isolated before cleaning and these were negative after UMF/steam cleaning. Although patients with diarrhea and confirmation of *C. difficile* or VRE had been accommodated in the rooms for at least 4 days, *C. difficile* was not

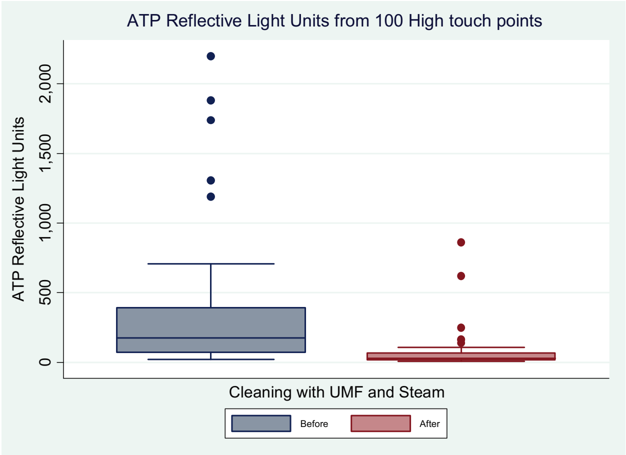

Fig 2. Measurements using bioluminescence (50 readings) before cleaning and (50 readings) following cleaning. *ATP*, adenosine triphosphate *UMF*, ultramicrofiber.

isolated before or after cleaning. Staff members expressed enthusiasm for the UMF/steam cleaning protocol. Comments during the focus groups suggested staff members were no longer exhausted after their shift and 1 cleaner referred to hand calluses that were now gone after many years. The saving in time for removal and reassembly of drapes together with the cost of outsourced dry cleaning created a significant cost-saving opportunity of $AUD 142 per room. Because the steam was 97% dry, UMF/steam cleaning was suitable for most surfaces. However, smoke detectors were avoided to prevent accidental activation.

DISCUSSION

An estimated 20%-40% of health-care acquired infections have been attributed to cross-infection via health care worker hands that are contaminated from direct contact with a patient or indirectly by touching contaminated surfaces.[8] Routine surface disinfection procedures in health care is also now recognized as potentially inadequate.[9] Our health service is committed to safe and effective care and this new technology enables superior cleaning of surfaces for every discharge, regardless of a patient's perceived risk of disease transmission.

The proliferation of surface disinfectants has raised concerns about their safety.[10] This new cleaning technology removes the risk of negative effects on the environment because chemicals are eliminated and water use is reduced by 90%. Initial capital costs to purchase steam machines and ultramicrofiber cloths and mops were offset by eliminating chemicals and replacing dry cleaning. Time savings also provided additional opportunities to save costs by improving the range of cleaning tasks able to be achieved by the existing cleaning workforce.

Our study demonstrates that using UMF/steam resulted in a visually cleaner environment in both settings. Infection control participation in the education of cleaning staff and the use of fluorescent markers created positive teaching opportunities that reinforced the cleaning staff role in protecting patients from cross-infection risks. Compared with previous studies the fluorescent marker results reflect the advantage gained from education.[9] Microbiologic testing validated the removal of VRE from patient environments using this new technology.

With the changes to procedures, our cleaning staff members now perform a uniform discharge clean for all patients regardless of their isolation requirements. Unless visibly soiled, cleaning of walls routinely also ceased and external dry cleaning of drapes was replaced with steam cleaning for patients identified as potentially at high risk. Our results showed that there was considerably less time spent in discharge cleaning using the UMF/steam protocol compared with the previous methods, but the environment was cleaner. There was a statistically significant improvement or 6-fold reduction in bioburden from before to after, when UMF/steam was used.

Because all discharge cleans became 1 procedure, cleaning education was simplified. Less water has reduced the risk of slips and falls, as well as the risk of back injury associated with lifting and emptying buckets of water. Cleaning staff members were adamant they did not wish to return to the previous cleaning method of using chemicals and buckets of water.

UMF/steam has been applied to both acute and residential aged-care clinical settings with favorable results. Extending the technology to high-risk environments such as operating suites and intensive care units has been investigated and procedures developed and assessed. This technology has the potential for application into other health service areas and nonhealth organizations such as schools and businesses, including other industries such as primary production (eg, wine making).

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