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Brief report

Using microfiber and steam technology to improve cleaning outcomes in an intensive care unit

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The use of microfiber and steam technology may be seen as a novel cleaning method that can improve the outcome of cleaning. We describe its use in an intensive care setting, its impact on vancomycin-resistant enterococci acquisition, and the importance of ensuring adequate education of cleaning staff. Such new methods can have a significant impact on the transmission of multidrug-resistant organisms, provided systems are in place to ensure that the methodology is adhered to and that cleaning hours are adequate.

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In April 2013, microfiber and steam technology were introduced into the intensive care unit (ICU) at Dandenong Hospital, Monash Health. The aim was to improve cleaning in response to an increase in vancomycin-resistant enterococci (VRE) transmission during the preceding 4 months.

Previously, terminal cleaning for VRE-colonized patients had involved a 2-step cleaning process, using detergent and water, followed by disinfection with hypochlorite solution 1,000 ppm. Every 3 months, a unit-wide 2-step clean was undertaken to assist in reducing environmental burden of VRE. This process involved using additional cleaning staff, and there was some disruption to ICU services.

Details of the new cleaning methodology have been reported previously,[1] and its value during a gastroenteritis outbreak has been demonstrated.[2]

The new cleaning was introduced after completion of an education program by cleaning staff, which was developed in collaboration with infection control.

METHODS

Monash Health is Victoria's largest metropolitan health service, with 2,150 beds and 13,500 staff. Dandenong Hospital is a 550-bed acute medical-surgical and trauma facility. The Dandenong ICU has 14 beds and admits 105 patients on average per month. VRE screening of ICU patients is performed on admission, weekly, and on discharge. Adherence to the VRE screening program aims to identify patients on admission to ICU and transmission occurring within the unit. Routine VRE screening does not occur in other units within the hospital.

Patients identified as VRE transmission positive were those who screened negative on admission and subsequently returned a positive result on discharge or weekly screen. Those not screened on admission were excluded unless their weekly screen was negative and subsequently returned a positive result.

Prior to introduction of the new cleaning, there were 14 cleaning staff covering a 24-hour period, 7 d/wk (40 hours for cleaning and related activity per day). The cleaning education program commenced in April 2013 and involved 14 cleaning staff and 3 managers. All staff were credentialed as competent using fluorescent marker assessments.

Fluorescent marking was introduced for environmental assessments from November 2013. This involved weekly application as described previously.[3] These assessments continued until results demonstrated alignment with the cleaning procedure. To improve results, increased education and supervision were added to the training schedule of cleaning staff. Casual cleaners were excluded from cleaning in ICUs, and only strained and competent staff were permitted to clean the unit. Cleaning staff needed to achieve 80%

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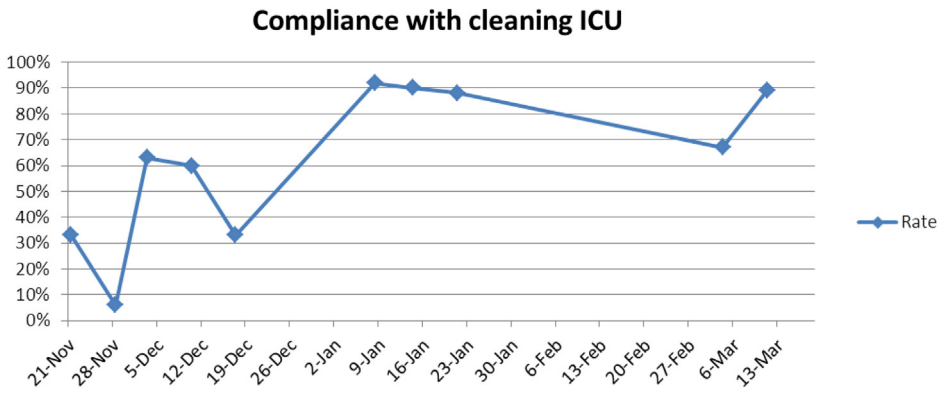

Fig 1. Fluorescent marker results. *ICU*, intensive care unit.

removal of fluorescent marker from high touch points when being assessed, to be credentialed for cleaning.

The new cleaning involved using microfiber dampened with water for daily cleaning and a combination of microfiber with steam for discharge cleaning. No chemicals are used.[1] The microfiber is of very fine grade (<0.3 decitex) and is used alongside steam for terminal cleaning. The steam is used to dislodge organic matter, and no scrubbing is required. The microfiber collects the loosened organic matter, leaving surfaces visibly clean and removing bacterial burden.

From March 2013-July 2014, hand hygiene compliance was assessed using the Hand Hygiene Australia (HHA) auditing process. This included National HHA auditing of 350 moments each in March 2013 and March 2014 plus local HHA auditing by trained HHA auditors.[4] In September 2013, additional roles were assigned to the cleaning staff involving attendance at emergency patient events (assisting in minimizing and managing clinical aggression), outside the ICU. This required cleaning staff to leave the ICU to attend, without being replaced.

In November 2013, cleaning hours were increased by 4, to 44 h/d.

VRE transmission per 1,000 occupied bed days was calculated weekly. A Mann-Whitney *U* test performed using Stata 12 (StataCorp, College Station, TX) analyzed transmission in each period. Box plot graphs representing median and interquartile ranges with a *P* value ≤.50 were considered significant.

Periods were categorized as baseline (January-April 2013), education (May-August 2013), emergency patient event (September-November 2013), and compliance (June-July 2014).

RESULTS

Cleaning process

The use of microfiber and steam cleaning was met with approval by cleaning staff, who became comfortable with its use 1-2 weeks after introduction. Their feedback was positive, and they engaged by contributing to ongoing peer training.

Cleaning Effective Full Time

During the period described, cleaning effective full time remained constant except during September-November 2013 inclusive. During this time there were 259 emergency patient events requiring ICU cleaning staff to attend. The cleaning staff were not replaced while attending these events.

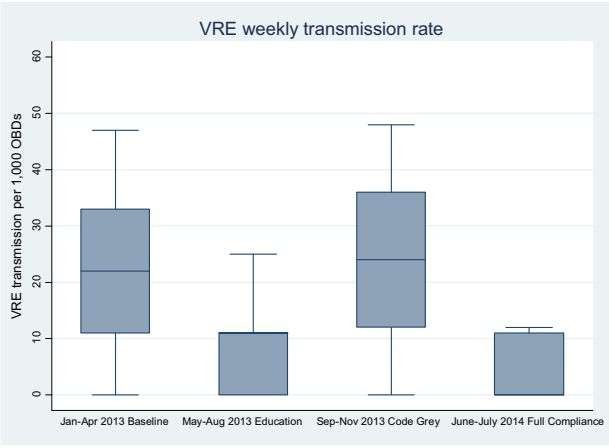

Fig 2. VRE acquisition Dandenong Intensive Care Unit. *OBD*, occupied bed days; *VRE*, vancomycin-resistant enterococci.

Hand hygiene rates

A total of 1,117 hand hygiene moments were assessed during March 2013-July 2014. Compliance to hand hygiene was >70%, with results for all designations at 74% in March 2013 and 77% in March 2014. Local audits demonstrated rates >70%.

Fluorescent marker rates and compliance

During November 2013, the fluorescent marker assessment resulted in <50% being removed during cleaning. This increased to 90% by January 2014 (Fig 1). A comparison of the results from the months prior to the introduction of the new cleaning (baseline) to the first 4 months of its introduction (education) showed a statistically significant improvement ($P = .004$) (Fig 2).

VRE transmission

VRE was universally Van-B *Enterococcus faecium*. Transmission reduced after the introduction of the new cleaning in April 2013 (Fig 3). However, when cleaning staff hours reduced with the introduction of attendance to emergency patient events, transmission was noted to increase. A further significant improvement was demonstrated by June-July 2014 ($P = .003$).

DISCUSSION

Transmission of multidrug-resistant organisms (MDROs) is reliant on a number of elements, with cleaning being a significant

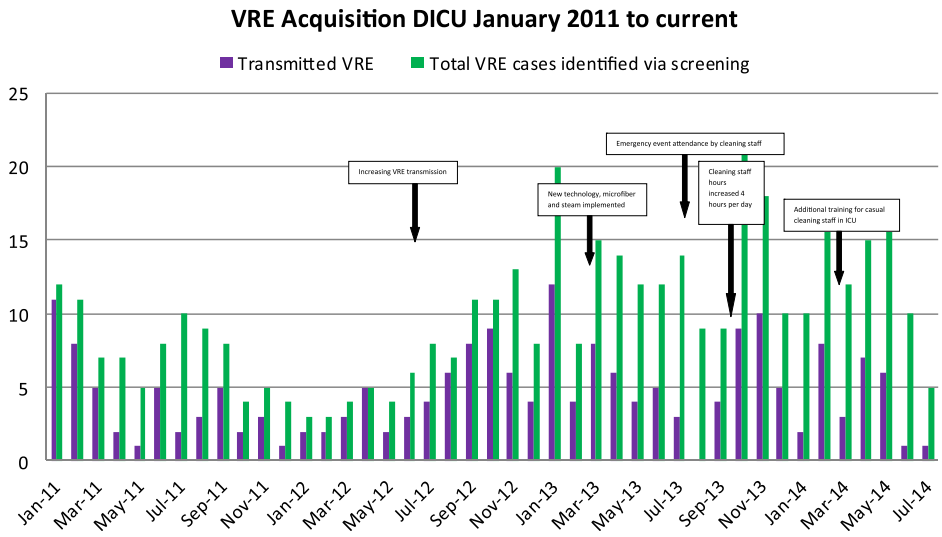

Fig 3. VRE acquisition in the intensive care unit, 2011-2014. *DICU*, Dandenong Intensive Care Unit; *ICU*, intensive care unit; *VRE*, vancomycin-resistant enterococci.

factor.[5] Hand hygiene has been associated with a decrease in acquisition of health care–associated pathogens.[6] Previous studies have demonstrated that MDROs can persist on environmental surfaces after routine cleaning.[7] Interventions addressing the thoroughness of cleaning have been successful in reducing environmental contamination. Cleaning requires sufficient removal of pathogens to minimize patient risk of acquiring MDROs from hospital environments.[8] Best results arise when cleaning occurs first, followed by disinfection. Combining these 2 steps into 1 process may not be as effective because organic matter can inactivate disinfectants.[9] Two-step cleaning is time consuming, and many surfaces do not tolerate hypochlorite disinfection, including fabric drapes or chairs, carpets, or stethoscopes.

Our cleaning involves removal of pathogens, eliminating the need to follow cleaning with a second step of disinfection. Advantages include time efficiency, occupational health and safety benefits, reduced water use, cost opportunities, and capacity to provide superior cleaning, regardless of the patient's perceived risk.[1]

We eliminated VRE transmission intermittently using this new cleaning technique. During periods of transmission for November and December 2013, fluorescent marker assessments demonstrated cleaning procedures were not being completed, showing the importance of continual training auditing of cleaning methods. Casual cleaning staff are now required to undertake specific ICU cleaner training before they can work in the ICU.

Studies have also demonstrated the evidence of fluorescent marking to improve cleaning outcomes.[1,3,10] In our study they provided the impetus to increase training and support the cleaning role. Training and reinforcing procedures is paramount, regardless of the method of cleaning used. Without the capacity to assess cleaning compliance, there may have been an assumption that cleaning was completed, but the cleaning method was inadequate.

In summary, the use of microfiber and steam is a novel cleaning method that can assist in reducing the transmission of VRE. This cleaning method aids in preventing transmission by reducing environmental burden, whether or not the MDRO carriage is known. Adequate training and cleaning hours, measurement for completion of procedures, and ongoing review are essential for successful cleaning outcomes.

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