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Manual cleaning of hospital mattresses: an observational study comparing high- and low-resource settings

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SUMMARY

Background: Hospital-associated infections (HAIs) are more frequently encountered in low- than in high-resource settings. There is a need to identify and implement feasible and sustainable approaches to strengthen HAI prevention in low-resource settings.
Aim: To evaluate the biological contamination of routinely cleaned mattresses in both high- and low-resource settings.
Methods: In this two-stage observational study, routine manual bed cleaning was evaluated at two university hospitals using adenosine triphosphate (ATP). Standardized training of cleaning personnel was achieved in both high- and low-resource settings. Qualitative analysis of the cleaning process was performed to identify predictors of cleaning outcome in low-resource settings.
Findings: Mattresses in low-resource settings were highly contaminated prior to cleaning. Cleaning significantly reduced biological contamination of mattresses in low-resource settings ($P < 0.0001$). After training, the contamination observed after cleaning in both the high- and low-resource settings seemed comparable. Cleaning with appropriate type of cleaning materials reduced the contamination of mattresses adequately. Predictors for mattresses that remained contaminated in a low-resource setting included: type of product used, type of ward, training, and the level of contamination prior to cleaning.
Conclusion: In low-resource settings mattresses were highly contaminated as noted by ATP levels. Routine manual cleaning by trained staff can be as effective in a low-resource setting as in a high-resource setting. We recommend a multi-modal cleaning strategy that consists of training of domestic services staff, availability of adequate time to clean beds between patients, and application of the correct type of cleaning products.

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Introduction

Hospital-associated-infections (HAIs) are more frequently encountered in low- than in high-resource settings.[1,2] Interventions to prevent HAIs have been reported to be cost-effective in high-resource settings and it is likely that this is also the case in low-resource settings.[3–5] However, it is unclear which of the infection control measures that have proven to be cost-effective in high-resource settings might be sustainable in low-resource settings. There is an urgent need to identify and implement feasible and sustainable approaches to strengthen HAI prevention in low-resource settings. Factors contributing to the differences in HAI prevention in high- and low–middle-income countries include the availability of managerial commitment and accountability for infection prevention, personnel and financial resources, availability of microbiological surveillance data, appropriate infrastructure, and maintenance of hospitals and wards.[6,7] Environmental contamination of the patient zone is an important contributor to HAI.[8–10] Still, the extent to which the patient surroundings is contributing to the spread of multidrug-resistant micro-organisms (MDROs) and HAIs both in high- and low-resource settings is poorly understood.

Many campaigns are currently initiated in low-resource settings to improve hand hygiene and to prevent surgical site infections.[11–17] However, the question remains whether these strategies will be equally applicable in a low-resource setting. Furthermore, the spectrum of pathogens differs between low–middle- and high-income countries. Warm and moist climatic conditions are more often present in many low–middle-income countries, probably contributing to an increased proportion of infections with Gram-negative bacilli (GNB). GNB are, for example, a major contributor to surgical site infections in low-resource settings.[2] The increasing antimicrobial resistance to extended β-lactam antibiotics in GNB is posing an emerging risk for patients globally and reduces the treatment options.[18] From high-resource settings we have learned that contamination of the environment, including sinks and sluice areas, may become a permanent source for transmission of GNB in the direct patient zone.[19] Eradication of these sources is a time-consuming and an expensive operation and is unlikely to be performed in a low-resource setting. Hence, differences in contamination levels of the environment between high- and low-resource settings could contribute to the differences in published HAI rates from these settings.

In this study we evaluated the level of contamination of routinely cleaned mattresses that pose as one of the sources of environmental contamination, in both high- and low-resource settings, and we evaluated the effectiveness and sustainability of a training programme for cleaning staff. Furthermore, a qualitative analysis of the cleaning process was performed to identify predictors for the cleaning outcome in low-resource settings, in order to present possible interventions.

Methods

Institutional review for the study was obtained from the Health Research Ethics Committee of Stellenbosch University (Reference N14/08/096). Due to the absence of any patient involvement and because it was considered to be an evaluation of a standard operating procedure, the Medical Ethical Committee of the Radboud University Medical Center (Radboud UMC, The Netherlands) waived the requirement for ethical clearance.

In a two-stage observational study the quality of manual cleaning under 'routine' circumstances in high- and low-resource settings was recorded. The level of contamination was measured using adenosine triphosphate (ATP) as surrogate marker for the presence of residual organic materials. The mattresses were sampled using commercially available Clean-Trace Surface ATP swabs (3M Health Care Ltd). A clean trace NG Luminometer (3M Nederland B.V., Delft) was used to analyse and record the relative light units (RLU).[20]

Training was provided in both high- and low-resource settings. The cleaners involved in the Radboud UMC were trained for three weeks prior to the blinded sampling. In Tygerberg Academic Hospital (Tygerberg, South Africa) an in-house training curriculum for domestic services staff had started only in the previous three years; nurses were not included in the training.

Products used for cleaning in Tygerberg were D-germ® (Biocide Ltd, Cape Town, South Africa), Bioscrub® (Dismed, Midrand, South Africa), Handysan® (Deluxe chemicals, Johannesburg, South Africa) and Sparkle® (Sparkle Products, Cape Town, South Africa) and Terralin®, a quaternary ammonium compound (Schulke, Oss, The Netherlands) in Radboud UMC. D-germ is a chlorhexidine gluconate and alcohol hand rub; Bioscrub is an antiseptic skin cleaner with 4% chlorhexidine gluconate solution. Sparkle is a dishwashing liquid and Handysan is an ammoniated non-scratch general purpose cleaner. Fresh Soap is a liquid hand soap containing surfactants, glycerine, and formalin (AC Products, Parow, South Africa).

First, a two-month study was conducted between July and August 2012 at the surgical short-stay unit of the Radboud UMC, as part of a study aiming at evaluating mechanical and manual bed-cleaning regimens.[20] A three-week training period was conducted prior to sampling. A total of 150 mattresses were sampled for the presence of organic matter using ATP. The cleaning team was blinded for the ATP sampling. Three samples were obtained from designated locations on each mattress after the patient had been discharged and the mattress cleaned.[20] Two of the samples from the mattresses were obtained at the head-end of the mattress and one in the pelvic region.

Second, in 2014, the same sampling protocol was carried out at Tygerberg. The study supervisor from The Netherlands trained the local investigator in South Africa. No extra training was provided in relation to this study before the ATP sampling had occurred. The local investigator collaborated with the unit managers to identify patients who were going to be discharged. A total of 96 beds were sampled on the same three sites of the mattress as in Radboud UMC. The same sampling technique and sampling areas were used. Wards evaluated included the emergency room, ICU, high care, medicine, surgery, ear–nose–throat, urology, orthopaedics, obstetrics, and paediatric wards. After identifying the beds to be sampled, the investigator took a swab from the mattresses immediately after the patient had left the room. After sampling, the mattresses were cleaned and the investigator observed the cleaning procedure. To improve the quality of cleaning, feedback of the study results was given to the domestic staff, unit mangers, and nurses after completion of the sampling of each bed.