Journal of Hospital Infection (2009) **73**, 378–385

Available online at www.sciencedirect.com

ScienceDirect

www.elsevierhealth.com/journals/jhin

REVIEW

The role of environmental cleaning in the control of hospital-acquired infection

S.J. Dancer*

Department of Microbiology, Hairmyres Hospital, East Kilbride, UK

Available online 1 September 2009

KEYWORDS
Acinetobacter;
Environmental cleaning;
C. difficile;
Hospital-associated infection;
Infection control;
MRSA;
Norovirus;
VRE

Summary Increasing numbers of hospital-acquired infections have generated much attention over the last decade. The public has linked the so-called 'superbugs' with their experience of dirty hospitals but the precise role of environmental cleaning in the control of these organisms remains unknown. Until cleaning becomes an evidence-based science, with established methods for assessment, the importance of a clean environment is likely to remain speculative. This review will examine the links between the hospital environment and various pathogens, including meticillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, norovirus, *Clostridium difficile* and acinetobacter. These organisms may be able to survive in healthcare environments but there is evidence to support their vulnerability to the cleaning process. Removal with, or without, disinfectants, appears to be associated with reduced infection rates for patients. Unfortunately, cleaning is often delivered as part of an overall infection control package in response to an outbreak and the importance of cleaning as a single intervention remains controversial. Recent work has shown that hand-touch sites are habitually contaminated by hospital pathogens, which are then delivered to patients on hands. It is possible that prioritising the cleaning of these sites might offer a useful adjunct to the current preoccupation with hand hygiene, since hand-touch sites comprise the less well-studied side of the hand-touch site equation. In addition, using proposed standards for hospital hygiene could provide further evidence that cleaning is a cost-effective intervention for controlling hospital-acquired infection.

Introduction

There has been much debate over hospital cleanliness and increasing numbers of hospital-acquired

* Address: Department of Microbiology, Hairmyres Hospital, Eaglesham Road, East Kilbride G75 8RG, UK. Tel.: +44 1355 585000; fax: +44 1355 584350.
E-mail address: stephanie.dancer@lanarkshire.scot.nhs.uk

0195-6701/$ - see front matter © 2009 The Hospital Infection Society. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.jhin.2009.03.030

infections (HAIs). The public have linked their visual experience of dirty hospitals with the risk of HAI but there is little evidence to support this at present.[1] Cleaning has never been regarded as an evidence-based science and consequently receives little attention from the scientific community. Since there are no scientific standards to measure the effect of an individual cleaner, or assess environmental cleanliness, finding the evidence for benefit in the control of infection is further hampered.[2] There are always basic aesthetic considerations that cannot be disregarded; a perception of cleanliness, however defined, is expected for patients, their relatives and staff from healthcare environments.

Cleaning is routinely monitored by visual audit in the UK. Looking to see if a ward is clean may fulfil aesthetic obligations but it does not provide a reliable assessment of the infection risk for an individual patient on that ward.[3] The organisms that cause infection are invisible to the naked eye and their existence is not necessarily associated with the presence of visual dirt. Furthermore, the impression of cleanliness is confounded by clutter, and fabric and maintenance deficits.[4] Visual assessment will inevitably be subject to bias under these circumstances. It is more difficult to clean a crowded, cluttered environment, perhaps related to a cleaner's incentive, when confronted with peeling plaster, cracked tiles or worn floor coverings.[4]

Sites that are frequently touched by hands are thought to provide the greatest risk for patients, and those situated right beside patients provide the biggest risk of all.[5–7] The responsibility for cleaning near-patient hand-touch sites does not always rest with the ward cleaners, however, since beds, drip stands, lockers and overbed tables are more usually cleaned by nurses.[7,8] Nurses are also responsible for the decontamination of more delicate clinical equipment. This overlapping of cleaning responsibilities has created some confusion; it has also meant that cleaning opportunities of some items are missed or abandoned.[9,10]

The microbial pathogens that cause HAI have two special properties: first, they are recognised as hospital pathogens; second, they have an innate ability to survive on surfaces in the hospital environment for long periods of time.[1] They include organisms such as meticillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, vancomycin-resistant enterococci (VRE), *Acinetobacter* spp. and norovirus.[1,6] This mini-review will summarise the evidence for the presence and survival of these organisms in the clinical environment as well as support for cleaning as a valid infection control intervention for patients. There will also be some discussion on the measurement of 'cleanliness' of the healthcare environment and why this is important for future work evaluating the role of hospital cleaning and HAI.

Meticillin-resistant *Staphylococcus aureus*

MRSA resists desiccation and can survive in hospital dust for up to a year.[11] It is found throughout the hospital environment, particularly around patients known to be colonised or infected with the bacterium. Molecular fingerprinting of these strains shows that MRSA-positive patients tend to shed their own strain of MRSA into the near-patient environment.[12] If staff enter a room containing an MRSA patient, two-thirds of them will acquire the patient's strain on gloved hands or apron.[12] Even if they do not touch the patient directly, four in ten will still exit the room carrying the patient's strain of MRSA on hands or apron.[12]

MRSA can be found on general surfaces such as floors and radiators, furniture such as beds and lockers, and clinical equipment.[7–10,12–14] Some sites, e.g. linen, curtains, beds, lockers and overbed tables, tend to harbour MRSA more frequently than others.[7,8,13] It is thought that contamination of near-patient hand-touch sites provides the biggest risk of MRSA acquisition for patients.[2,6] In addition, there is a small but significant increase in the risk of acquiring MRSA if a patient is admitted into a room previously occupied by carrier patients.[15]

There is some evidence that cleaning removes MRSA from the ward environment with benefit for patients.[6,16] An outbreak of MRSA lingered for several months on a urological ward, resisting all the usual infection control interventions such as promotion of hand hygiene and isolation of patients.[16] The investigating team found the outbreak strain of MRSA scattered throughout the ward environment and doubled the number of domestic cleaning hours from 60 per week to 120. Following this, there was no further isolation of the outbreak strain from the environment and the number of patients affected decreased immediately. The cleaning intervention was thought to have played a significant role in the termination of the outbreak and was estimated to have saved at least £28,000.[16]

Another outbreak of glycopeptide-intermediate *S. aureus* (GISA) in an intensive therapy unit proved difficult to control until a wave of further control measures, including enhanced cleaning,