

Infection Prevention Model Policy and Procedure
Control of the Environment

REVIEW OF LITERATURE

TEAM UNDERTAKING REVIEW: Parts A, B and C - Health Protection Scotland. Part D – Welsh Healthcare Associated Infection Programme (WHAIP).			
CONTACT PERSON: Dawn Hill			
TOPIC: Control of the environment			
PRINCIPAL RESEARCH QUESTION/OBJECTIVE: To review the evidence in relation to measures for the control of environmentally mediated infection.			
METHODOLOGY			
i) Search strategy for identification of studies			
Period of publication	Part A: 1966 – 2004 Part B: 2004 – 2006 Part C: 2007 Part D: 2007 -2008		
Strategy key words for Part D	exp *Infection microbial.mp. microorganisms.mp. exp *Bacteria/ exp *Air Microbiology/ exp *Health Facility Environment/ or Environment/ exp *Hospitals/ut, st [Utilization, Standards]] (health and care).mp. healthcare.mp. setting.mp. exp *Nursing Homes/og, st [Organization & Administration, Standards]] clinics.mp. environment\$.mp. exp *Infection Control/ exp *Cross Infection/ or infection transmission.mp. airborne.mp. exp *Housekeeping, Hospital/ hospital acquired infection		
Electronic databases for Part D (tick as appropriate)	MEDLINE	√	PsycINFO
	Science Direct		EMBASE
	CINAHL	√	SIGLE
	Cochrane Library	√	British Nursing Index
	HMIC	√	Health Technology Assessment
	Bandolier	√	
Specialist web sites/portals searched for Part D	JBI-connect, National Electronic Library-Infection, National Library for Health Guidelines finder, CDC, Welsh Assembly Government (WAG), Scottish Executive Health Dept. (SEHD), Health Protection Agency (HPA), Health Protection Scotland (HPS), Department of Health (DH), Healthcare Associated Infection Research Network, Department of Health & Social Services & Public Safety (DHSSPS-NI) Northern Ireland, WHO, Hospital Infection Society, Infection Prevention Society, Society for Healthcare Epidemiology of America (SHEA), NPHS Knowledge Base		

<i>Hand searching journals</i>	American Journal of Infection Control, British Journal of Infection Control, BMJ, Infection Control and Hospital Epidemiology, Journal of Hospital Infection
ii) Selection criteria for inclusion of studies	
<i>Sample</i>	All health and social care workers.
<i>Outcome measure(s)</i>	Interventions to minimise the spread of environmentally mediated infection.
<i>Other inclusion criteria</i>	N/A
<i>Language Limitations</i>	English language only.
iii) Quality assessment	
Study quality assessment	
<i>Part A (1966-2004)</i>	Identified articles were reviewed according to Roe's model. Guidance documents, however, were unable to be subjected to all such criteria.
<i>Part B (2004-2006), Part D (2007-2008)</i>	Identified articles were reviewed according to either the ROE model for critical appraisal of scientific studies, Sign 50 methodology for systematic reviews and meta-analyses and the AGREE instrument for the evaluation of guidance documents as appropriate.
Data collation and analysis	
	Qualitative analysis of data performed on studies uncovered. Guidance documents reviewed for any relevant commentary. Anecdotal evidence also considered.

Results	
<i>Part A (1966-2004)</i>	<p>The healthcare setting contains a diverse population of microorganisms, but only a few are significant pathogens for susceptible humans. Pathogenic microorganisms can be detected in the air and water and on fomites posing the potential for cross infection, however, determining their role in any infection can be difficult (Bennett & Brachman, 1998). Few reports specify a clear link between the environment and infection as surfaces are not generally implicated in the transmission of infection to staff or patients. According to Centers for Disease Control and Prevention (CDC) guidance published in 2003, where transfer of microorganisms from environmental surfaces to patients does occur it is largely via hand contact with such surfaces (Maki et al., 1982; Danforth et al, 1987). As a consequence, hand decontamination is paramount in reducing infection spread via this route. Guidelines are in place in relation to environmental infection control which outline strategies to prevent environmentally mediated infection and, consequently, reduce HAIs.</p> <p>Environmental surfaces can fall into two categories: i) medical equipment surfaces (e.g. handles of hemodialysis and x-ray machines), ii) housekeeping surfaces (floors, walls, tabletops) (Favero & Bond, 2001). This review will focus on the latter. (See Review of Care of Equipment for information relating to medical patient care equipment surfaces). Healthcare workers, and less frequently patients, can have direct contact with these surfaces and can act as a potential vehicle if such surfaces are contaminated. Indeed, housekeeping surfaces can be categorised further as those with minimal hand-contact (e.g. floors, ceilings) and those with frequent hand-contact (e.g. door handles, light switches).</p> <p>Cleaning is the first step in any process of disinfection or sterilisation. Cleaning is a form of decontamination which removes organic matter and visible soil from environmental surfaces, both of which interfere with microbial inactivation (Favero & Bond, 1991). The physical action of scrubbing/cleaning itself removes large numbers of microorganisms from surfaces and is just as important as the anti-microbial effect of any cleaning agent (Rutala & Weber, 1995).</p>

The method, thoroughness and frequency of cleaning and agents used are dependent on the type of surface being cleaned and the level of touch contact. This choice should be based on local risk assessment. According to CDC guidance (2003), the choice of cleaning agent is largely a matter of judgment based on the nature of the surface to be cleaned, the type of contamination, the degree of contamination, the presence of organic matter, the type and concentration of agent required, the duration of contact and other manufacturer instructions. It should be noted that products approved as skin antiseptics are not recommended for use as environmental surface disinfectants. Furthermore, although alcohol can be used to disinfect certain equipment surfaces, it is not recommended for large environmental surfaces (Favero & Bond, 2001). The selection of cleaning and disinfection agents will vary according to particular settings, however, no clear evidence or guidance is available to date in this regard.

Prior to undertaking cleaning of the environment, a risk assessment should be performed by health and social care workers to establish the appropriate PPE which should be worn (e.g. gloves, aprons). On completion of the task these items should be disposed of appropriately (e.g. if soiled with blood/body fluids, dispose as clinical waste) and hands should be decontaminated (CDC, 2003). Guidance produced by the Medicines and Healthcare Products Regulatory Agency (MHRA) (2002) draws on all the evidence available and recommends the use of water and 'general purpose detergent' for the cleaning of environmental surfaces which are only likely to be in contact with healthy skin and, therefore, are considered low risk (e.g. floors, walls, table tops). Surfaces of lockers etc. can simply be wiped with a disposable wipe using this solution. For surfaces which become contaminated with blood and other body fluids, this guidance suggests that a disinfectant solution of 1000 ppm available chlorine should be applied. However, just as care must be taken to clean surfaces appropriately, unwarranted cleaning of floors has been shown to be unnecessary in healthcare settings. For example, the disinfection of floors offers no advantage over general purpose detergent and has minimal or no impact on the occurrence of HAIs (Dharan, Mourouga, Copi et al., 1999). Evidence suggests that general cleaning of non-porous floor surfaces should be carried out using wet mopping or wet vacuuming, or dry dusting with electrostatic materials (Gable, 1966). Evidence also suggests that care must be taken to minimise contamination of cleaning solutions and cleaning tools during use as mop heads have been shown to be a source of contamination if left soaking (Ayliffe et al., 1967). Laundering of mop heads after use or use of disposable alternatives is recommended (CDC, 2003). Similar care must be given to the cleaning agent used by ensuring the solution is stored correctly and replaced as necessary. Studies have shown gram negative bacilli in certain disinfectants if stored for long periods or if prepared incorrectly (Givan et al., 1971). Disinfectant fogging is not recommended given the lack of published supporting evidence to date (HPS, 2005).

The NHS Scotland Code of Practice for the Local Management of HAI (2004) outlines the responsibility of health care organisations to ensure a safe, effective and clean physical environment of care for service users, staff and visitors, as well as their individual responsibilities. Staff involvement in the cleaning process is essential and must occur at the appropriate level, according to this guidance, and in collaboration with Estates departments. Cleaning services should be monitored regularly using benchmarking to assess their efficacy and efficiency. Underpinning cleaning services, this guidance focuses on the importance of cleaning services staff being trained appropriately, beginning with induction and followed up with regular training and supervision until an acceptable standard is reached. A cleaning schedule outlining the levels of cleaning services for each area and the identification of an appropriate manager for each clinical area and the Cleaning Services Manager should be available to all staff. By doing so, this guidance aims to create a standardised approach to cleaning. All of this work should be set within a risk assessment framework in line with The NHS Scotland Code of Practice for the Local Management of HAI (2004).

As highlighted by the NHS Estates document '*Cleanliness Matters*' (2004), the public perceive cleanliness within health care facilities to be extremely important. Therefore, much attention has been paid to this aspect in recent months. The NHS Scotland National Cleaning Services Specification was published in May 2004 and gives considerable detail as to the tasks which should be undertaken and schedules which should be followed to ensure as far as possible that the environment within health care settings is clean as appears below. Literature suggests that the following surfaces are the most important due to touch contact (CDC, 2003).

1. Hard floors:

The floor should be free of dust, grit, litter, chewing gum, marks and spots, water or other liquids;

The floor should be free of polish or other build-up at the edges and corners or in traffic lanes;

The floor should be free of spots, scuffs or scratches on traffic lanes, around furniture and at pivot points;

Inaccessible areas (edges, corners and around furniture) should be free of dust, grit, lint and spots;

Polished or buffed floors should be of uniform lustre;

Appropriate signage and precautions are taken regarding pedestrian safety on newly cleaned or wet floors.

2. Soft floors:

The floor should be free of dust, grit, litter, chewing gum, marks and spots, water or other liquids;

The floor should be free of spots, scuffs or scratches on traffic lanes, around furniture and at pivot points;

Inaccessible areas (edges, corners and around furniture) should be free of dust, grit, lint and spots;

Carpets should be of even appearance without flattened pile.

After deep cleaning, there is no shrinkage, colour loss or embrittlement of fibers.

Barrier matting zones should be free from ingrained dust, dirt and stains.

3. Toilets, sinks, basins, baths, taps and fixtures:

Porcelain, cubicle rails and plastic surfaces should be free from smudges, body fluids, soap build-up and mineral deposits;

Metal surfaces, shower screens and mirrors should be free from streaks, soil smudges, soap build-up and oxide deposits. Wall tiles and wall fixtures (including soap dispensers and towel holders) should be free of dust, grit, smudges/ streaks, mould, soap build-up and mineral deposits;

Shower curtains and bath mats should be free from stains.

Plumbing fixtures should be free of smudges, dust, soap build-up and mineral deposits;

Bathroom fixtures should be free from unpleasant smudges, smears, odours, mould and body fluids;

Polished surfaces should be of a uniform lustre;

Sanitary disposal units should be clean and functional;

Consumable items should be in sufficient supply;

Waste is removed in accordance with Service Standards of Waste Management Service Level Specification or Local Policy.

4. Furniture, fixtures, fittings and soft furnishings:

Hard surface furniture should be free of spots, film, dust, fingerprints and spillage;

Soft furnishings should be free from stains, soil, film and dust;

Furniture legs, wheels and castors should be free from mop strings, soil, film, dust and cobwebs;

Inaccessible areas (edges, corners, folds and crevices) should be free of dust, grit, lint and spots;

All high surfaces should be free from dust and cobwebs;

Equipment should be free of tapes/plastic etc. which may compromise cleaning;

Furniture should have no unpleasant or distasteful odour;

Shelves, bench tops, cupboards and wardrobes/lockers should be clean inside and out and free of dust, litter or stains; Internal

plants should be free of dust and litter.

5. Low level surfaces:

Internal and external walls and ceilings should be free of dust, grit, lint, soil, film, graffiti and cobwebs;

Walls and ceilings should be free of marks caused by furniture, equipment or site users;

Light switches should be free of fingerprints, scuffs and any other marks;

Light fittings should be free of dust, grit, lint and cobwebs.

6. High level surfaces:

Internal and external walls and horizontal surfaces should be free of dust, grit, lint, soil, film, graffiti and cobwebs; Walls and ceilings should be free of marks caused by furniture, equipment or site users.

	<p>7. Telephones: Telephones should be visibly clean.</p> <p>8. Paintwork – Walls and Doors: Internal and external doors and doorframes should be free of dust, grit, lint, chewing gum, soil, film, fingerprints and cobwebs; Doors and doorframes should be free of marks caused by furniture, equipment or staff; Air vents, grilles and other ventilation outlets are kept unblocked and free of dust, grit, soil, film, cobwebs, scuffs and any other marks; Door tracks and door-jambs should be free of grit and other debris.</p> <p>9. Glass partitions and panels and ceramic wall tiles: Glass partitions, panels and ceramic wall tiles should be free from dust, soil, smears fingerprints, and have a polished finish; External and internal surfaces of glass should be clear of all streaks, chewing gum, spots and marks, including fingerprints and smudges; Window frames, tracks and ledges should be clear and free of dust, grit, marks and spots.</p> <p>10. Curtains/screens: Curtains, blinds and drapes should be free from stains, dust, cobwebs, lint. Cords should be clean and knot free.</p> <p>11. Window blinds: Curtains, blinds and drapes should be free from stains, dust, cobwebs, lint. Cords should be clean and knot free.</p> <p>12. Hand hygiene products: Consumable items should be in sufficient supply.</p> <p>13. Ashtrays: Ashtray should be visibly clean.</p> <p>14. Refuse: Waste/rubbish bins or containers should be clean inside and out, free of stains and mechanically intact; Waste should be removed in accordance with the Service Standards of the Waste Management Service Level Specification or local policy.</p> <p>15. Kitchen/servery, fixtures, fittings and appliances: Fixtures, surfaces and appliances should be free of grease, dirt, dust, deposits, marks, stains and cobwebs; Electrical and cooking fixtures and appliances should be kept free from signs of use or non-use; Cooker hoods and filters should be free of grease and dirt on inner and outer surfaces; When cleaning food preparation areas, fixtures and appliances, the requirements of the Royal Environmental Health Institute of Scotland or the Royal Institute of Public Health and Hygiene, as appropriate, must be satisfied; Motor vents etc. are clean and free of dust and lint;</p>
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Refrigerators/freezers should be clean and free of ice-build-up;
Waste should be removed in accordance with the Service Standards of the Waste Management Service Level Specification or local policy.

16. Cleaning equipment:

Equipment should be clean, dry and serviceable;
Equipment should be stored correctly.

Within the NHS Estates document, *Infection control in the Built Environment* (2001), guidance is given with regards to the type of building materials which should be used and the ergonomics within healthcare settings to minimise the spread of infection. HAI Task Force Working Group 6 & 8 has been established to consider such guidance and output will be available in due course.

As is evident from this review, the majority of literature relevant to this area is published in the form of guidance and recommendations. Underpinning evidence is limited and focuses primarily on the need for cleaning and the use of particular methods for cleaning the environment. From this array of guidance, clear recommendations are available which outline those products and techniques to be applied to the cleaning of the environment within healthcare settings, however, the lack of specific evidence to support key procedures and schedules must be addressed in order to substantiate the importance of this measure in the prevention of potential infection spread.

National Standards of Cleanliness for NHS Trusts in Wales (2003) and the subsequent Performance Toolkit (2003) focus on cleaning output requirements based on the use of risk assessment. The standards require Health care Trusts to demonstrate that cleanliness is being maintained to consistent standards that meet the expectation of stakeholders. The national standards can be used as the basis for specifications for all service level agreements and contracts, standards for benchmarking, and for auditing of standards of cleanliness. The performance assessment (toolkit) document provides the tools required for Trusts to measure the efficacy of the cleaning service administered.

Part B (2004-2006)

The annual review aims to identify, review and critique any scientific studies or guidance, which have been published in the intervening period since the original literature review, to determine if changes to guidance are required.

The literature search using the described strategies identified a number of additional studies specifically on contamination and cleaning of the healthcare environment. However, most of the published articles were in the form of commentary, which did not provide any additional scientific evidence that would effect a change in guidance.

Several scientific studies recently published; focus on the ability of microorganisms to survive in the healthcare environment. One study, (Hardy *et al.*, 2006) looked at the spread and survival of MRSA in wards and demonstrated that viable organisms were found some distance from colonized patients. Another study (Lankford *et al.*, 2006) looked at the survival of two different organisms vancomycin-resistant *enterococcus* (VRE) and *pseudomonas aeruginosa* on different upholstery and flooring materials, commonly used within healthcare environments. The results demonstrated survival rates of these organisms of approximately 35-50% after 24 hours. These studies demonstrate the importance of effective and appropriate environmental cleaning,

Several articles have been published looking at the benefits of surface cleaning with disinfectant versus detergent. One review, (Rutala & Weber, 2004) discussed persistence of certain organisms in the environment, such as MRSA and VRE, which have demonstrated viable survival for hours and even weeks on dry surfaces and thereby becoming a possible reservoir of infection. The authors discuss the relative advantages and disadvantages surrounding the routine use of disinfectants versus detergents for surface cleaning of non-critical surfaces. The authors recommend that hospital disinfectants should be used in preference to detergents for non-critical surfaces such as bedside tables and rails. However, this review is written as a commentary and does not contain sufficient data to allow full analysis.

A study (Barker *et al.*, 2004) looked at the effects of cleaning and disinfection in reducing the spread of norovirus via contamination on environmental surfaces. The authors concluded that in the case of an outbreak, which had resulted in environmental contamination with body fluids, that disinfection with an appropriate compound should take place.

This use of appropriate disinfectant in the case of an outbreak (i.e. Norovirus) is in line with the guidance within this policy, that further advice from infection control teams must be sought in the case of outbreaks of specific organisms and additionally the model policy on Management of Blood and Body fluid spillages.

Part C (2007)

The annual review aims to identify, review and critique any scientific studies or guidance, which have been published in the intervening period since the last update (2007), to determine if changes to guidance are required.

1.1 Control of the Environment

The literature search identified a number of additional studies specifically on cleaning of the healthcare environment. One recently published article examined the effectiveness of current cleaning within NHS hospitals in the UK. The authors (Cooper et al., 2007) described a survey of the efficacy of hospital cleaning in four hospitals in the UK which was assessed using a combination of visual assessment; ATP bioluminescence methodology and microbiological assessment. The results of this study showed no significant difference between results obtained using microbiology and ATP bioluminescence methods to assess cleaning; however there was a statistically significant difference between the use of these methodologies and visual assessment, which consistently under estimated the actual cleaning. This study is relatively small scale, however does indicate visual inspection to assess cleanliness may not be reliable.

A review article on the role of the contamination of the patient environment and possible contribution to HAI (Boyce, 2007) has been recently published. The actual method for literature search and assessment of scientific evidence has not been well described in this review, however the possible role of environmental contamination in a number of outbreaks was clearly discussed. The author concludes that a number of microorganisms associated with HAI have been shown to survive on environmental surfaces for extended periods of time and therefore have the potential to be spread via the hands of HCWs if inadequate hand hygiene is performed. This article therefore further supports the importance of thorough cleaning of the patient environment.

A recently published microbiological evaluation of current hospital cleaning methods (White et al., 2007) examined the reduction in bacterial load achieved by four cleaning methods which were; mop and vacuum; spray clean; wet scrub and one steam cleaning method used for bed curtains. The results of this assessment showed that all three of the floor cleaning techniques resulted in a reduction in the bacterial load, although occasionally a high microbiological count remained despite cleaning.

Wet scrubbing caused the largest reduction in bacterial load, particularly coagulase-positive staphylococci, for at least a week after this cleaning method had been carried out and this was shown to be statistically significant. The results of the steam cleaning methods for cleaning of bed curtains also showed a reduction in the overall bacterial load, however not a reduction in coagulase-positive staphylococci specifically and therefore this method may need further assessed before use as a potential replacement to laundering of bed curtains. This study was relatively small scale and performed at one hospital site and therefore the results should be treated with caution. The authors of this study discuss that although floors are not thought to be a big contributor to HAI, that there is the potential for microorganisms to be transferred by contact e.g. dropped articles, patients feet etc, therefore it is important that the efficacy of different cleaning methods are properly evaluated to enable choice of effective and appropriate cleaning methods for use in hospitals.

1.1.1 Disinfectant versus detergent

There has been a great deal of debate regarding the use of disinfectants versus detergent. This has been fuelled by publications detailing the efficacy of hypochlorite for dealing with *Clostridium difficile* spores. Consequently there have been calls for the routine use of disinfectants for cleaning and maintenance of the patient environment. This subject will be reviewed further as part of work taking place on transmission based precautions and is available via the HPS website.

One recently published review (Dettenkofer and Spencer, 2007) challenges the use of disinfectants for routine decontamination citing safety concerns and also the potential for emerging resistance of pathogens to commonly used disinfectants. The authors carried out a systematic review to assess the current evidence and noted that few published studies included sufficient controls for inclusion and that many publications were based on expert opinion. The authors concluded that based on analysis of the four studies included that there was insufficient evidence to show that environmental cleaning with disinfectant versus detergent was associated with a drop in infections rates. It is clear however that the number of good quality studies in this area is relatively low and subsequently the authors call for well-designed studies to properly evaluate the evidence surrounding the use of detergents versus disinfectants and to provide clear advice and guidance for healthcare settings.

1.1.2 New cleaning technologies – use of steam cleaning and microfibre cloths

There are a number of new technologies for cleaning which have received publicity due to public concerns regarding cleanliness of NHS hospitals. The Department of Health (DH) has recently released a report into the benefits and implications of two of these methodologies namely steam cleaning and the use of microfibre cloths (DH, 2007). This report examines the results of studies on their efficacy for cleaning and decontamination of the hospital environment of pathogenic organisms.

The results of one study demonstrated that both traditional and microfibre cloths result in reduction of bacterial load of environmental surfaces if used correctly as measured by ATP detection, although it is not reported whether this is statistically significant. The microfibre cloth technology is based statically charged fibres which cause dirt to cling to the cloth by electrostatic attraction, and this enables easier cleaning of 'difficult to reach' areas. The material is strong and able to stand up to repeated laundering. However there are a number of drawbacks in that they are not suitable for use with disinfectants or detergents and therefore should not be used for dealing with blood or body fluid spillages. The report also highlights that the cloths should only be used, one per patient area and cleaning staff will require additional training in their use.

The results of the studies into the efficacy of steam cleaning demonstrated that this methodology results in complete disinfection of the surfaces assessed of the test organisms, which included MRSA, *Acinetobacter* and *Clostridium difficile* spores. An additional study was performed to assess the potential aerosolisation of microorganisms, however the result showed that there was no evidence of dispersion of viable organisms, however the results of these tests are not reported in full.

The report concludes that steam cleaning is very effective, particularly for periodic deep cleaning of hospital environments. There are also advantages in that soft furnishings can be cleaned using this method. However, it is not suitable for regular daily use due to constraints such as a requirement for intensive training and health and safety issues associated with steam hoses, electric cables and activation of fire alarms etc. Therefore, although a highly effective method, it is not suitable for replacement of current regular cleaning regimes.

Part D (2007-2008)

This review aims to identify and critique any scientific studies or guidance, which have been published in the period since the last literature review was carried out, to determine if changes to guidance are required.

1. The healthcare environment

An observational study by *Hayden et al.* (2008), emphasized the risk of hand or glove contamination after contact with the environment of patients colonized with VRE. Samples were obtained from 22 patients colonized with VRE, and specific sites within their environment. 17% (+/- 12%) of environmental samples grew VRE. The PFGE patterns of VRE isolates from patients matched those from the environment in all episodes. 44% of HCW's touched only the patient environment, whilst 56% touched both the patient and the patient's environment. No HCW touched only the patient. Culture samples were obtained from HCW's hands and gloves before and after care. Of 103 HCW's whose hands were negative for VRE when they entered the patient's room, 52% contaminated their hands or gloves after touching the environment only, and 70% contaminated their hands or gloves after touching the patient and their environment. The authors highlight the need to view touching the environment of a patient colonized with VRE as an activity that poses a high risk for hand contamination.

Boyce et al. (2007), conducted a study to determine whether patients with heavy gastrointestinal colonization with MRSA accompanied with diarrhoea contaminated their environment more than patients without gastrointestinal MRSA colonization. Samples from a standardized list of 10 environment surfaces were cultured from the rooms of 8 patients who had diarrhea that yielded heavy growth of MRSA (case patients) and from the rooms of 6 MRSA positive patients with stool cultures negative for MRSA (control patients). Isolates from 13 patients (8 cases and 5 controls) and 64 environmental isolates were compared by PFGE. MRSA was recovered from 47/80 (59%) of surfaces in case rooms and 14/60 surfaces in control rooms (23%). The most commonly contaminated environmental sites were bedside rails, blood pressure cuffs, TV remote controls and toilet seats. 78% of environmental isolates had PFGE types that were indistinguishable or closely related to patient isolates. The authors concluded that patients with heavy gastrointestinal colonization with MRSA and concomitant diarrhea appear especially likely to contaminate items in their immediate environment that are frequently touched.

2. Cleaning and the healthcare environment

In June 2008 *Free to Lead Free to Care - empowering ward sisters/charge nurses ministerial task and finish group*, was published by the Welsh Assembly. Recommendations relating to the ward environment, cleanliness and the role of the ward sister in environmental management are made to include:

- The National Standards of Cleanliness for NHS Trusts in Wales (2003) should be updated by 2009

- An all-Wales monitoring tool for cleanliness should be adopted across the NHS in Wales.
- Ward Sisters/Charge Nurses should have additional involvement in decisions relating to cleanliness standards and specifications
- To ensure the ward sister/charge nurse is able to maintain the highest standards of cleanliness on the wards the NHS in Wales should adopt the Cleaning Operatives Proficiency Certificate award from the British Institute of Cleaning Science as the national minimum standard of training for ward cleaners.
- A national advisory forum, hosted by Welsh Health Supplies in association with Welsh Health Estates, should be established to review standardising products for cleaning and infection control across the NHS in Wales. This forum should also review new and innovative technologies for cleaning and infection control and advise the NHS accordingly.

Carling et al. (Infection Control and Hospital Epidemiology, 2008) undertook a study to evaluate the thoroughness of disinfection and cleaning in the patient's immediate environment and identify opportunities for improvement in 23 acute care hospitals. A transparent, easily cleaned, environmentally stable solution that fluoresces when exposed to UV light was used to assess the cleaning of high risk areas in the patient environment as part of terminal room cleaning. The overall thoroughness of cleaning expressed as a percentage of objects evaluated was 49% +/- 11%. However the study uncovered a wide range of results with respect to how well individual areas were cleaned. The study suggested cleaning could be improved by identifying reasons for problems within domestic services and by using focused educational interventions with domestic staff.. A second paper by *Carling et al.* (JHI, 2008) using the same marker system to assess cleaning, looked specifically at ICU's. Results from 16 units showed that post-discharge only 57% of standardized frequent touch areas were cleaned. High rates of cleaning were found for some areas eg. toilet seats mean 82% (range 66-100%), tray table 86% (range 57-100%), sink 92% (range 45-100%). Other areas eg. toilet area handholds, doorknobs, light switches, had low rates of cleaning.

Similar themes were investigated by *Goodman et al* (2008). They evaluated adequacy of discharge cleaning of ICU rooms and the impact of cleaning interventions on the presence of MRSA and VRE on environmental surfaces. High frequency touch surfaces on ICU were identified. Evaluation and culturing during a baseline period involved marking areas with an invisible light sensitive substance that was removed with a moist cloth applied with moderate pressure, and culturing pre-selected areas for MRSA and VRE. The intervention involved 3 components: changing the method of application disinfectant to the cleaning cloth, education of cleaning staff and timely feedback of thoroughness of cleaning from the indicator system. The intervention improved cleaning and decreased the likelihood of environmental cultures being positive for MRSA or VRE.

Griffiths et al. (2007) used a combination of bacterial counts and assessment of residual organic soil using ATP detection. A baseline assessment using existing cleaning regimens (lacking in details, specifying frequency of cleaning rather than how or with what areas were to be cleaned and using a non-ionic detergent) was compared with (a) more detailed regimen which added a rinsing and drying stage (b) the same more detailed regimen but replacing the non-ionic detergent with a quaternary ammonium sanitizer possessing both detergent and disinfectant properties. Both (a) and (b) yielded significantly lower and more consistent bacterial counts and lower ATP levels than the existing regimen. Incorporating a quaternary ammonium sanitizer produced a further, slight but not significant, improvement in cleaning efficacy. Their findings suggest that simple improvements in existing cleaning regimens can improve cleaning efficacy.

Bartels et al. (2008), published a paper on environmental MRSA disinfection using dry-mist-generated hydrogen peroxide. Whilst clearly not applicable to everyday routine healthcare practice, it did highlight the problem of persistence of MRSA in soft furnishing.

No scientific study was found on the effects of any of the interventions discussed above on acquisition of MRSA and VRE as colonizing organisms or on rates of healthcare associated infections. Much work requires to be carried out in this area.

CONCLUSIONS

Part A (1966-2004)

- The healthcare setting contains a diverse population of microorganisms. Pathogenic microorganisms can be detected in the air and water and on fomites posing the potential for cross infection, however, determining their role in any infection can be difficult (Bennett & Brachman, 1998).
- Surfaces are not generally implicated in the transmission of infection to staff or patients. However, according to CDC guidance published in 2003, the transfer of microorganisms from environmental surfaces to patients is largely via hand contact with these surfaces.
- As a consequence, hand decontamination is paramount in reducing infection spread via this route.
- Guidelines are in place in relation to environmental infection control which outline strategies to prevent environmentally mediated infection.
- Environmental surfaces can fall into two categories: i) medical equipment surfaces (e.g. handles of hemodialysis and x-ray machines), ii) housekeeping surfaces (floors, walls, tabletops). This review deals only with the latter.
- The physical action of scrubbing/cleaning itself removes large numbers of microorganisms from surfaces and is just as important as the anti-microbial effect of any cleaning agent (Rutala & Weber, 1995).
- The method, thoroughness and frequency of cleaning and agents used are dependent on the type of surface being cleaned and the level of touch contact. This choice should be based on local risk assessment.
- Staff should don appropriate PPE (e.g. gloves, aprons) following risk assessment and dispose of this accordingly on completion of cleaning. Staff should then decontaminate their hands to avoid contamination.
- Guidance produced by the Medicines and Healthcare Products Regulatory Agency (MHRA) (2002) recommends the use of water and 'general purpose detergent' for the cleaning of environmental surfaces which are only likely to be in contact with healthy skin and, therefore, are considered low risk (e.g. floors, walls, table tops).
- The NHS Scotland Code of Practice for the Local Management of HAI (2004) outlines the responsibility of health care organisations to ensure a safe, effective and clean physical environment of care for service users, staff and visitors.
- Cleaning services should be monitored regularly using benchmarking to assess their efficacy and efficiency.

	<ul style="list-style-type: none"> • This guidance focuses on the importance of cleaning services staff being trained appropriately, beginning with induction and followed up with regular training and supervision until an acceptable standard is reached. • A cleaning schedule outlining the levels of cleaning services for each area and identification of the appropriate manager for each clinical area and the Cleaning Services Manager should be available to all staff. • The NHS Scotland National Cleaning Services Specification (2004) gives considerable detail as to the tasks which should be undertaken and schedules which should be followed in relation to environmental surfaces, including hard floors, soft floors, toilets, sinks, basins, baths, taps and fixtures, furniture, fixtures, fittings and soft furnishings, low level surfaces, high level surfaces, telephones, paintwork (walls and doors), glass partitions and panels and ceramic wall tiles, curtains/screens, window blinds, hand hygiene products, ashtrays, refuse, cleaning equipment, kitchen/servery, fixtures, fittings and appliances. For specific details see results section. • Guidance with regards to the type of materials which should be used and the ergonomics within healthcare settings to minimise the spread of infection are being dealt with by HAI Task Force Working Group 6 & 8. Output will be available in due course. • National Standards of Cleanliness for NHS Trusts in Wales should be applied in all relevant Healthcare settings and can be used for all other healthcare settings as a guide
Part B (2004-2006)	<ul style="list-style-type: none"> • Recently published studies demonstrate the potential of pathogenic organisms such as MRSA and VRE to persist in the environment, thereby becoming a potential reservoir of infection, which can transfer to the hands of HCWs and patients. • These studies demonstrate the importance of effective environmental cleaning.
Part C (2007)	<ul style="list-style-type: none"> • One recent study examined the efficacy of hospital cleaning in four hospitals in the UK using a combination of visual assessment; ATP bioluminescence methodology and microbiological assessment. • This study which although relatively small scale indicated that a visual inspection of cleanliness is not a reliable method. • There has been much debate regarding the use of disinfectants versus detergents and there are calls for use of disinfectants for routine cleaning and maintenance of the patient environment. It is clear that in the case of outbreaks e.g. CDAD that there is a requirement for the use of disinfectant due to the nature of the microorganisms.

	<ul style="list-style-type: none"> • One recently published review article challenges the use of disinfectants for routine decontamination citing safety concerns associated with disinfectants and also the potential for emerging resistance in pathogens to commonly used disinfectants. • The authors note that the number of good quality studies in this area are relatively low and call for well-designed studies to properly evaluate the evidence surrounding the use of detergents versus disinfectants and to provide clear advice and guidance for healthcare settings. • The Department of Health (DH) has recently released a report into the benefits and implications of steam cleaning and use of microfibre cloths. • The microfibre cloth technology is based statically charged fibres which result in dirt clinging to the cloth by electrostatic attraction, which enables easier cleaning of 'difficult to reach' areas. • The material is strong and able to stand up to repeated laundering, however they are not suitable for use with disinfectants or detergents and should therefore not be used for dealing with blood or body fluid spillages. • The report also highlights that the cloths should only be used, one per patient area and cleaning staff will require additional training in their use. • The results of the studies into the efficacy of steam cleaning of bed curtains demonstrated complete disinfection of the surfaces assessed, of the test organisms that included MRSA, <i>Acinetobacter</i> and <i>Clostridium difficile</i> spores. • An additional study was performed to assess the potential aerosolisation of microorganisms, however the result showed no evidence of dispersion of viable organisms, although the results were not reported in full. • The report concludes that steam cleaning is a very effective method particularly for periodic deep cleaning of hospital environments. • Steam cleaning is not suitable for regular daily use due to constraints such as a requirement for intensive training, health and safety issues associated with steam hoses, electric cables etc and possible activation of fire alarms • Therefore, although a highly effective cleaning methodology, it is not currently suitable for replacement of regular / daily cleaning regimes.
<p>Part D (2007-2008)</p>	<ul style="list-style-type: none"> • The ward sister should play a pivotal role in the control of the environment and in maintaining standards of cleanliness

	<ul style="list-style-type: none"> • Touching the environment of a patient colonized with VRE is an activity that poses a high risk for hand or glove contamination • Patients with gastrointestinal colonization with MRSA and concomitant diarrhoea are especially likely to contaminate their immediate environment • Wide ranges have been identified in studies looking at the thoroughness of cleaning of patients' environment, even in high risk areas like ICUs. • Monitoring systems have been used to show that cleaning efficacy can be improved by <ul style="list-style-type: none"> - optimizing cleaning regimens - education of domestic staff - providing feedbacks to staff about thoroughness of cleaning
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RECOMMENDATIONS

<p><i>Part A (1966-2004)</i></p>	<ul style="list-style-type: none"> • Cleaning service staff should be trained appropriately, beginning with induction and followed up with regular training and supervision until an acceptable standard is reached. • Cleaning services should be monitored regularly using benchmarking to assess their efficacy and efficiency. • A cleaning schedule outlining the levels of cleaning services for each area and identification of the appropriate manager for each clinical area and the Cleaning Services Manager should be available to all staff. • Prior to undertaking environmental cleaning, staff should don appropriate PPE (e.g. gloves, aprons) according to risk assessment. • Dust control mops (anti-static type) should be used for collecting dust and grit. • Cotton or mixed fibre mops should be used to collect dirt and soil. • Disposable mop heads should be used. • Neutral detergent and hand hot water should be used to clean surfaces as required. • Non-disposable cleaning equipment (e.g. buckets) should be cleaned regularly and stored properly. • Hard floors and soft floors should be free of dust grit, litter etc, with particular attention being paid to hard to reach areas, such as edges, corners. • Toilets, sinks, basins and baths should be free from soap build-up and mineral deposits. Attention should be paid to fixtures, shower curtains, wall tiles and hand rails.
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	<ul style="list-style-type: none"> • Furniture should be free of dust and staining. Inaccessible areas and high surfaces should also be free of dust and grit. Soft furnishings can be vacuumed or wet vacuumed, but if so, should be allowed to dry fully. Items such as mattresses should be cleaned/repaired/replaced if stained, torn or worn. • Walls and ceilings should be free of dust, grit, etc. Attention should be paid to light fittings and light switches. • Telephones should be visibly clean. • Paintwork should be clean and free of dust etc, as should glass partitions, panels, curtains, screens, and window blinds. • Refuse containers should be clean inside and out and free of stains. • Kitchen fixtures and appliances should be free from grease, dirt and dust. • Staff should dispose of any PPE (e.g. gloves, aprons) appropriately on completion of cleaning. • Staff should then decontaminate their hands to avoid contamination.
Part B (2004-2006)	No change to present guidance recommendations in literature review available 11/08/05
Part C (2007)	There is no change to the model policy on control of the environment recommended as a result of this review.
Part D (2007-2008)	Nothing additional needs to be added to Infection Prevention Model Policy/Procedure 1 (version 1) as a result of this literature search.
PRACTICAL APPLICATION	As the environmental measures described have been recommended for some time, no significant change to practice should be required; however, the standards set down must be achieved.
RESOURCE IMPLICATIONS	As per current policies. All resources required for dealing with control of the environment should already be in place.

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