Introduction

Cleaning staff blend into the background on a busy ward. Although they go about their duties generally unnoticed, their work is hardly unimportant. Keeping the hospital clean is a heavy responsibility. It is, in fact, likely to be a critical factor in infection control and in the continuing fight against hospital-acquired infections.

Hospitals provide a reservoir of micro-organisms, many of which are multiply-resistant to antibiotics. Patients and staff supply some of these organisms, but the hospital environment forms a substantial repository for others – if allowed. Thorough and conscientious cleaning significantly disturbs the ecological niches found by potentially pathogenic organisms. If there were no domestic staff, it seems likely that there would be far more cases of hospital-acquired infection. Apart from reducing reservoirs of micro-organisms, cleaning also has an aesthetic purpose.1-4 The apparent level of cleanliness is important for patient confidence. Patients and their visitors make comments about hospitals they consider dirty and will associate this with a general lack of care.1 Thus the environment should not only be microbiologically safe, it should be clean enough not to cause concern to patients.

Aesthetic and infection control considerations should provide enough impetus to support a comprehensive cleaning programme for all hospitals. This is not the case at present, because there appears to be an overall deterioration in
hygiene in our hospitals. Why is this? It could be hypothesized that current cost-cutting in the British National Health Service (NHS) has targeted cleaning services because a reduction in the domestic budget does not directly affect the patient waiting lists. Cleaning, by its very nature, is labour-intensive and staffing costs are the greatest single cost to the NHS. When financial savings are required, labour-intensive services are inevitably going to be scrutinized for potential savings.

Contracting out hospital cleaning services has further contributed toward falling standards. There is no one to champion the cleaner’s cause except for infection control personnel. Hospital cleaning is hardly glamorous. Infection control staff themselves are in short supply and sometimes not even based on-site. They rarely have enough power to stop managers tinkering with the domestic budget and the whole issue is compounded by the fact that hospital infection control lacks a scientific basis. There is little convincing evidence that the work of infection control practitioners has any effect on the incidence of hospital-acquired infections. Forced to economize, therefore, managers will not favour an extensive service for cleaning policies when there is a perceived low risk to patients from dirty hospitals.

Is there any evidence with which to confront the business-minded? Florence Nightingale can be credited with one of the first accounts describing the effect of hospital cleaning on patient outcome. Taking on senior doctors and the War Office, she reduced the death rate from cholera, typhus and dysentery from 42% to only 2% in a Crimean hospital in the 1850s. This she did by organizing a laundry service, cleaning equipment, structural repair of wards and hospital cleaning. She also imposed her own views about general and personal hygiene on her team of nurses. Her writings regarding such issues are as relevant today as they were over a century ago. She fully realized (unlike many doctors at the time) that dirt could be fatal to health. With this in mind, she had the floors of the hospital scrubbed, ‘... for the first time anyone could remember’.

Now, of course, it is known that floors provide a huge reservoir of bacteria which can be cultured, identified and assessed for pathogenic risk. Florence Nightingale did not have the benefit of current knowledge regarding microbiology and control of infection. Indeed, at that time, the significance of micro-organisms was still unconfirmed and certainly no one had postulated a link between microscopic creatures and macroscopic infections. She utilized experience and common sense and a certain forcefulness of character. One wonders how she would have fared with today’s Chief Executives? Sadly, one hundred and fifty years later, there is still little evidence regarding the link between cleaning and hospital-acquired infections. What impact does thorough cleaning actually have on infection control? If we are to examine this, we should first consider the organisms associated with hospital-acquired infection and their epidemiology.

Hospital-acquired micro-organisms

Many of the organisms associated with hospital-acquired infections display two particular features: firstly, they are pathogens of well-established medical importance and secondly, they can withstand the rigours of the hospital environment. It benefits them to survive outside temperate human tissues because an appropriate environmental niche will provide shelter until some timely mechanism facilitates their transfer back to patients. Not all of them demonstrate this capacity; some originate from the patients’ own flora, especially those who are immunocompromized and others can survive only in human tissues and thus rely upon person-to-person spread in order to disseminate. In an article about generalized hospital cleaning, therefore, only the common pathogens of established environmental longevity will be considered.

Micro-organisms have a choice regarding their environmental habitats. These can be discrete, such as a piece of equipment, or general, such as the hospital floor. Some organisms may
reside on both. In an outbreak situation, it is always advisable to seek a discrete source because identification of such a reservoir is more likely to allow eradication of an organism and bring the outbreak to a prompt conclusion. Then, once a point source is established, local policies can be fashioned or adapted to reduce the risk of further outbreaks.

More general reservoirs are not so easily managed. It may be difficult to know how to target a general or widespread source of an ‘outbreak’ organism. Complex epidemiology (staff carriage, cross-infection, etc.) may further hamper control efforts. Such outbreaks are at risk of becoming endemic. Generalized cleaning is rarely seen as a primary solution at the present time.

Attributing individual cases of hospital-acquired infection to general deficiencies in routine cleaning is also rare, due to the difficulties in providing sufficient evidence. Whilst the specialized typing of organisms may suggest an outbreak source, such investigations are of little benefit for sporadic cases over long periods of time and are costly and time-consuming. It is therefore not surprising that hospital cleaning lacks a scientific basis.

What are the common organisms associated with hospital-acquired infections and where are they found? One of the most robust is Clostridium difficile, the anaerobic Gram-positive rod linked with antibiotic-associated colitis. This spore former can withstand temperature extremes, drying and the majority of hospital disinfectants.\(^1\)\(^4\)–\(^1\)\(^6\) It is found in the gastrointestinal tract of both symptomatic and asymptomatic patients, but the major vehicle of spread is patients with diarrhoea.\(^1\)\(^7\)–\(^1\)\(^8\) Sampling bed-clothes, commode and the floor under the bed of a patient with antibiotic-associated colitis often reveals heavy contamination with \textit{C. difficile}.\(^1\)\(^8\),\(^1\)\(^9\) The organism can also be isolated from sphygmomanometers, hands and underneath finger-nails.\(^1\)\(^7\),\(^2\)\(^0\) Spores will survive for months if left undisturbed.\(^1\)\(^8\),\(^2\)\(^1\) Visitors and staff consequently carry the spores away from the patient on hands, shoes and clothes and eventually the entire ward may become a reservoir.\(^9\),\(^1\)\(^7\),\(^2\)\(^1\) Both outbreaks and sporadic cases spring from such fertile ground, especially in conjunction with heavy antibiotic prescribing.\(^1\)\(^7\),\(^2\)\(^2\) In a recent outbreak attributed to \textit{C. difficile}, twenty-four patients were affected over four months; the first cases identified in early November.\(^2\)\(^3\) Throughout the outbreak there was rigorous attention to environmental cleaning, staff movement, hand washing and antibiotic usage – all factors known to be associated with \textit{C. difficile}. Despite these infection control measures and two complete ward closures, the outbreak continued. It was eventually noticed that the radiators on the affected ward were surrounded by a ‘cage’ which was fixed to the wall so that removal was difficult. Cleaning behind the cages was not routine and thick dust and dried faecal material were found behind them. Sampling this material revealed \textit{C. difficile}. The authors noted that the outbreak began when the radiators were turned on and suggested that thermal convection from the radiators may have played a part in disseminating spores to susceptible patients.\(^2\)\(^3\)

Environmental contamination by \textit{C. difficile} is now well accepted as a risk factor for the acquisition of \textit{C. difficile}.\(^1\)\(^6\)–\(^1\)\(^9\),\(^2\)\(^1\) It is likely that the frequency of environmental spread, together with prolonged viability of spores, explain the difficulty in eliminating \textit{C. difficile} once it has become established in hospitals.\(^2\)\(^5\) Vacuuming up dust from floors is probably one of the best and simplest methods to remove spores from the environment.\(^2\)\(^5\),\(^2\)\(^6\) Buffing and mopping may only serve to spread them around an even wider area.\(^2\)\(^7\) Most authors lament the lack of a cheap non-toxic effective sporicide but reality in simple mechanical removal is all that is required.\(^2\)\(^5\),\(^2\)\(^7\) Too much reliance is placed on miracle ‘kill-all’ disinfectants.\(^2\)\(^7\) The cleaning of commodes used by infected patients, in particular, is a responsibility that should not be delegated to an uninformed member of staff.\(^1\),\(^1\)\(^9\),\(^2\)\(^5\) The value of generalized cleaning is demonstrated by a seven-year study examining the incidence of hospital-acquired infections in an American hospital. There was a sustained decrease in nosocomial \textit{C. difficile}, when
cleaning was included as a major part of an aggressive infection control programme. Bacillus is another spore-forming rod. This ubiquitous organism clouds the atmosphere and carpets the floors of homes and hospitals. Spores can persist in soil for years and are remarkably resistant to high temperatures. The presence of Bacillus on agar plates in the laboratory is often dismissed as contamination, yet there are many species linked with significant human infections. B. cereus is particularly associated with food poisoning, where precipitous vomiting occurs just hours after a takeaway meal. Outbreaks of non-gastrointestinal B. cereus infections have been recorded in maternity, surgical and intensive care units. The main vehicles for transmission were contaminated nappies or linen, although patients in hospitals undergoing building work appear to be at increased risk of infection. Last summer, extensive building work at one end of the maternity unit in this hospital resulted in 12 cases of B. cereus infection in neonates (Dancer SJ: unpublished observations). The hospital management had refused to move the ward elsewhere because it was deemed too expensive to transfer the surveillance cameras necessary for security purposes. The ward was noticeably dirty throughout the work. Conclusion of the building work brought a halt to the outbreak.

Investigation into a large outbreak in a London teaching hospital highlighted environmental contamination originating from a building site. It was also found that the cleaning in the hospital laundry had been abolished in deference to financial constraints. Serological typing confirmed a link between building site, laundry and patients. It was concluded that the building works were responsible for increased numbers of Bacillus spores around the hospital, but the organism concentrated in the laundry from a reservoir on the floor. It was noted that clean linen frequently touched the floor whilst undergoing steam-pressing. At least forty-five cases were identified with two deaths.

Gram-negative bacteria associated with hospital-acquired infections do not form spores and are generally not quite so well accomplished at environmental longevity. Given the right conditions, however, they can attract infection control interest by virtue of isolation from compromised patients and occasional outbreaks. Although they often originate from patients themselves, they are adept at finding an appropriate environmental niche if allowed. They prefer equipment and areas which are damp and inadequately cleaned, disinfected or sterilized. Florence Nightingale herself stated that, ‘Dry dirt is comparatively safe, but (that) wet dirt becomes dangerous’. Numerous reports describe infections from genera such as Klebsiella, Enterobacter, Escherichia, Serratia and Pseudomonas spp. Their environmental sources are many and varied. Klebsiella and Escherichia, for example, are frequently found on mops and in buckets; Serratia has been described on a theatre shaving brush; Pseudomonas can contaminate sink surrounds. The latter organism can also colonize basins and respiratory equipment. Enterobacter prefers parenteral feeds. These organisms do not survive if equipment and surfaces are kept scrupulously clean and dry, although Klebsiella, in particular, is known to survive well on surfaces. Once a reservoir is established, the organisms may be transferred to patients directly or indirectly, generally via hands.

Acinetobacter is another Gram-negative rod implicated in an increasing number of hospital-acquired infections and outbreaks. Members of this genus appear to have a significant capacity for long-term survival on dry surfaces or dust particles compared to the Gram-negative bacteria already mentioned. One species, A. radioresistens, exhibits a phenomenal ability to survive on dry surfaces as shown by a mean survival time of 157 days on glass coverslips. It is likely that the persistence of these bacteria in the hospital environment increases the opportunity for transmission, colonization and ultimately infection.

The Gram-negative organisms often generate infection control interest because of their propensity for multiple antibiotic resistance. Hospitals tend to select for resistant bacteria following heavy use of antibiotics. Such
organisms become the dominant colonizing flora of patients as well as nosocomial pathogens in those who are more vulnerable. One postulated mechanism is that an antibiotic resistant flora is endemic within the institution and is transferred to the patient during the course of hospitalization. The constitution of that endemic reservoir, i.e., other patients, staff, environment, etc. and the importance of each of these in infection control, remains unclear.

Environmental sources are more likely to exist for non-Enterobacteriaceae (Acinetobacter, Pseudomonas) because they are not cultured from hypopharynx or rectum before their appearance in tracheal cultures. This is in contrast to Enterobacteriaceae, which are. This suggests that generalized cleaning could be useful in controlling Pseudomonas and Acinetobacter, although some of the environmental habitats for Enterobacteriaceae already mentioned could also fall within this remit. Several authors stress the importance of meticulous environmental cleaning in controlling Acinetobacter. One report describes an outbreak of A. baumannii, which was controlled by isolation, hand-washing and cleaning after patients’ rooms were found to be widely contaminated by the outbreak organism. If an organism can find an appropriate niche in which to survive, it will do so, whatever the origin; careful and conscientious cleaning provides the opportunity to eliminate such niches, thus disrupting the chain of transmission. In contrast, therapy for patients infected with multiply-resistant Gram-negative bacteria is difficult, toxic and expensive.

Viruses, too, can be included in the list of resilient hospital-acquired micro-organisms. Small round structured virus, or Norwalk agent, causes winter vomiting disease, a type of gastro-enteritis. This condition generally affects older patients although staff and visitors of any age may be involved during an outbreak. The virus really does appear to fly through the air. If one person vomits in the middle of the ward, patients nearby are likely to exhibit symptoms within 48 h and so on, until the whole ward is affected. It is presumed that infective droplets are projected into the air, probably during vomiting and remain suspended until they eventually fall to the ground. Alternatively, they may be inhaled or ingested by others either directly from the air or indirectly from a contaminated environment. Survival is long enough to infect persons entering the ward hours after an index case displayed symptoms. Thorough and vigorous cleaning with double strength chlorine-based detergents is advised to eradicate the environmental reservoir, especially toilets; cleaning is also required for curtains, carpets and other soft furnishings. Most authors agree that thorough environmental cleaning is essential to contain an outbreak. Patients themselves should be isolated or cohorted if the outbreak is to be confined to one ward or unit. Staff movements must also be restricted, as asymptomatic carriers can transmit the virus to other staff and patients elsewhere. It is not unusual for this virus to close entire units during the winter and early spring – precisely the time when hospital admissions tend to be high anyway.

Another organism adept at closing wards is Methicillin-resistant Staphylococcus aureus (MRSA). MRSA has penetrated virtually every hospital in the country. A chronic endemic state remains in most, punctuated by episodes of cross-infection and an occasional flurry of outbreaks. Although people are known to carry staphylococci and subsequently transmit them to others, there are plenty of reports citing environmental involvement. MRSA has been isolated from the knobs of television sets, cushions, computer keyboards and even consultants’ pens. The staphylococcus can withstand desiccation and is thus a frequent component of hospital dust. S. aureus is present on bedding, curtains and nurses uniforms. It can survive for at least 175 days under dessicating conditions. It can also be carried on doctors stethoscopes, clothing and hands. Doctors are not renowned for washing their hands and many believe that their white coats and hands are bacteriologically sterile.

Some outbreak investigations have revealed a defined source of MRSA within the ward, e.g., ventilation grilles; others have implicated...
airborne spread, especially in burns and intensive care units. Occasionally, members of staff or patients themselves are identified as initiating an outbreak. Persistent carriers can recolonize themselves from a contaminated home environment, following apparently successful attempts at clearance. In the event of a serious outbreak, the infection control team would be wise to consider the identification of carriers as well as attention to the ward environment, staff hand-hygiene and appropriate management of patients themselves. Complex staphylococcal epidemiology makes it mandatory to practise the whole package of infection control strategies, otherwise the outbreak tends to grumble on. A recent outbreak at this hospital was almost certainly prolonged because ward cleaning did not include washing the curtains around patients’ beds (Dancer SJ: unpublished observations). Judging from the relentless rise in MRSA infections over the last few years, epidemic strains are spreading successfully throughout hospitals and community despite best efforts to contain them.

Another organism set to devastate hospitals is vancomycin-resistant enterococcus (VRE). This appears to outclass the staphylococcus on several counts; it is more resistant to disinfectants and antibiotics, it survives longer in the hospital environment and there are no effective regimens available with which to clear human carriage. It is also successfully disseminated into the environment by carriers. It resides in both human and animal gastrointestinal tracts and once colonized, persists in its host long-term. The origin remains a mystery. Europe has specified the use of the veterinary glycopeptide avoparcin, but this agent is little used in the USA, where there are also considerable problems with VRE. Americans cite the increasing use of vancomycin and teicoplanin against *C. difficile* and MRSA as the main factors for VRE selection. Certainly, there is now evidence to show that the veterinary use of antimicrobials in animals promotes antibiotic resistance in micro-organisms and that these organisms can be transferred to humans. Thus, it is possible that ingesting VRE colonized chicken leads to gut carriage in the community; once admitted to hospital, such patients are then at risk of developing VRE sepsis, usually after receiving broad spectrum antibiotics. The organism is, however, less pathogenic than *S. aureus*, although when infections do occur, they are extremely difficult to treat. VRE is also very difficult to eradicate from the environment. A recent article describes the persistence of the organism following a blocked toilet and subsequent flooding of two isolation rooms. The toilet was used by a patient who was actively isolated for VRE carriage. The toilet flooded after it was blocked with paper towels and water penetrated an adjacent side room. Both rooms were aggressively and thoroughly cleaned; this included washing down to clear the water and faeces and then disinfection with phenolic followed by bleach. The bleach treatment was repeated two days later when environmental cultures of the second room demonstrated persistence of VRE on the cleaned floor. Cultures taken after the repeated cleaning did not detect VRE in either of the rooms. Twelve days after the accident, another patient was admitted into the second room and subsequently became colonized with the organism. Molecular typing showed that the environmental strains, the strain from the first patient and the strain from the second patient were indistinguishable. There are other reports of the environmental persistence of VRE and published strategies on eradicating the organism. As there is no effective protocol for clearing human gastrointestinal carriage, it is worth promoting tougher action on reducing environmental contamination by this organism. Despite its lesser pathogenicity, immunocompromized patients are at risk of untreatable infection and there is always the possibility that uncontrolled spread of VRE potentiates the transfer of multiple-antibiotic resistance genes to other organisms. Glycopeptide-tolerant strains of *S. aureus* (GISA) have already been isolated in several countries, although there is no evidence that resistant enterococci have contributed towards the appearance of these strains.

There are other organisms which are associated with hospital-acquired infections and are
capable of surviving in the hospital environment, e.g. *Legionella* spp. *Aspergillus* spp. and hepatitis B. General cleaning could potentially play a role in controlling these, but their more specialized epidemiology make it inappropriate to include them in this article. Hospital kitchens and their cleaning also falls outside the scope of this article. A mention should be made, however, of rather larger ‘pests’ which have implications for hospital infection. These are insects, birds and small mammals. There is a vicious circle involving litter, pests and a low standard of cleaning. The presence of litter makes thorough cleaning impossible and provides hiding places for pests. If there is food or organic material such as soiled dressings or linen, then pests will feed on it. Droppings from the pests add to the litter and reduce the level of hygiene even further. The whole makes more work for the cleaners and destroys their incentive. The most common pests include rats and mice, ants, cockroaches, pigeons and flies. All of these carry micro-organisms on their bodies and their droppings are laden with microbes. Hospital hygiene is dependent upon eradicating such pests and ensuring that they do not return. Domestic cockroaches, in particular, have been shown to harbour a wide variety of pathogens in their hind gut and on their body surface, including enterobacteria, polio and hepatitis viruses and nematodes. Salmonellae have been isolated from cockroaches infesting a children’s ward where there was an extensive outbreak of gastroenteritis. Ants also carry a variety of organisms. Every hospital should have a mechanism in place for pest control and a member of staff responsible for such duties should regularly attend control of infection committee meetings.

**Impact of cleaning on infection control**

Little is known about the effects of thorough cleaning in today’s hospitals. Only scanty evidence supports a link between general domestic activities and hospital-acquired infection, other than outbreaks proven to originate from a contaminated point source – *Klebsiella* from mops, for example. Hospital-acquired infection is itself complicated by staffing issues, airborne transmission, human carriage, person-to-person spread, disinfection and sterilization, hand washing practices and antibiotic policies. Simple environmental cleaning is usually placed at the end of the list and may not even be mentioned in discussions or publications on infection control. This is despite generalized agreement that a clean environment is necessary to provide both good standards of hygiene and maintain patient and staff confidence.

There are some studies, however, which would appear to support a discernible role for domestic cleaning in the control of infection. A letter in the Journal of Hospital Infection describes the environmental contamination of a new general surgical ward with MRSA. Infection control personnel sampled the ward before and after the ward was opened. Within the first week, they found that 20% of sampled sites were positive for *S. aureus* and one of those isolates was MRSA, found on the top of a paper towel holder. The authors postulated that the presence of *S. aureus* in the first week reflected the transfer of dust and organisms on ward equipment and furniture from the old ward. They emphasised the importance of adequate cleaning of equipment, furniture and the ward environment.

A recent outbreak of MRSA in a surgical unit was attributed to sub-optimal cleaning (one cleaner for two hours daily) and deficiencies in the ward fabric. The outbreak, involving fourteen patients, was halted by the institution of a major cleaning programme in all areas of the unit and improvements in the ward fabric. The problem of improving the routine cleaning was also addressed. The authors were quite sure that cleaning deficiencies were an important factor in this outbreak. They felt that the deterioration in the quality of regular cleaning services and the managerial loss of such services to outside organisations were also relevant.
If hospital cleaning achieves low status, domestic activities at home achieve even less. People may or may not clean their homes and for most, this would have no bearing on hospital infection. Persistent carriage of MRSA, however, occasionally directs attention toward the home environment – especially if the carrier is a member of the hospital staff.\textsuperscript{82,83} Patients with MRSA do not generally receive such attention on discharge from hospital. In any case, topical clearance of the organism is not regarded as high priority once the patient is in the community.\textsuperscript{113} Unfortunately, patients tend to come back into hospital still carrying MRSA.\textsuperscript{114,115} Infection Control teams neither have the time, nor indeed the jurisdiction, to attempt MRSA clearance from both body and home outside the hospital. Neither are they likely to offer cleaning advice to the family of a treated MRSA patient on discharge. The inexorable rise of MRSA is a problem in hospitals and the community.\textsuperscript{116}

Two other reports highlight the home environment as a source of infection. The first describes an outbreak of \textit{Nocardia farcinica} wound infections in surgical patients originating from a carrier anaesthetist.\textsuperscript{117} The outbreak terminated only after extensive cleaning of his home. The second describes the effect of introducing a programme of education and environmental cleaning, including cleaning of toys, into a pre-school nursery for predominantly Down’s Syndrome children. Cases of infection decreased significantly following implementation of this programme.\textsuperscript{118}

Small round structured viruses ignore the divide between hospital and community. Outbreaks of viral gastroenteritis have been associated with schools, nurseries, camps, cruise liners, hotels and residential and nursing homes as well as hospitals.\textsuperscript{63,64,119} An outbreak involving a hotel occurred in spring 1995 and proved difficult to control.\textsuperscript{64} The hotel was large and traditionally offered weekend or midweek breaks, catering for up to 500, mainly older, people. The outbreak initially presented with several guests reporting ill, primarily with vomiting, approximately 48 h into their holiday. Control measures were introduced, including employing extra staff to clean the building. The numbers of affected guests continued to rise. During the third week, hotel management agreed to close the establishment for extensive cleaning. This had the desired effect and the outbreak was declared over after four weeks. In total, nearly 300 guests and 36 staff were affected.

Many patients in hospital are vulnerable to hospital-acquired infection, but none more so than burns patients.\textsuperscript{79} High standards of environmental hygiene have been described in a number of burns units.\textsuperscript{120} For example, a rigidly-controlled environment, including a laminar-flow air curtain, was described in a paediatric burns unit in America.\textsuperscript{121} The use of this was associated with a large reduction in the number of bacteria settling on the floors and a subsequent reduction in mortality of children with 50% burns. Sophisticated air-filtering systems may augment the efforts made by cleaning staff, but it is noteworthy that high floor counts of bacteria were linked with the incidence of infection in these patients. Although hospital floors are accepted as a reservoir of potentially pathogenic micro-organisms, most authorities agree that the risk of acquiring infection from these surfaces, including operating theatres, is low for most patients.\textsuperscript{3,9,11,45,122}

Other reports emphasise the importance of generalized hospital cleaning. The first describes the effect on sepsis rates of closing and cleaning hospital wards.\textsuperscript{123} This was performed in order to control several outbreaks of MRSA in an old hospital with no side-rooms. There was an impressive reduction in staphylococcal infections following closure and cleaning. The authors suggested that besides the obvious benefits of thorough cleaning, the psychological effect of working in a clean ward may have caused nursing techniques to be carried out with increased care. The same authors published a further study two years later describing the reduction in hospital-acquired infections in the same district general hospital.\textsuperscript{124} In the attempt to overcome the lack of isolation facilities, separate wards were closed to new admissions, emptied and cleaned. Concurrent activities also
included a disinfectant policy and a more rational use of chemical disinfectants. Substantial decreases in infections with staphylococci, *Streptococcus pyogenes* and *P. aeruginosa* occurred, prompting editorial comment in the *Lancet* that hospital infection can be controlled.\(^\text{125}\) It was not possible to single out generalized cleaning as the sole reason for success, but domestic efforts provided a significant component in these studies.

More recently, a letter to the *Lancet* describes the effect of cleaning on a ward with a continuing problem with VRE.\(^\text{126}\) A substantial increase in the number of newly colonized patients appeared to coincide with a high level of environmental contamination. The only intervention used was a very thorough and systematic cleaning of the ward, after which both the level of environmental contamination and the numbers of new patients with VRE decreased. The authors stated that cleaning of hospitals needs neither highly skilled personnel nor sophisticated equipment and is a cost effective method of infection control that should not be forgotten.\(^\text{126,127}\)

**Conclusion**

Why is there so little written about cleaning? Perhaps most people prefer not to think about it. Housework has been a traditional female role for thousands of years and even now, approaching the 21st century and with far more women working, most domestic tasks are still performed by women. There are more men than women in the workplace and significantly more men in senior positions – such as hospital consultants, managers and infection control officers. These persons, including those who are women, probably have their housework done for them whilst they pursue their chosen career, i.e., those in the position to influence conscientious cleaning, may not be aware of its importance simply because they have never had to do it for themselves. On the wards, today’s nurses perform specialized cleaning only, unlike the Nightingale nurses. Florence Nightingale emphasized that complete care of the patient included attention to their environment.\(^\text{13}\) She said that, ‘Very few people, be they of what class they may, have any idea of the exquisite cleanliness required in a sick room!’ Nightingale made cleaning high priority, but that is not the case nowadays. Hospital cleaning is the ‘Cinderella’ of infection control. How often is it discussed in relation to this subject? Articles, editorials, original research and complete symposia on infection control rarely mention domestic duties. Even in the recent Department of Health publication, ‘The Path of Least Resistance’, examining the unremitting increase in antimicrobial resistance, there is only one paragraph headed ‘Hygiene, Infection Control and Cross Infection’.\(^\text{128}\) The paragraph includes the statement that infection control is outside the Terms of Reference of the subgroup and refers the reader to the Cooke report.\(^\text{129}\) The remainder of the document deals mostly with antimicrobial prescribing. No one will ever be able to control antibiotic use world wide but good infection control, including cleanliness and hygiene, is eminently achievable.\(^\text{112}\) As the report itself states, ‘in some cases, the solutions are well known; it is implementation that is deficient’.\(^\text{128}\)

Another recent publication addressing the problem of antimicrobial resistance comes from the House of Lords Select Committee on Science and Technology.\(^\text{130}\) The Infection Control Nurses Association (ICNA) reported to the committee that their survey had revealed contractor’s cleaning cloths and mops being unwashed from day to day and adequate cleaning and training requirements being omitted from contracts because of cost-cutting. The report also stated that, “Putting more resources into hospital cleaning might result in longer waiting times for treatments”. It is not surprising, then, that the domestic budget is an easy target for NHS managers. If it is slashed, levels of cleanliness will almost certainly deteriorate. Over-stretched domestic staff will not have time to wipe over door handles, television controls or computer keyboards. One wonders how much of the current MRSA epidemic is
directly attributable to decaying standards of hygiene.

Managers generally regard infection control measures as more disruptive than effective, especially when following such procedures as isolating a potential MRSA patient from another hospital. Perhaps they should consider the cost of an outbreak of MRSA which ultimately closes a ward, unit or even the hospital.\textsuperscript{65,131} Hospital-acquired infection costs money.\textsuperscript{95,132–134} In an average sized district general hospital, 100 cases of \textit{C. difficile} infection can be expected each year with an extra annual cost of £400,000 and 2100 lost bed-days.\textsuperscript{135} How much does it cost to employ an extra cleaner? Most infection control personnel are in agreement regarding the importance of hospital cleaning, but they have yet to convince managers that cutting the domestic budget is a false economy.\textsuperscript{1,6}

The Dutch have already noted that hospital economizing has led to the ‘streamlining’ of cleaning practices, resulting in lower standards of cleanliness.\textsuperscript{136} A letter, detailing the in-vitro survival of an epidemic MRSA strain in the Netherlands, comments, ‘... the number of staphylococci hiding in dust can be substantially greater than on apparently clean dust-free surfaces.’ The Netherlands currently have a much lower rate of MRSA than most other countries, following an active ‘seek and destroy’ policy instituted toward the end of the 1980’s.\textsuperscript{137}

In local Control of Infection (COI) Committees, the new NHS managerialism has had a deleterious effect. Liquid soap, as opposed to bar, and types of paper towel, engender squabbles over whose budget is accountable. This is regardless of the fact that hand washing is the single most important practise in the control of hospital-acquired infection.\textsuperscript{138} If these committees cannot organize soap supplies, they are hardly likely to be able to reinstate comprehensive cleaning schedules.

Although there are few studies examining the effect of generalized cleaning on hospital-acquired infections, there is a flourishing number of reports describing outbreaks from a presumed or proven discrete point source. The sad procession of such outbreaks is a reminder that lessons are not rapidly learnt from the experience of others.\textsuperscript{27} Mops, ice-machines, breast-milk pumps, ventilation grilles, scrubbing machines, toilets, curtains, nurses uniforms, sinks, ventilators, shaving brushes, etc., have all been implicated and doubtless many more will be. If an outbreak occurs from such a discrete source, cleaning disinfecting or sterilizing practices for that item should be reviewed. It is only fair to say that general cleaning of the surrounding environment should also be reviewed. Bad or misguided practice in one area may reflect bad or misguided practice in another.

A hospital which attends to cleanliness and hygiene is likely to attend to patient care. Sloppy wards suggest sloppy treatment.\textsuperscript{1} Public perception is all important – if a hospital cannot be clean, what can be? Patient morale may be significantly damaged by a dirty hospital, whether or not the patient acquires an infection.\textsuperscript{1–4} This could be a problem in today’s litigious and quality-conscious society.\textsuperscript{45,84}

The solution to stem the seemingly inevitable tide of multiply-resistant microorganisms, should offer a whole package of practices, which includes hospital cleaning. The whole must be applied to achieve any discernible effect upon the spread of antibiotic resistant organisms.\textsuperscript{84} Regarding MRSA, attention remains focused on the role of human carriers and point sources as identifiable and therefore eradicable origins of infection. Few are interested in highlighting the potential benefits of frequent vacuuming to remove skin scales (and adherent staphylococci), laundering of curtains or wiping over door handles (which everyone touches) etc. How often are the covers and cushions on hospital furniture cleaned, for example? Yet these are likely vehicles for the transmission of MRSA, especially in Care of the Elderly units.\textsuperscript{67} Even national guidelines on the control of MRSA fail to deliver the correct emphasis on cleaning.\textsuperscript{113} Like antibiotic prescribing, no-one will ever be able to ensure total compliance with hand washing, but a high standard of cleaning is achievable.\textsuperscript{112}
There is no doubt that there is a need for national standards for hospital cleaning.\textsuperscript{6,11} This has already been proposed and the Infection Control Nurses Association (ICNA) is currently preparing a draft following a pilot study.\textsuperscript{5} Published guidelines will prompt additional comments and perhaps some research; this would be welcome, since at present practical, applied microbiological research is not considered sufficiently academically respectable and thus does not win funds.\textsuperscript{6}

In the meantime, cleaning practises will continue to deteriorate unless the infection control team champion their retention. Extra support is required from the nurses. If nurses believe in the original Nightingale definitions of nursing, they should take a lively interest in the cleanliness of their patients’ environment and campaign accordingly.\textsuperscript{11} Cleaning practises should not be left to the managers. Significant improvements could be made if more nurses would take responsibility for the cleanliness and hygienic standards on their own wards.\textsuperscript{1} Table I shows some aids to cleaner hospitals.\textsuperscript{27}

Standards of hygiene are ultimately determined by people. There are no miracle cleaning materials or equipment. Effective cleaning is usually through hard work.\textsuperscript{27} Contamination is important in a hospital, and cleaning is a valuable way of dealing with it; perhaps a new standard for hospital cleaning will show when the former matters and how the latter may best be performed.\textsuperscript{139} Florence Nightingale would have approved.

\section*{Acknowledgement}

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\section*{References}

11. Maki DG, Alvarado CJ, Hassemer CA, Zilz MA. Relation of the inanimate environment to

\begin{table}[h]
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\textbf{Table I} & \textbf{Aids to cleaner hospitals}\textsuperscript{27} \\
\hline
I & Good relationships between those who direct cleaning and those who do it \\
II & Maintenance of hospital fabric to allow adequate cleaning \\
III & Prompt removal of rubbish \\
IV & Adequate lighting and ventilation for cleaners \\
V & Suitable equipment: easy to handle and easy to clean \\
VI & Facilities for washing, disinfecting, sterilizing and storing cleaning equipment \\
VII & Suitable cleaning agents \\
VIII & Supervision of equipment and cleaners \\
IX & Clean water; no surface can be cleaned with dirty water \\
X & Appropriate frequency of cleaning in different areas of the hospital \\
XI & Audit of standards and staff training \\
\hline
\end{tabular}
\end{table}

(Adapted from Maurer, I.M. \textit{Hospital Hygiene}; Edward Arnold, London, 1974)


60. Russo PL, Spelman DW, Harrington GA et al. Hospital outbreak of Norwalk-like virus. *Infection Control and Hospital Epidermology* 1997; **18**: 576–579.


