

## Importance of the Environment in MRSA Acquisition: The Case for Hospital Cleaning

Stephanie J Dancer - Director, Department of Microbiology, Southern General Hospital, Glasgow  
Editor, Journal of Hospital Infection

*Also In This Issue:*

**Golden Rule:  
Cleaning Must Precede  
Sterilization.....2**

**Virox Update .....3**

**Dr. Syed Sattar Receives  
Achievement Award .....4**

**Sanitary Pioneers and  
Theories.....4**

**Bacteria Can Hide Out in  
Cells for Weeks.....5**

There is much concern over the state of hygiene in hospitals. The general public seem to associate visibly dirty wards with increasing rates of methicillin-resistant *Staphylococcus aureus* (MRSA) acquisition, but historically there has been little evidence that the environment is important in endemic hospital-acquired infection. This premise has been challenged since the increase in MRSA in hospitals in the past decade. Because a clean environment is usually taken for granted, it is not surprising that there is little evidence to show that cleanliness could be an important control factor in the spread of MRSA. Furthermore, the measurement of how clean a hospital is other than by visual assessment, which is both subjective and inaccurate, is difficult because such an assessment does not necessarily correlate with microbiological risk.



The issue of hospital-acquired infections is compounded by the current politically generated drive to reduce waiting lists. Hospitals are crowded with sick people in close proximity to one another, even though years of work in infection control have shown us that patients pass their microorganisms to those nearby. This was first recognised by Florence Nightingale in the 19th century, at least 10 years before the advent of bacteriology. She concluded that the use of small separate rooms could have prevented the high rate of mortality in maternity cases after an outbreak of erysipelas at a midwife training school. However, lack of isolation facilities and continued pressure on the availability of beds provide a serious challenge to standard principles of infection control.

A recent study has confirmed an association between MRSA bacteraemia rates, bed occupancies, and even bed turnover times. However, not only do governmental faculties not understand

the link between visible dirt and the presence of pathogenic microorganisms, they also do not support the premise that crowded hospitals facilitate the spread of infection.

Only a few studies provide evidence that cleaning reduces the risk of acquiring MRSA in health-care institutions. There is another way, however, of justifying cleaning as a useful control strategy for MRSA. We already have evidence to support each of the individual components of the staphylococcal transmission cycle between patients, staff, and the inanimate environment. Much of the work on coagulase-positive staphylococcus, originally done 50 years ago, is as relevant for MRSA as it is for its susceptible predecessor.

The epidemiological properties of *S aureus*, whether methicillin resistant or not, remain the same. One difference between the hospital staphylococcus of the 1960s and current MRSA strains is that isoxazolyl penicillins (eg, flucloxacillin) quickly cured patients with *S aureus* infections before it had a chance to spread to other patients or into the environment. Additionally, the hospitals received more cleaning at that time, since they had not been exposed to today's emphasis on cost cutting. Of course, we do not have a quick cure for MRSA—currently available drugs are either toxic or expensive, or relatively inefficient, and most have to be given parenterally. Resistance has already been shown for newly released agents. This condemns colonised or mildly infected patients to conservative management only, thus enhancing their risk for future sepsis as well as providing the organism with an opportunity for dispersal throughout the environment and to others.

**Continued on page 6**

*"The secret of success is constancy of purpose"*

Benjamin Disraeli

## Golden Rule: Cleaning Must Precede Sterilization

Nicole Kenny, Virox Technologies Inc.



that remain on the surfaces of instruments interfere with the effectiveness of these processes.”

The most oft-repeated phrase in the industry is, “If it’s not clean, you can’t sterilize it”. That sounds a little funny, but it’s really very serious. As long as there is bioburden on an instrument, no matter how miniscule, the instrument is unsafe to use and can cause cross-contamination.

Much of the literature on disinfectants and sterilants opens with a definition of terms. Which indicates that the subject is not a simple one, although it can be understood with a little effort. William A. Rutala, PhD, MPH, University of North Carolina at Chapel Hill, a world-renowned expert on the subject, describes sterilization as “the complete elimination or destruction of all forms of microbial life, required for instruments or devices that have contact with sterile tissue. Disinfection describes a process that eliminates many or all pathogenic microorganisms on inanimate objects with the exception of bacterial spores.” Therefore, chemicals that eliminate all microbial life, including spores, are referred to as sterilants, whereas disinfectants eliminate all or most pathogenic organisms but not spores.

### The importance of pre-cleaning

Before objects are disinfected or sterilized, they must be rendered safe to handle, so first they must be decontaminated. In fact, the most important step toward disinfection or sterilization is a thorough cleaning of the objects. And while cleaning does help to reduce the microbial load, its real purpose is to remove soil such as blood, pus, or mucous that would interfere with the disinfectant or sterilant in doing its job by blocking direct contact to the object. “Cleaning is the removal of foreign material (eg, soil and organic material) from objects,” Rutala says, “and it is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization since inorganic and organic materials

Bioburden that is not cleaned from instruments before disinfection or sterilization can translate to added costs due to cross-contamination, which can lead to lengthier hospital stays and further treatments for patients, but it also can shorten the life of the instrument unnecessarily, causing the need for repairs or early replacement. Residual bioburden can cause harmful corrosion, rusting, and pitting, reducing the life of the instrument. That is why it is important to remove all bioburden (blood, fat, carbohydrates, starch, and protein). If you have an enzymatic cleaner containing only a protein enzyme, you are not going to be able to remove fat, carbohydrates, or starch; so, you must have a pre-cleaner to remove each contaminant: carbohydrates, starch, blood, protein, and fat.

### Factors to consider when choosing disinfectants

Disinfectants and sterilants should be selected carefully, with consideration given to the type of material out of which the instrument or item to be disinfected or sterilized is made. For instance, heat is one of the suggestions for sterilizing critical items, but the item must be able to tolerate the heat or it could be mined. Clearly, it’s important to have a knowledge of which chemicals are appropriate to use on which materials. Manufacturer’s recommendations must be given serious consideration.

Some of the chemicals cross categories, the difference being the level of disinfection, which is determined by the length of time the object is exposed to the chemi-

cal. For example, some disinfectants will kill spores, sterilizing objects, if the objects are exposed to the chemicals for an extended period of time. These same disinfectants, at different concentrations and at shorter periods of exposure, will perform high-level disinfection by killing all microorganisms except high numbers of bacterial spores. Which disinfectant is chosen, the concentration of the disinfectant, and the exposure time is determined by the risk of infection posed with the use of the instrument or item.

### Properties of ideal disinfectants

Disinfectants should be a broad-spectrum antimicrobial, be fast-acting, be unaffected by environmental factors, be nontoxic, be surface-compatible so that it doesn’t cause corroding or deterioration, be easy to use, be odorless, be economical, be water-soluble, be stable in concentrate and use-dilution, have good cleaning properties, be nonflammable.

An interesting point is that certain organisms seem to have a built-in resistance to certain disinfectants that leave an active residue. In some cases the concentration of the chemical can make a difference in the organisms’ susceptibility to the disinfectant.

There’s a great deal about which one must be educated when in charge of choosing chemicals and methods used to sterilize or disinfect items reused on or by patients, much that’s really important to understand before it’s possible to make informed and responsible choices. But there is one thing that isn’t understood, and, oddly enough, that’s how sterilants and disinfectants work. “The mechanisms by which germicides inactivate microorganisms remain incompletely understood,” said Rutala. “Unlike antibiotics, most disinfectants have multiple target sites of action to include the cell wall, cytoplasmic membranes, and cytoplasmic constituents (eg, nucleic acids, ribosomes, etc).”

We can live without complete knowledge of how disinfectants work. Fortunately, strict adherence to using them properly makes that possible for many people each day.

## Virox Update

### Another First for AHP!

The Virox team is excited to have launched a new line of products through Anivac Corporation. Our Accelerated Hydrogen Peroxide technology is being used as an anti-fungal wash in the Anivac Vacuum Bathing Systems for animals that can be used for general cleaning and pre and post surgery cleansing. The system has been validated by the University of Guelph and is widely used in the equine industry including by Jay Hayes, two-time Olympian on Team Canada.

### New Patent Received!

Virox has received yet another patent for AHP-based technology. The new patent is for an endoscope-compatible high level disinfectant. The receipt of the patent is doubly exciting as this formula has been submitted for FDA registration - approvals expected in late 2008. STERIS Corporation carries the global rights to the AHP technology for disinfection and sterilization of medical devices. STERIS will be marketing the endoscope-compatible technology and have validated the formula as an OPA replacement.

### Accel TB Soft Packs!

At Virox, we are very aware of the increasing importance of pandemic planning and the deployment of pandemic kits within health care facilities and industry as these organizations take a proactive role to protect their staff and clients. The Accel TB Soft Pack maintains the current 30-second sanitizing, 5-minute bactericidal, 5-minute general virucidal (non-enveloped viruses such as Noroviruses), 5-minute fungicidal, and 5-minute Tuberculocidal claims. The Accel TB Soft Packs offer employees, physicians and nurses the flexibility to carry personal wipes to clean and disinfect those non-critical devices and surfaces (stethoscopes, countertops, light switches, door knobs, elevator buttons etc.) that may not be included in regular cleaning and disinfection practices.

Further information on the Accel TB Soft Packs product can be found on the Virox website ([www.virox.com](http://www.virox.com)) including the efficacy study, MSDS, and product information.

### 2008 CHICA Scholarship

The Virox Patron Scholarship is in its 6th year, and to date Virox and the Patron Members (JohnsonDiversey, Butchers, Deb, STERIS and Webber Training) have contributed \$90 000.00 towards the fund that has provided more than 50 infection control professionals the opportunity to attend the annual CHICA-Canada Conference. The scholarship application deadline was at the end of January and we look forward to meeting the 2008 recipients in Montreal!

### Website Update: [www.virox.com](http://www.virox.com)

Virox prides itself on being a resource tool to the infection control community and will be unveiling a newly designed website in mid-March. Some of the exciting changes to the website include a section devoted entirely to infection control that provides resource materials such as guidelines, protocols, outbreak information, technical bulletins, as well as a section devoted to hot topics in infection control.

If you are interested in learning more about how the Professional and Technical Services team at Virox can provide educational or consulting opportunities at your facility please contact Nicole Kenny at 1-800-387-7578 x118 or via email at [nkenny@virox.com](mailto:nkenny@virox.com).

## Conference & Education Winter / Spring Schedule

Virox representatives will be participating in the following functions during the upcoming months:

**February 12** - South Eastern Infection Control Network & CHICA-Eastern Ontario Education Day in Kingston

**March 6-8** – Pacific Dental Conference in Vancouver

**March 27** – North Simcoe-Muskoka Infection Control Network Education Day in Barrie

**March 28** – Northeastern Ontario Infection Control Network Francophone Education Day in Ottawa and Sudbury

**April 5-7** – SHEA in Orlando, Florida

**April 10-11** – Ontario Dental Association Conference in Toronto

**April 30 – May 1** – CSSA Can Clean Conference in Toronto

**May 1-2** – CIPHI Communicable Disease Conference in Toronto

We are very excited about participating in each of these conferences & education days. We wish the best to all of the various organizers and would like to thank them for their dedication and effort in organizing these very important educational opportunities. We look forward to attending and talking to all of the participants.

## Virox Supports Teleclass Education

We applaud Paul Webber and Dr. Syed Sattar for the outstanding schedule of teleclass lectures that they have put together in 2008, and we are pleased to sponsor the following teleclass topics:

- *The Human and Environmental Toxicity of Microbicidal Chemicals* (April 3)
- *Infection Control in Personal Services Settings* (May 1)
- *Clostridium difficile – Prevention Better than Cure* (September 16)

Refer to [www.webbertraining.com](http://www.webbertraining.com) for more information.

**Accel TB SOFT PACK**

Ready-To-Use Disinfectant and Cleaner for use in Pandemic Planning Kits and Home Health Care

**ACCELIMATED MICROBICIDAL TECHNOLOGY**

**TUBERCULOCIDAL (5 min. at 20°C)**  
 Manufacturer's label (EPA, 4176)

**GENERAL VIRUCIDAL (5 min. at 20°C)**  
 Product label (EPA, 4176)  
 EPA 4176 (EPA) also lists the product label claim against other enveloped and non-enveloped viruses (EPA, 4176)

**BACTERICIDAL (5 min. at 20°C)**  
 Product label (EPA, 4176)  
 Manufacturer's label (EPA, 4176)  
 Laboratory confirmation (EPA, 4176)

**FUNGICIDAL (5 min. at 20°C)**  
 Product label (EPA, 4176)  
 Manufacturer's label (EPA, 4176)  
 Laboratory confirmation (EPA, 4176)  
 EPA 4176 (EPA)

**SPOROBIKICIDAL (EPA, 4176)**  
 Product label (EPA, 4176)  
 Manufacturer's label (EPA, 4176)  
 Laboratory confirmation (EPA, 4176)  
 EPA 4176 (EPA)

**Key Features:**  
 - Kills all forms of life, including all varieties of pathogenic organisms (including the spores of *Bacillus anthracis* & *Clostridium*)  
 - Active ingredients break down to water and oxygen. The absence of other ingredients makes it safe for use on all surfaces.  
 - Biodegradable and easily decontaminated in water tanks, reservoirs and used in approved OTC (Over-the-Counter) Containers.  
 - May be disposed in accordance with local regulations. Hazardous Product development facility in a water sensitive facility.

## Dr. Syed Sattar Receives Career Achievement Award



In the Autumn of 2007, world renowned scientist and researcher, Dr. Syed Sattar, was the recipient of the distinguished Ottawa Centre for Research and Innovation (OCRI) Career Achievement Award. We at Virox Technologies are tremendously proud of Dr. Sattar and congratulate him on this milestone in his career. The award ceremony video can be seen at <http://www.youtube.com/watch?v=03kLTsIxazI>. What follows is the transcript of Dr. Sattar's acceptance speech.

*"Thank you very much. Good evening everyone. I am truly delighted to have won this award, and I am most grateful to my colleagues. The award becomes truly meaningful when your colleagues, with whom you have been working for several years, recognize your achievements and they nominate you.*

*In fact, when Dr. Zemin Yao, the chairman of our department, suggested that he might want to nominate me for this award, I told him not to waste his time because I didn't think I deserved it. I'm so glad that he ignored my suggestion.*

*I also want to thank OCRI, for the award and the sponsors of the award, and my family, as well as those who wrote the testimonials on my behalf.*

*The time is short so I want to talk to you about my favourite subject, the women in my life ... not all of them, just a couple of them. First of all, my wife Parveen, my life's partner for some 37 years. They say that 90% of your life's problems are solved when you marry the right person, and that certainly happens to be the case in my life. I am doubly fortunate in that I also found a remarkable colleague in Susan Springthorpe, my professional associate for over 30 years now. These two ladies together have not only solved most of my life's problems, but they are truly responsible for the modicum of success that I have achieved in my personal and professional lives.*

*As mentioned I retired as professor of microbiology some four years ago, but I am working harder than ever. This causes some concern in the minds of my well-wishers, and when they express their concern I tend to respond by quoting what the American poet Edna St. Vincent Millay said some hundred years ago, and I'm paraphrasing her here. It goes something like this: My candle is burning at both ends, it may not last the night, but I hope that while it burns it will give those around me a soothing guiding light. Thank you."*

## Sanitary Pioneers and Theories

It's suggested that during the 19th century, "sanitarians" in Europe and the U.S. awakened a sanitary consciousness among the common people and popularized cleanliness. This, in turn, led in whole or in part to the decline of such serious endemic diseases as infant diarrhea (a leading cause of death among children), typhus, trachoma, and certain skin diseases. If the hypothesis is true, this contribution cannot be dismissed as trivial.

The pioneers of the sanitary era were all active prior to 1850 — Edwin Chadwick, John Snow, William Budd, and John Simon in England; Ignaz Semmelweis in Austria; and Lemuel Shattuck in Boston. They maintained that illness and death were associated with unsanitary conditions or practices, and they all advocated sanitary reform. Among the sanitary reformers, some supported the "miasma" theory of transmission and some were "contagionists." Arguments among the advocates of these epidemiologic theories continued for decades — even after the germ theory of disease had been well-accepted.

From a practical point of view, all of the sanitarians recognized the relationship between filth and disease. The evolution of epidemiological reasoning from 1849 to 1878 is well described. The sanitary reformers were joined in the next decade by Florence Nightingale and Joseph Lister, who reformed medical and surgical care. Louis Pasteur and Robert Koch subsequently provided scientific evidence that the sanitarians' aims — though not always their reasoning — were realistic.

## Bacteria Can Hide Out in Cells for Weeks

Nicole Kenny, Virox Technologies Inc.

Another interesting study was released recently that revealed a fascinating survival strategy used by *Staphylococcus aureus*. The paper, “A global view of *Staphylococcus aureus* whole genome expression upon internalization in human epithelial cells”, was published earlier this year in BMC Genomics and profiled in ScienceDaily. It explained that Staph. bacteria may evade the immune system’s defenses and dodge antibiotics by climbing into our cells and then lying low to avoid detection. The research shows how *S. aureus* makes itself at home in human lung cells for up to two weeks.

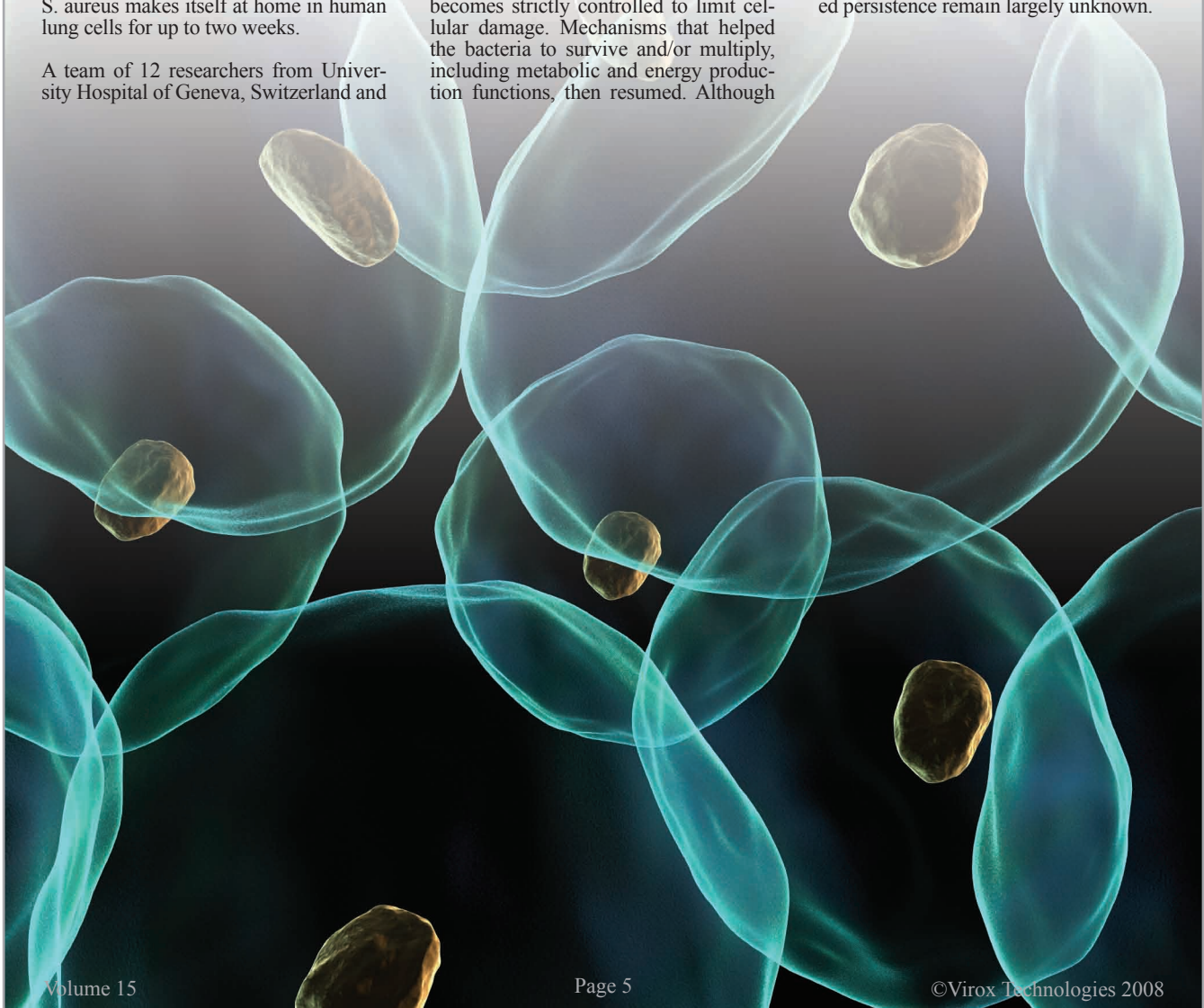
A team of 12 researchers from University Hospital of Geneva, Switzerland and

the Institute of Food Research, Norwich, UK set out to uncover what *S. aureus* did inside human lung epithelial cells using an in vitro model. They found that shortly after *S. aureus* entered the lung cells, the bacteria’s gene expression profile dramatically changed: gene expression for bacterial metabolic functions and transport shut down, putting the bacteria in a dormant state.

Simultaneously, production of toxins potentially lethal for the epithelial cells becomes strictly controlled to limit cellular damage. Mechanisms that helped the bacteria to survive and/or multiply, including metabolic and energy production functions, then resumed. Although

most of the bacteria had died by about four days as a result of antibiotic treatment, the team still found viable bacteria in their model system two weeks after infection.

The findings may help in understanding relapsing infections (even years after the first episode was apparently cured), and in designing new antibacterial drugs. *S. aureus* has not traditionally been considered an intracellular pathogen, but the molecular details that govern its extended persistence remain largely unknown.



## Importance of the Environment in MRSA Acquisition: The Case for Hospital Cleaning

Continued from page 1

Even if the epidemiology of staphylococcus has not changed over the years, there are, however, differences in the type of patients that we see nowadays and the clinical environments in which they are nursed. Patients are older, immunologically weaker, and are subjected to far more invasive procedures and devices than the patients of 50 years ago. Furthermore, there has been a huge influx of electronic equipment into the near-patient vicinity, providing more hand-touch sites that require a greater degree of sophisticated cleaning attention. Certain liquid cleaning agents would damage many items of medical and nursing equipment. All of these differences could have contributed towards an increase in MRSA acquisition in modern hospitals.

Given the preoccupation with hospital budgets, we need another strategy for tackling the presence of MRSA in our hospitals other than campaigning for more cleaning hours. Visual appearance is an unreliable guide to the presence of pathogenic microbes and, indeed, rates of infection. Perhaps targeting the areas in a hospital that constitute the highest risk for the presence of MRSA would be a feasible option in the short term. Buffing the floors in outpatient departments might improve the appearance of the waiting areas, but patients do not generally acquire MRSA from floors. The greatest risk for patients is contaminated near-patient hand-touch sites in clinical areas. This is borne out by studies that have seeded viral or other molecular fragments onto a door handle or a telephone, and then charted their movements over the course of a few days. Such studies show the importance of sites that human hands touch more

frequently, and can be used as an indicator for what might happen regarding the spread of MRSA.

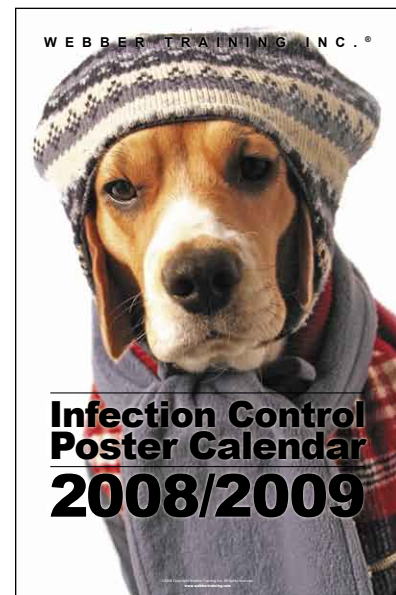
Cleaners (Environmental Services) should be included as an integral part of the infection-control team. They should be allocated more cleaning hours from the hospital budget, particularly when there is evidence for substantial savings. Cost of drugs alone to treat MRSA, without even considering the costs of extended bed-stay for infected patients, justifies targeting domestic resources in clinical areas. Furthermore, the increasing prevalence of MRSA and other multiple-drug-resistant bacteria in hospitals support the prioritization of cleaning and other control measures before definitive validation. We should have faith that we are doing the right thing.

If cleaner hospitals ultimately reduced the number of patients acquiring health-care-associated MRSA, there would be a concomitant reduction of MRSA in the community, because acquisition in hospital invariably leads to patients taking the infection home. A cleaner culture adopted by hospitals might impinge on the community in other ways. The general public should consider their own attitude to hygiene when cleaning themselves and their homes, and when preparing food. Any societal erosion of hygiene might be caused by complacency emanating from the discovery of antimicrobial agents. This issue requires urgent appraisal, since the increasing numbers of community strains of MRSA have been associated with hygiene issues and more frequent antibiotic consumption. These community strains are more virulent than established hospital strains and have already shown their potential to start hospital outbreaks

People look towards hospitals to treat the sick and set appropriate standards of hygiene. But modern hospitals are often cluttered, overcrowded, and visibly dirty. Cleaning staff and hours have been drastically reduced over the past decade. Even if scientific validation is obtained, regenerating interest in the removal of dirt in the 21st century will require mon-

umental effort. Aside from its low status, cleaning costs money and it is hard work. It is difficult to measure the process of cleaning, its impact, or assess it against the risk of acquiring MRSA. We should take the half-century's worth of data that we have and try to change things while we still can. We do not yet know exactly what impact cleaning could have on control, but this ignorance should not be used as an excuse for doing nothing.

(This article is edited from a Review published in the Lancet. For a copy of the entire article, or to obtain Dr. Dancer's contact information, please contact Nicole Kenny [nkenny@virox.com](mailto:nkenny@virox.com).)



Look for the new Webber Training Poster Calendar later this Spring

Several professionally designed posters are available for download in the Free Poster Downloads section of [www.webbertraining.com](http://www.webbertraining.com)

2815 Bristol Circle, Unit 4, Oakville, Ontario L6H 6X5  
Tel: (905) 813-0110 • Toll Free: 1-800-387-7578 • Fax: (905) 813-0220  
E-mail: [info@virox.com](mailto:info@virox.com) • Website: [www.virox.com](http://www.virox.com)

