Decontamination strategies in ICU

The recent pandemic has once again highlighted the importance of robust infection prevention strategies in all clinical settings, including ICUs. Anne Savage, a senior staff nurse, and Rachel Crisford, ICU lead nurse, at the Royal Berkshire NHS Foundation Trust, provide an insight into decontamination strategies and discuss the evidence to support best practice.

Nosocomial infections continue to be a significant cause of morbidity, mortality, and added costs in the healthcare setting. Half of all life-threatening nosocomial bloodstream infections and pneumonias occur in intensive care units (ICUs), despite ICUs representing only 15 to 20% of all hospital beds.[1] This means that an efficient focus for prevention and control of life-threatening healthcare-associated infections should be in ICUs. This article examines the potential role of decontamination in ICU as part of an overall infection prevention strategy.

Healthcare-associated infections (HCAIs) are described as 'infections occurring in a healthcare setting that were not present prior to a patient entering that care setting,'.[2] Estimates of HCAI prevalence vary and the most recent National Institute for Health and Care Excellence (NICE) data estimates a prevalence in hospitals in England of 6.4%.[3] However, more recent modelling estimates that, in 2016/2017, in NHS hospitals in England, there could have been 834,000 HCAIs, which potentially cost the NHS £2.7 billion, accounted for 28,500 patient deaths and led to an additional 7.1 million occupied hospital bed days (equivalent to 21% of the annual number of all bed days across all NHS hospitals in England).[4]

Recent studies have found that 5%-15% of hospitalised patients acquire an HCAI and between 9%-37% of patients admitted to intensive care units have an HCAI.[5] There is evidence that patients admitted to ICU with an HCAI have a worse clinical outcome (higher mortality and length of stay), and are more severely ill on admission than patients without.[6] A study looking at infections in ICU patients found that 26.4% of infections were HCAIs and that they are associated with substantially increased morbidity and mortality.[7]

Nosocomial infections are caused by a wide range of microorganisms, some of which are carried by patients themselves. Around 25% to 30% of the UK population is positive for skin or nasal carriage of *Staphylococcus*.[8] The most common HCAIs include respiratory infections particularly pneumonia and infections of the lower respiratory tract.[3]

HCAIs are often caused by methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-sensitive *Staphylococcus aureus* (MSSA), *Clostridium difficile* (C. diff) and *Escherichia coli* (E. coli).[3] These bacterial infections commonly occur as a direct result of healthcare interventions (such as medical or surgical treatment), or from being in contact with a healthcare setting.[8] It is recognised that most of these infections are caused by multidrug-resistant organisms.[9] The emergence of new infections also poses a risk to patients and staff, as highlighted by ▶

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the transmission of COVID-19 in healthcare settings during the recent pandemic.

Staphylococcus aureus accounts for more HCAIs than any other pathogen. It is the most common cause of ventilator-associated pneumonia and surgical site infection and the second most common cause of central-catheter–associated bloodstream infection.[10] Despite the recent decline in incidence of MRSA, infection remains a major cause of avoidable morbidity and mortality in patients admitted to hospital, particularly those in ICU. Many of its most serious clinical manifestations, such as bloodstream infection and ventilator-associated pneumonia, are seen in ICU.[11]

MRSA infection increases the risk of death, increases the length of hospital stay, and increases treatment costs.[12] Patients may become colonised with MRSA but remain asymptomatic. Such colonisation increases the risk of developing a clinical MRSA infection and is a source of cross infection.[12] Colonisation is a proven risk factor for developing surgical site infection during hospital stay with isolates matching those of nasal swabs in 85% of cases.[8] Around 30% of patients identified as MRSA positive develop a subsequent infection.[13]

Isolation and decontamination are two of the main targeted control measures for reducing the transmission of MRSA. Isolation interrupts cross infection through physical or behavioural barriers such as disposable gloves and aprons (contact precautions) or the placement of patients in isolation wards or single rooms designated for the exclusive care of MRSA infected patients.

Decontamination attempts to eliminate or suppress MRSA using topical and sometimes intranasal antimicrobials, to help reduce the bacterial load available to cause endogenous infection and transmission to other patients. Isolation and decontamination are often combined with screening to detect colonised patients. Early and accurate detection of colonised or infected patients allows timely implementation of interventions aimed at preventing transmission or infection.

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A 2011 study concluded that all decontamination strategies in ICU improved health outcomes as well as cutting costs of healthcare provision, but universal decontamination was found to be the most cost effective, provided resistance is lacking.[12] It has been documented that the excessive use of mupirocin for nasal MRSA decolonisation leads to resistance.[11] Also the recent observation that MRSA strains carrying the antiseptic resistance genes qacA/B can be clinically resistant to chlorhexidine raises a note of caution against its unfettered use.[14]

Decontamination helps reduce transmission and prevent disease in *Staphylococcus aureus* carriers. Using an antimicrobial body wash and nasal gel has been shown to improve health outcomes as well as reduce costs.[12] A study in over 74,000 patients demonstrated that universal decontamination is more effective and efficient compared to alternative methods such as screening with selective decontamination. Universal decontamination in adult ICUs led to a 37% reduction in risk of an MRSA clinical isolate and a 44% reduction in risk of bloodstream infections due to all pathogens.[10]

In a large, randomised multicentre trial, the risk of developing hospital associated *Staphylococcus aureus* infection in MSSA-carrier patients who 'were decolonised on admission to hospital fell by nearly 60% compared with placebo'.[15] In patients undergoing cardiothoracic or orthopaedic surgery, screening for *Staphylococcus aureus* nasal carriage and decontaminating carriers resulted in a substantial reduction in hospital costs. This approach resulted in a cost saving of almost £3,000 per cardiothoracic patient compared to the non-screened and non-treated patients.[16]

Decontamination in ICU offers potential infection control benefits not just to the patients in ICU but it also has a positive impact across the whole hospital. A 2017 study undertaken at University Hospitals Birmingham (UHB) NHS Foundation Trust investigated the impact when routine MRSA decontamination in ICU was discontinued. They found a 250% increase in bacteraemia cases across the whole hospital. Six months after reinstating routine decontamination in ICU, cases showed a significant decrease. The researchers concluded that 'routine decolonisation for MRSA in a large ICU setting is an effective strategy to reduce the spread and incidence of MRSA across the whole hospital'.[17]

A number of studies have evaluated the efficacy of decontamination with an octenidine-based antimicrobial. In 2013, preventive body washing with an octenidine based antimicrobial was introduced for all patients on a 32 bed ICU which had experienced an increasing number of nosocomial cases despite robust hand hygiene and environmental disinfection measures. The implementation of universal decontamination using an octenidine based antimicrobial in combination with a standardised washing regimen, led to a significant reduction in nosocomial colonisation. Nosocomial incidence density of 7.55 (pre-intervention) was reduced to 2.61 (post-intervention) per 1000 patient days. Nosocomial infections were significantly reduced from 13 cases to 1 case after intervention.[18]

A two-year retrospective pilot study in a mixed medical and surgical ICU / high dependency unit examined the use of an octenidine based antimicrobial for routine patient washing. The study showed a 76% reduction in the acquisition of multi-drug resistant organisms.[19]

To investigate the effect of universal decontamination with octenidine on the incidence of ICU-acquired bloodstream infections (BSI) and MDR organisms (MDRO) a total of 12,855 medical ICU patients were included in a study. A significant reduction in ICU-acquired blood-stream infections and MRSA in medical ICUs was observed after implementation of an octenidine-based antimicrobial for decontamination.[20] The researchers highlighted the 'significant effect on the reduction of ICU-acquired BSI in medical ICUs.'.[20]

Octenidine is a broad-spectrum antimicrobial and, to date, has not shown any descrease in antimicrobial efficacy to multi-resistant bacteria[21] and there have been no reports of the development of resistance to octenidine.[22] Octenidine has a residual antimicrobial effect on the skin, which lasts for at least 24 hours, which may result in a better preventative outcome.[23] A randomised trial of 60 participants compared the effects of using soap or an octenidine based antimicrobial on colony forming units (CFUs) for up to six hours. Octenidine was found to be more effective than soap in reducing CFUs on the skin of healthy volunteers.[24]

The recent pandemic has once again highlighted the importance of robust infection prevention strategies in all clinical settings, including intensive care units (ICU). Minimising the risks of patients acquiring a healthcare associated infection should be integral to these strategies, and decontamination offers a useful tool.

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