

## **Evaluating the effectiveness of octenidine-containing wash mitts in intensive care settings**

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### **Abstract**

This article describes the context and rationale for the use of an alternative approach to preventing HCA (Healthcare associated infections) in the Intensive Care setting. It draws upon currently available evidence on the incidence of HCAI, decontamination approaches, and the rationale for the use of octenidine containing wash mitts in intensive care units (ICUs).

### **Introduction**

*Staphylococcus aureus* is a major cause of healthcare associated infections (HCAI) and despite the decline of Methicillin-resistant *S. aureus* (MRSA), infection remains a major cause of avoidable morbidity and mortality in hospitals [Bradley, 2018]. Patients in intensive care units (ICU) are at particular risk from the complications of HCAI and have a worse clinical outcome than patients without [Nuvials, 2015]. ICU is also a potential reservoir for the spread of hospital infections [Edgeworth, 2011; Bradley, 2018] and research suggests that infection control procedures undertaken in ICU have an impact on patients across the entire hospital [Bradley, 2018].

For many years, a key approach to infection prevention was to identify MRSA colonised patients, isolate these patients, and instigate a targeted decontamination regime using topical antimicrobials. There is however evidence that universal rather than targeted decontamination in ICU is more effective at reducing rates of bloodstream infections and in reducing costs [Huang, 2014, Robotham, 2011]. One concern about this strategy is reliance on chlorhexidine for body washing, due to growing reports of resistance [Spencer, 2013]. This has led to interest in octenidine as an alternative agent [Spencer, 2013], in particular the use of octenidine containing single use wash mitts, which may offer significant advantages in ICU as part of an overall infection control strategy.

### **Healthcare associated infections (HCAIs)**

HCAI describes infections occurring in a healthcare setting that were not present before the patient was admitted for care and they remain one of the most common types of adverse events affecting patients [Haque, 2018]. HCAI have the potential to exacerbate illnesses, delay recovery and negatively impact on quality of life [NICE, 2017]. Each HCAI increases the cost of care, uses additional resources, and decreases patient safety [NICE, 2017].

It is estimated that between 5% – 15% of hospitalised patients acquire an HCAI [Haque, 2018], but assessments do vary. The most recent National Institute for Health and Care Excellence (NICE) data estimates a hospital prevalence in England of 6.4% [NICE, 2014], but this data is almost ten years old. More recent modelling estimates there could be 834,000 HCAs, potentially costing £2.7 billion and leading to an additional 7.1 million occupied hospital bed days in 2016/17 in England [Guest, 2020]. It is worth noting that the latest data on HCAs predates the recent Covid pandemic and it is uncertain when more recent data which includes HCAs during the pandemic will be available.

A 2020 analysis found that the total annual cost of HCAI to NHS England in 2020 is likely to be between £1.6 billion and £5 billion [Cawthorne, 2020]. To put this in context, the total NHS England commissioning budget for 2019/20 was £121 billion, meaning the cost of HCAI represents roughly 1.3% to 4.1% of the total budget [Cawthorne, 2020].

There is a robust body of evidence describing interventions that can substantially reduce the incidence of HCAs and analyses indicate that at least 50% are preventable [Zimlichman, 2013].

### ***Staphylococcus aureus* and HCAI**

HCAs are caused by a wide range of microorganisms, including methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-sensitive *Staphylococcus aureus* (MSSA), *Clostridium difficile* (C. diff) and *Escherichia coli* (E. coli) [NICE, 2014]. Some of these microorganisms may be carried by patients themselves, and 25% to 30% of the UK population are positive for skin or nasal carriage of *Staphylococcus* [Jeans, 2018]. This type of colonisation is a proven risk factor for subsequently developing infection during a hospital stay [Jeans, 2018].

*S. aureus* (including both methicillin-resistant and methicillin-susceptible strains) accounts for more HCAs 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 [Huang, 2013]. Up to 33% of patients newly identified as MRSA positive subsequently go on to develop an infection, regardless of whether the initial MRSA-positive culture represented colonisation or infection [Huang, 2013].

Despite the decrease in MRSA bacteraemia since mandatory surveillance began in April 2007, rates have recently shown an increase, with the highest rates seen for hospital-onset MRSA bacteraemia since 2011 [UKHSA, 2022].

Likewise, rates of MSSA bacteraemia continue to rise with a peak in 2021 of 13.4 cases per 100,000 bed-days and 998 cases - the highest MSSA hospital-onset rate and count since MSSA surveillance began [UKHSA, 2022].

The current rates of MRSA and MSSA confirm that vigilance and preventative measures continue to be of paramount importance.

### **Intensive Care Units - definitions**

The Intensive Care Society defines four levels of hospital-based patient care:

**Ward Care** where Patients needs can be met through normal ward care in an acute hospital.

**Level one Enhanced Care** describes patients requiring more detailed observations or interventions, including basic support for a single organ system and those 'stepping down' from higher levels of care.

**Level 2 Critical Care** includes patients requiring increased levels of observations or interventions (beyond level 1) including basic support for two or more organ systems and those 'stepping down' from higher levels of care.

**Level 3 Critical Care** includes Patients needing advanced respiratory monitoring and those requiring monitoring and support for two or more organ systems at an advanced level.

[ICS, 2021]

This article utilises the acronym 'ICU' to focus on patients undergoing levels 2 and 3 critical care.

### **HCAIs – ICU**

Patients are at greater risk of contracting an HCAI, when invasive procedures or devices are used. Indwelling urinary catheters are the most common cause of urinary tract infections, and bloodstream infections are associated with vascular access devices [NICE, 2017]. In ICU, invasive procedures are frequently required, leading to a heightened risk of HCAI [Nuvials, 2015]. In ICU HCAIs have a significant negative impact on clinical outcomes and patients are at greater risk from complications of HCAI. These patients have higher mortality rates, increased length of hospital stay and are more severely ill than patients without an HCAI [Nuvials, 2015].

Between 9% to 37% of patients admitted to ICU have an HCAI [Haque, 2018] and a study examining all infections in ICU found that 26.4% of infections were HCAIs [Nuvials, 2015].

ICU patients also have higher rates of methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation and transmission compared to patients on non-critical care wards, with a

prevalence on admission to ICU of 11.3% compared to 6.7%, on other hospital wards [Edgeworth, 2011]. The MRSA acquisition rate on ICU is almost twice as high as outside the critical care setting [Edgeworth, 2011]. Once discharged from ICU, patients colonised with MRSA will spend significantly longer in hospital than MRSA-colonised patients admitted to general wards without previous treatment in ICU [Edgeworth, 2011].

### **The case for decontamination in ICU**

Decontamination is used to help reduce HCAs and particularly *S. aureus* transmission; it usually includes a multi-day regime of body washing with an appropriate skin cleanser [Huang, 2013].

Both targeted and universal decontamination of patients in ICU are potential strategies to help prevent HCAs [Huang, 2013]. Targeted decontamination involves screening, isolation, and decontamination of MRSA carriers, whereas patients are not screened but all undergo a decontamination regime when universal decontamination is employed [Huang, 2013].

A trial examining the impact of both strategies in ICU concluded that universal decontamination was the most effective, as it significantly reduced MRSA-positive clinical cultures by 37% and bloodstream infections from any pathogen by 44% [Huang, 2013]. The trial reported that 181 patients needed to undergo decontamination to prevent one MRSA-positive clinical culture, and 99 patients to prevent one blood-stream infection from any pathogen [Huang, 2013]. It was not specified whether the decontamination to produce these results was targeted or universal.

A 2011 study concluded that **all** decontamination strategies in ICU improved health outcomes as well as cutting costs of healthcare provision, although universal decontamination (regardless of MRSA status) was the most cost effective [Robotham, 2011].

In a US study, universal decontamination was found to provide both lower intervention costs and lower total ICU costs than either screening and isolation or targeted decontamination [Huang, 2014]. It was estimated to save \$171,000 and prevent 9 additional bloodstream infections, for every 1,000 ICU admissions [Huang, 2014]. Although this study applies to US settings where practices and cost savings may be different to the UK, the findings do support other studies which suggest universal decontamination in ICU could offer cost savings.

Colonised and infected patients in ICU act as reservoirs for the spread of MRSA and this is supported by a study at University Hospitals Birmingham (UHB) NHS Foundation Trust. UHB is a tertiary referral teaching hospital in Birmingham, UK that provides clinical services to nearly 1 million patients every year.

The researchers found that decontamination in ICU has a positive impact across the entire hospital [Bradley, 2017]. In 2014, routine MRSA decontamination in ICU was discontinued, which led to a 250% increase in bacteraemia cases across the UHB [Bradley, 2017]. As a result, in December 2015, routine decontamination in ICU (using daily octenidine hydrochloride solution) was reinstated. Six months later, cases showed a significant decrease in MRSA, from 2.8 to 0.9 per 100,000 bed days. The researchers concluded that routine decontamination for MRSA in a large ICU setting is an effective strategy to reduce the spread and incidence of MRSA across the whole hospital [Bradley, 2017].

### **Selecting an antimicrobial body wash**

Chlorhexidine remains the main active used for decontamination and indications for routine use in ICU are increasing. These include topical application before peripheral and central cannulation, blood culture sampling, impregnated intravascular devices, dressings for intravascular devices and oral decontamination to prevent ventilator-associated pneumonia [Spencer, 2012]. However, there are concerns about increasing microbial resistance to chlorhexidine [Spencer, 2012]; and chlorhexidine resistance genes have been reported in around 5-10% of the UK population [Edgeworth, 2011].

Several side effects have been reported relating to the use of chlorhexidine including contact dermatitis and anaphylactic reactions [Lachapelle, 2014].

Another available agent for topical decontamination use is octenidine, a broad-spectrum antimicrobial that is less susceptible to bacterial resistance [Siebert, 2010] and has the potential to lower HCAs in ICU [Spencer, 2013].

### **Octenidine**

Octenidine dihydrochloride is a topical antiseptic, used for more than 30 years in a range of preparations for antisepsis at sites including skin, wounds and the oral cavity. It binds to negatively charged microbial cell envelopes and disrupts microcellular metabolism. In vitro it has been shown to be more potent than chlorhexidine against pathogens including *S. aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Pseudomonas aeruginosa* [Spencer, 2013].

With activity against Gram-positive and Gram-negative bacteria [Al-Doori, 2007] octenidine is a broad-spectrum antimicrobial. It has not shown any decrease in antimicrobial efficacy to multi-resistant bacteria [Siebert, 2010], it has good skin compatibility [Vanscheidt, 2012] and no side effects have been described when used as a topical antiseptic [Lachapelle, 2014]. Octenidine also has a residual antimicrobial effect on the skin, which lasts for at least 48 hours and may contribute towards a decreased risk of infection [Lutz, 2016].

Additionally, there are reports of patient preference for octenidine, with Birmingham University Hospitals switching from chlorhexidine 4% body wash to octenidine hydrochloride solution, when decontamination was reintroduced in 2015 [Bradley, 2017]. The reason(s) for octenidine hydrochloride solution being preferred by patients were not however indicated in the study report.

### **Octenidine in ICUs**

There is considerable evidence supporting the use of octenidine for decontamination in ICUs because of its potential impact on reducing the number of HCAs [Gastmeier, 2016; Spencer, 2013; Messler, 2019].

A study of 12,855 patients on medical ICUs, where the MRSA screening and isolation policy was replaced with universal decontamination with octenidine nasal gel and octenidine wash cloths, reported a significant reduction in ICU-acquired BSI and ICU-acquired MRSA [Gastmeier, 2016].

In a twelve-month study on a 24 bed ICU, octenidine was routinely used on a five-day cycle for all patients, whether or not they were colonised with MRSA. Acquisitions of MRSA decreased from 25 to 6 following the switch to octenidine and the mean number of monthly cases was 76% lower than before the octenisan intervention [Spencer, 2013].

Universal octenidine-based bathing was introduced to help reduce the rising incidence of Vancomycin-resistant *Enterococcus faecium* (VRE) in ICUs in Germany. There were also an increasing number of nosocomial cases occurring. In the first seven months of the post intervention period, the mean incidence density of nosocomial cases fell from 7.55/1000 patient-days (PD) to 2.61/1000 PD. Nosocomial infections were significantly reduced from 13 cases to 1 case [Messler, 2019].

With a growing body of evidence supporting the use of octenidine in ICU, the first multicentre, cluster-randomised, placebo-controlled, cross-over trial evaluating antiseptic body wash with octenidine is being undertaken. Researchers are testing the hypothesis that daily antiseptic body washing with octenidine reduces the risk of ICU-acquired primary bacteraemia and ICU-acquired multidrug-resistant organisms (MDRO) in a standard care setting. The experimental intervention consists of using octenidine-impregnated wash mitts for the daily routine washing procedure of ICU patients. This will be compared with using placebo wash mitts. The EFFECT study aims to recruit 45 ICUs with approximately 225,000 patient-days per year [Meibner, 2017]. Results are expected later in 2022.

This research that is being currently conducted where placebo mitts versus Octenidine mitts will be significant in illuminating whether it is the Octenidine agent that is having an impact on MDRO. Further research on whether it is the practice of using wash mitts (octenidine or

placebo), or more generally providing training, raising staff awareness regarding decontamination, and routine cleansing which has the most significant impact is needed.

### **Octenidine containing wash mitts**

In addition to evidence supporting the use of octenidine as a body wash in ICU, there is also interest in the possibilities offered by octenidine-containing wash mitts. The mitts have been positively evaluated in several studies in ICUs, including one which demonstrated a significant reduction in ICU-acquired BSI and ICU-acquired MRSA [Gastmeier, 2016].

The ICU at Royal Berkshire NHS Foundation Trust started using octenisan wash mitts in 2014 for routine skin cleansing of all ICU patients. The mitts replaced washing with a disposable bowl, soap and towels and became an element of agreed Best Practice on the Unit. Their use is now mandatory for daily patient cleansing and every patient admitted to ICU is prescribed octenisan wash mitts. In a qualitative evaluation, it was reported that the mitts make it easier to thoroughly clean patients, even in difficult to reach areas. Staff were highly positive about their use, commenting on their 'ready to use convenience' and 'time saving' qualities. Unlike washing solutions, which require a leave-on period and then rinsing, the mitts do not need to be rinsed and the skin dries quickly [Savage, 2022]. It would be worth acknowledging that introducing a new intervention can itself increase vigilance and compliance with interventions and routine care. This may be contributing to the positive effects seen.

### **Benefits of waterless patient washing**

The use of wash mitts also helps facilitate a move towards waterless patient washing in healthcare facilities including ICU, which helps reduce HCAs [Hopman, 2017].

Sinks in patient rooms are associated with HCAs. A two-year study evaluated the effect of removing sinks from ICU patient rooms and introducing 'water-free' patient care, on gram-negative bacilli (GNB) colonisation rates [Hopman, 2017]. This intervention was followed by a statistically significant immediate reduction in GNB colonisation. The reduction rate became more pronounced in patients with longer stays in ICU; from a 1.22-fold reduction ( $\geq 2$  days) to a 3.6-fold ( $\geq 14$  days;  $P < 0.001$ ) reduction [Hopman, 2017]. Researchers concluded that the removal of sinks from patient rooms and introduction of 'water-free' patient care is associated with a significant reduction of patient colonisation with GNB, especially in patients with a longer ICU length of stay' [Hopman, 2017].

Further research shows both staff and patients are generally positive about washing without water [Schoonhoven, 2015]. Staff working in this Dutch nursing home-based setting graded

washing without water with a 7.5 out of 10 (sd 1.2) and their workload as a 1.7 out of 10 (sd 1.9). Sixty-one percent preferred washing without water to standard bed baths and it was viewed as a more efficient alternative [Schoonhoven, 2015].

A 12-month evaluation of octenidine-based wash mitts compared to bucket washing, found a real reduction in the prescription of antibiotics for wound infections, a reduction in unwarranted infections and improvements in the quality of care delivered. In this primary care setting patients and healthcare staff both preferred waterless wash mitts to more traditional water-based cleansing methods [Dhoonmoon, 2020].

The comparison and preferences of patients and staff within an ICU setting for water-free washing has not been tested, however if a move towards water-free patient washing becomes part of ICU routine, octenidine containing wash mitts could play a key role.

## **Conclusion**

HCAIs are a serious complication of hospital treatment which increase morbidity, mortality, and costs, particularly for more vulnerable patients on ICU. Many HCAIs are avoidable and there is much evidence to support decontamination (either universal or targeted) with an antiseptic agent to reduce microorganism reservoirs as sources of potential pathogens on the skin.

With concerns about increasing resistance to chlorhexidine, octenidine is a promising alternative which could be more effective, has no known resistance and offers excellent skin compatibility. Also, the availability of octenidine containing wash mitts meets the need for effective water-free washing in ICU.

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