

New Alcohol-Free 2% CHG Solution Reduced Bacterial Counts of Drug-Resistant Acinetobacter and MRSA by 99.9%

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INTRODUCTION

Today's operating room professionals face many challenges, one of which is prevention of surgical site infections (SSIs), which are known to cause significant morbidity and contribute to post-surgical mortality.^{1,2} Up to 5% of patients undergoing surgery develop SSIs³, which are considered the most common healthcare-associated infection in surgical patients.⁴

Acinetobacter baumannii and *Staphylococcus aureus* commonly colonize the skin of hospitalized patients and are notorious for developing multi-drug antibiotic resistances.⁵ *A. baumannii* has emerged as a major cause of healthcare-associated infections and nosocomial outbreaks of infection.⁵ Methicillin-resistant *Staphylococcus aureus* (MRSA) is commonly implicated in SSIs and is associated with a higher 90-day mortality rate than infection with non-resistant strains.²

Nearly 60% of SSIs have been attributed to MRSA strains in intensive care unit patients with known *S. aureus*.⁶ Most MRSA infections are reported from large academic hospitals; however, even smaller community hospitals frequently report SSIs with MRSA. A recent retrospective study on pathogens in SSIs in a small rural hospital found 4.5% of SSIs were attributable to MRSA.⁷

Multi-resistant strains of bacteria are presenting another public health issue. Veterans of the war in Iraq are returning colonized with multi-resistant strains of *A. baumannii* and *S. aureus*, putting these individuals and those around them at risk for difficult to

treat infections. Soldiers with otherwise treatable wounds have succumbed to infection with drug-resistant *A. baumannii*.⁸

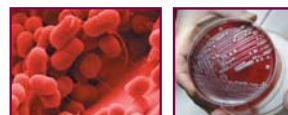
Along with increasing morbidity and mortality, SSIs increase healthcare costs. SSIs increase the length of hospital stay by 7-10 days.¹ Infection with drug-resistant bacteria leads to even higher medical costs. In patients with MRSA infection, SSIs with MRSA have been associated with a mean adjusted attributable charge of \$41,274 per case⁹, and the cost of care averages \$25,546 per patient.¹⁰

The CDC recommends a preoperative surgical scrub as well as patient skin antiseptics as part of a protocol to prevent SSI with these and other pathogens.¹ As strains of multi-drug resistant bacteria become more prevalent, the role of skin decolonization prior to the patient being rolled into the OR becomes more critical. The Institute

for Healthcare Improvement 5 Million Lives Campaign has collaborated with the Surgical Care Improvement Project (SCIP) and recommends decolonizing MRSA patients prior to surgery.¹¹ The operating room nurse is in a unique position to prevent or reduce these infections, including difficult-to-treat infections with drug-resistant bacteria, through careful attention to complete skin antiseptics.

OVERVIEW

This study sought to determine the antimicrobial effectiveness of an alcohol-free 2% CHG solution against drug-resistant strains of *A. baumannii* (2 strains) and MRSA (5 strains), including aggressive community-acquired strains. The minimum inhibitory concentration (MIC) needed for bacterial kills and the time to significant bacterial kills were measured.



Acinetobacter baumannii



Methicillin-resistant *Staphylococcus aureus* (MRSA)

This report further documents the efficacy of an alcohol-free CHG preoperative skin preparation. Alcohol-containing skin preparations have an intrinsic fire hazard and skin-drying effect that can be avoided by using an effective alcohol-free product.

After each time period lapsed, a sample of the CHG-bacteria suspension was added to product neutralizer. An aliquot of the bacterial solution containing the CHG and the product neutralizer was then inoculated onto an agar plate and incubated. Any bacterial growth that followed was noted.

MIC MEASURES

Laboratory testing was conducted at an outside facility (BioScience Laboratories Inc., Bozeman, MT). The MIC of 2% CHG was determined using a modification of the Macrodilution Broth Method. The strains of bacteria were cultured and suspensions were prepared in sterile saline. The suspension concentrations were approximately 1×10^8 CFU/ml. Dilutions of the 2% CHG were prepared in a series (1:2, 1:4, 1:8, 1:16, 1:32, 1:64, 1:128, 1:256, 1:512, 1:1024, 1:2048, and 1:4096).

A 1.0 ml of the bacterial suspension was placed in each of the product dilution tubes in the series. Following incubation, the tubes were examined for growth as determined by turbidity. The MIC was recorded as the highest dilution of the test product that completely inhibited growth, as detected by the unaided eye.

A positive control of culture medium and bacterial suspension was prepared for each microbial strain that was tested. Negative controls (with no inoculum) and turbidity controls (CHG dilutions plus broth) were also done.

TIME-KILL MEASURES

The antimicrobial properties of 2% CHG against 7 drug-resistant microorganism strains were determined with an in vitro time-kill method. Prior to initiation of the study, the effectiveness of the solution used to neutralize the antimicrobial properties of the CHG was verified. After culturing, an initial suspension of each microorganism in sterile saline was prepared. The suspension concentrations were approximately 1×10^8 CFU/ml.

A 0.1 ml aliquot of the bacterial suspension and 9.9 ml of 2% CHG were then mixed together. Each bacterial suspension was exposed to the 2% CHG for fifteen seconds (T_{15}), 1 minute (T_{60}), 3 minutes (T_{180}), 6 minutes (T_{360}), 9 minutes (T_{540}), 12 minutes (T_{720}), and 15 minutes (T_{900}). The percent and Log₁₀ reductions in the bacterial counts were determined for each of the time periods.

After each time period lapsed, a sample of the CHG-bacteria suspension was added to product neutralizer. An aliquot of the bacterial solution containing the CHG and the product neutralizer was then inoculated onto an agar plate and incubated. Any bacterial growth that followed was noted.

RESULTS

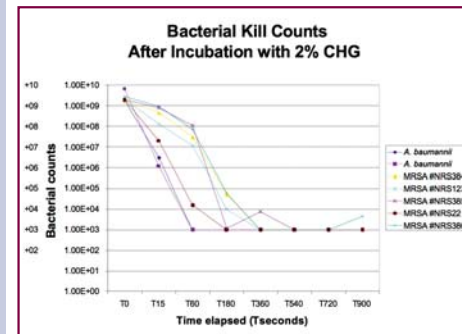
- The MIC of the 2% solution of CHG against *A. baumannii* was 1:2,048 and against *S. aureus* was >1:8,192.¹²

Results of MIC Evaluations for 2% CHG Solution

Microorganism by species (strain)	Inoculum population (CFU/ml)	Minimum Inhibitory Concentration (MIC) (As product dilution)
<i>Acinetobacter baumannii</i> MDR (BSL1 # 10506A81)	2.40×10^8	1:2,048
<i>Acinetobacter baumannii</i> MDR (BSL1 # 10506A82)	3.8750×10^8	1:2,048
<i>Staphylococcus aureus</i> MRSA (NARSA #NR8384, USA300, BSL1 #12052NR8384)	1.0650×10^8	>1:8,192
<i>Staphylococcus aureus</i> MRSA (NARSA #NR8323, USA400, BSL1 #015065aNR8323)	1.090×10^8	>1:8,192
<i>Staphylococcus aureus</i> MRSA (NARSA #NR8385, USA500, BSL1 #015065aNR8385)	1.360×10^8	>1:8,192
<i>Staphylococcus aureus</i> MRSA (NARSA #NR822, USA600, BSL1 #015065aNR822)	2.2250×10^8	>1:8,192
<i>Staphylococcus aureus</i> MRSA (NARSA #NR8386, USA700, BSL1 #015065aNR8386)	1.8750×10^8	>1:8,192

MDR = Multi-drug resistant
MRSA = Methicillin-resistant *S. aureus*
NARSA = Network on Antimicrobial Resistance in *Staphylococcus aureus* (NARSA Program), Herndon, VA
BSL1 = BioScience Laboratories, Inc.

- The time-kill measures demonstrated a 99.9% reduction in bacterial counts of *A. baumannii* from 15 seconds on. There was a 99.9% reduction in *S. aureus* counts by 3 minutes of exposure.¹²



CONCLUSION

This study demonstrated that an alcohol-free 2% CHG solution has both effectiveness and rapid onset of action against strains of drug-resistant *A. baumannii* and *S. aureus*. This effectiveness was maintained even at very low concentrations.

These results show that alcohol-free 2% CHG is effective, even against select strains of the multi-drug resistant microorganisms *A. baumannii* species, and MRSA.

LESSONS LEARNED

- Multi-antibiotic resistance is a serious concern for the OR nurse. These resistant microbes can colonize the skin and put the surgical patient at risk for SSIs that require treatment with potentially toxic antibiotics.
- Alcohol-free 2% CHG solution reduced bacterial counts of drug-resistant *A. baumannii* and MRSA by 99.9%.
- Antimicrobial counts were reduced after short exposure times and efficacy continued with significant dilutions of the 2% CHG solution.
- Alcohol-free characteristic of the product removes a fire hazard from the operating room environment.
- OR nurse has an additional tool, alcohol-free 2% CHG solution, to protect surgical patients against healthcare-associated SSI with multi-drug resistant bacteria.

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- MIC and Time Kill testing conducted by BioScience Laboratories Inc., Bozeman, MT.
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