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Evaluation of Compatibility of a Gum Mastic Liquid Adhesive and Liquid Adhesive Remover With an Alcoholic Chlorhexidine Gluconate Skin Preparation

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ABSTRACT

The compatibility of a 2% chlorhexidine gluconate/70% isopropyl alcohol (CHG/IPA) skin preparation with a gum mastic liquid adhesive (GMLA) and liquid adhesive remover (LAR) was assessed in healthy volunteers. Twenty subjects completed test material combination with microbial sampling at 3- and 7-day time points. Mean $\log_{10}$ reductions from baseline for normal flora were assessed. There was no significant difference in reduction of normal flora on skin prepped with CHG/IPA versus skin prepped with CHG/IPA followed by GMLA or LAR. The conclusion of the study was that the use of GMLA or LAR with CHG/IPA does not affect the antiseptic effectiveness of CHG/IPA.

Key words: catheter dressing removal, catheter-related bloodstream infection prevention, central vascular catheter dressing dislodgement, chlorhexidine skin preparation catheter care, medical adhesive-related skin injury

INTRODUCTION

Catheter-related bloodstream infection (CR-BSI) continues to be a major patient safety concern and a significant focal point for infection prevention practitioners and regulatory agencies, given the related increased morbidity, mortality, cost of care, and impact on quality of life.[1-3] The pathogenesis of CR-BSI involves complex microbial interactions with catheter materials, surrounding tissues, and blood components.[4-6] Effective pathogenesis-based prevention strategies are focused on inhibition of microbial access to the internal and external catheter luminal surfaces, skin, subcutaneous tissue, and the bloodstream.[7,8]

An immediate threat of bacterial transfer is encountered during insertion, with passage of the catheter through the skin in the absence of meticulous skin antisepsis and sterility. This leads to early onset of infection within the first 5 to 7 days; however, microbial access to the open cutaneous wound and bloodstream enhances the risk of extraluminal infection throughout the catheterization period. The intraluminal path of the infusion system (administration set, injection ports, needleless connectors, catheter hub, and catheter lumen) becomes the primary site of colonization and biofilm formation as manipulation of access sites increases, especially after approximately 7 days.[5,9]

Because microorganisms have access to the catheter from multiple sources, a multimodal approach, with

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The Gallatin Institutional Review Board (DHHS number: IRB00005939) approved data collection, validation of analysis, and dissemination of all information.

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implementation of insertion and maintenance intervention bundles, is required. Evidence-based strategies for the prevention of extraluminal colonization include preprocedure skin cleansing; surgical-site preparation with alcoholic chlorhexidine gluconate (CHG)/isopropyl alcohol (IPA); use of maximal sterile insertion barriers; an antimicrobial catheter; catheter securement; continuous postinsertion skin antisepsis with CHG foam disks or gel pads; and dry, adherent, sterile dressings.

Application of a sterile dressing is the primary strategy for the protection of the insertion-site wound from transient organisms and contamination. The Centers for Disease Control and Prevention (CDC) 2011 Guidelines for the Prevention of Intravascular Catheter-Related Infections recommend replacing the transparent dressing on short-term central vascular catheters at least every 7 days.[10] The Society for Healthcare Epidemiology of America/Infectious Diseases Society of America (SHEA/IDSA) Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update[11] and the 2016 *Infusion Therapy Standards of Practice*[12] (the *Standards*) recommend changing central vascular catheter transparent dressings every 5 to 7 days. The *Standards* also recommends changing dressings on short peripheral and midline catheters every 5 to 7 days.[12(S82)]

Alcoholic CHG is the preferred antiseptic for pre- and postprocedural vascular access skin antisepsis, owing to its residual activity, fast dry time, and broad-spectrum activity against gram-positive and gram-negative bacteria, facultative anaerobes and aerobes, yeasts, and some lipid-enveloped viruses including the human immunodeficiency virus.[10-14] However, viable bacteria may survive skin preparation even with proper application.[15] The residual activity of 2% CHG/70% IPA persists for approximately 48 hours,[13] after which regrowth of the normal flora under the sterile dressing provides the potential for catheter colonization and CR-BSI. Given the recurrence of microbial growth in the absence of antiseptic activity under a standard dressing before the 5- to 7-day scheduled replacement, a chlorhexidine-containing dressing, such as a CHG sponge or gel dressing, is used to suppress microbial growth at the insertion site for the full 5 to 7 days of desired dressing life, as long as it remains dry and intact.[8,15-19]

All 3 recommending organizations (CDC, SHEA/IDSA, INS) emphasize that all dressings (both central and peripheral) should be replaced immediately if they become damp, loosened, or visibly soiled. If the patient is diaphoretic, or if the skin is oozing or bleeding, a gauze dressing is preferable. These recommendations are centered on the findings that dressings compromised by drainage, bleeding, diaphoresis, moisture, or detachment increase the risk of colonization, potentially resulting in local site and/or bloodstream infection.[16-19] Dressing disruption of both peripheral and central vascular access devices often goes unrecognized and unappreciated as an infection risk.[13] Improved dressing adherence can be enhanced with a gum mastic liquid adhesive (GMLA) applied to the skin under the dressing. Maintaining dressing integrity diminishes the risk of infection and reduces unplanned dressing changes and associated costs.

Medical adhesive-related skin injury (MARSI) is another underrecognized complication that can occur with repeated dressing replacement and is an associated infection risk.[20] Removal of adhesive dressings, stabilization devices, and tape is well known to detach cells from the epidermal stratum corneum; however, increased friction and shear forces associated with adhesive removal can strip the underlying epidermis and result in skin trauma. The most common types of adhesive damage related to vascular access devices are skin stripping and tension blisters.[21] Proper application and removal of medical device adhesives are crucial for the prevention of MARSI and painful dressing changes, especially in the pediatric population.[20-22] A nonirritating liquid adhesive remover (LAR) is intended to gently remove adhesive and adhesive residue, prevent skin tears, reduce infection risk, and reduce pain and discomfort.

The GMLA is applied over the CHG/IPA skin preparation around the outer perimeter of the dressing, and the LAR is applied while removing the dressing, followed by reapplication of the CHG/IPA antiseptic. The interaction of these agents is unknown. Inactivation of CHG has been reported with anionic-based substances such as hand gels and lotions.[23] Inactivation of the CHG under vascular access dressings would be an undesirable and defeating effect of a liquid adhesive and adhesive remover, potentially increasing infection risk. The purpose of the present study was to evaluate the compatibility of a GMLA and an LAR with an alcoholic CHG skin preparation.

MATERIALS AND METHODS

Investigational Products

Two commercial test products were evaluated for compatibility with an alcoholic CHG skin preparation. Mastisol Liquid Adhesive (Eloquest Healthcare, Inc, Ferndale, MI), a non–water-soluble GMLA, and Detachol Adhesive Remover (Eloquest Healthcare, Inc), a liquid nonirritating mineral paraffin hydrocarbon, were each evaluated in combination with application of ChloraPrep (CareFusion Corp, San Diego, CA), a 2% CHG and 70% IPA antiseptic skin preparation.

Study Design

This study was a prospective, randomized, blocked-design trial conducted at BioScience Laboratories in Bozeman, Montana, over a 5-week period from June 26 to July 31, 2014. The study protocol was approved by the Gallatin Institutional Review Board (DHHS number: IRB00005939) before admitting subjects into the study. Written informed consent was received from all study subjects before testing.

Study Population

Forty healthy volunteer subjects at least 18 years of age were recruited for the study. Insofar as possible, the group of subjects selected was of mixed sex, age, and race, and the test sites were free from clinically evident dermatoses, cuts, lesions, and/or any other skin disorders that could have compromised the subject or the study. Twenty-one subjects were selected to receive the product and begin testing; 20 subjects completed the study.

Pretest Phase

The pretest phase comprised the 7 days before the testing period. During this time, subjects avoided the use of medicated soaps, lotions, deodorants, and shampoos, as well as skin contact with solvents, detergents, acids, and bases, or any other products known to affect the normal microbial populations of the skin. Subjects were supplied with a personal hygiene kit containing nonmedicated soap, shampoo, lotion, and rubber gloves to be worn when contact with antimicrobials, solvents, detergents, acids, or bases could not be avoided. The subjects were instructed to use the contents of the kit exclusively during the study period and to avoid using ultraviolet-light tanning beds, sunbathing and swimming, or bathing in biocide-treated pools or hot tubs. Subjects did not shave the anatomic sites within 5 days of the test period and were instructed not to bathe or shower during the 72-hour period before the test period, to allow for stabilization of the normal microbial flora of the skin.

At least 72 hours before the test period, the subjects were examined physically to ensure there was no evidence of injury, dermatosis, or dermatitis present at the test sites; hair on the sampling sites was clipped, if needed, to ensure the dressings used during testing remained secured to the test sites.

Before admission to the test period, subjects were questioned regarding their adherence to the protocol requirements. Those who did not comply with the 7-day antimicrobial product restriction period, and those who did not continue to meet the study eligibility criteria, were discontinued from the study. Twenty-one subjects were admitted to the test period.

Test Period

Before testing, a neutralization assay was performed, which ensured that the recovery medium quenched the antimicrobial activity of the CHG/IPA product and that all sampling/plating media were nontoxic to a representative bacterium of normal flora (indicator microorganism, *Staphylococcus epidermidis* [American Type Culture Collection, Manassas, VA; #51625]).

At the start of the test period, a sterile surgical marker was used to bilaterally demarcate 5 circular sites within 5 × 5-inch areas of skin for the right and left sides of the umbilicus that appeared to be similar in condition. The CHG/IPA antiseptic product was applied to a 4 × 4-inch area, and the baseline sample was obtained from the top 1 inch of the demarcated 5 × 5-inch area (Figures 1 and 2).

Randomization and Sample Configuration

Each side of the abdomen was randomly assigned to the 3- or 7-day postapplication sampling time according to the computer-generated randomization schedule. One site on each side of the abdomen was designated for baseline skin counts and 1 site for baseline counts of antiseptic-prepped skin immediately after application. Four sites were then randomly assigned to 1 of 4 sample configurations (Figure 2), as follows:

Sample 1: Site sampled immediately after skin preparation with CHG/IPA product

Sample 2: Site sampled 3 or 7 days after skin preparation with CHG/IPA product

Sample 3: Site sampled 3 or 7 days after skin preparation with CHG/IPA product and GMLA product

Sample 4: Site sampled 3 or 7 days after skin preparation with CHG/IPA product and LAR product

Sampling

Sampling was performed using the cylinder sampling method.[24] A 4 × 4-inch area of skin was then prepped with the CHG/IPA product according to the manufacturer's instructions using gentle repeated back-and-forth strokes for 30 seconds, wetting the entire area, and allowing it to dry for at least 3 minutes. The post–skin-preparation samples were collected within 30 seconds after the CHG/IPA had dried.

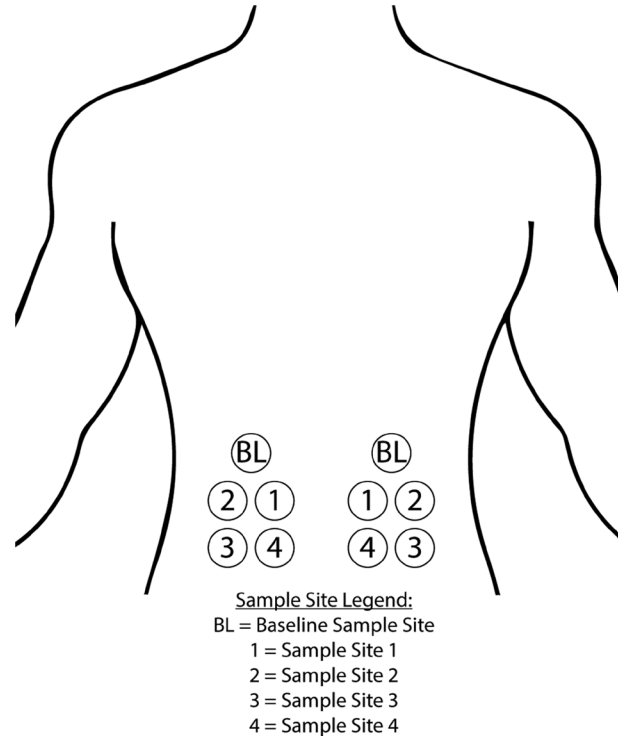

Figure 1 Anatomic test sites. (Image courtesy of BioScience Laboratories, Inc.)

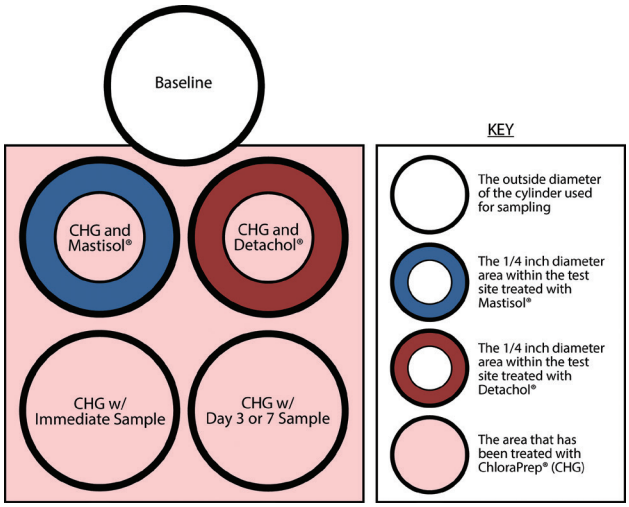

Figure 2 Diagram of sampling test sites and product application. *Abbreviation: CHG, 2% chlorhexidine gluconate/70% isopropyl alcohol.* (Image courtesy of BioScience Laboratories, Inc.)

After collection of the immediate postpreparation samples, each test product (GMLA and LAR) was applied to the designated site according to the manufacturer's instructions. A sterile template was used to apply the test products to the outer one-quarter-inch area of skin within the site and allowed to dry completely. Sites were covered with sterile polyester-blend gauze sponges (Avant Gauze; Medline Industries, Inc, Mundelein, IL) and a standard semipermeable polyurethane film dressing containing no antimicrobial agent (IV3000 Standard; Smith & Nephew, London, UK).

Subjects were allowed to leave the laboratory and return for sampling at 72 hours ± 2 hours and 168 hours ± 4 hours after application of the test materials. At the designated sampling times (72 and 168 hours), the dressings on the 3 sites on 1 side of the abdomen were removed, and the skin was sampled using the cylinder sampling method.

Cylinder Sampling Method, Neutralization, and Culturing

A sterile cylinder with an inside area of 3.46 cm^2 was held firmly to the test site to be sampled. A volume of 3.0 mL sterile stripping suspending fluid (SSF++) with product neutralizers/10% Tween was instilled into the cylinder, and the skin area was massaged in a circumferential manner for 1 minute with a sterile rubber-tipped glass rod. The SSF++ was removed with a sterile pipette and transferred to a sterile test tube. A second 3.0-mL aliquot of SSF++ was instilled into the cylinder, and the skin area was again massaged for 1 minute with the same rubber-tipped glass rod. The second aliquot was pooled in the test tube with the first aliquot.

Duplicate spread and spiral plates were prepared from each of the samples on tryptic soy agar with product neutralizers and incubated at 30°C ± 2°C for approximately 72 hours or until sufficient growth was observed. Colonies were counted and data were recorded using the QCOUNT plate-counting system (Spiral Biotech, Norwood, MA).

Statistical Analysis

The compatibility of the test materials was evaluated based on a comparison of the mean $\log_{10}$ reductions from baseline in microbial populations from the skin samples collected at 3 and 7 days after application. The plate count data were evaluated using MiniTab statistical computer software (Minitab Inc, State College, PA). Statistical calculations of mean and standard deviation (SD) were generated on the $\log_{10}$ data from the baseline samples, post–skin-prep samples, and post–product-application samples. A blocked, 2-factor analysis of variance (ANOVA) model ($\alpha = .05$) was used to compare the efficacy of GMLA and LAR applied to skin prepared with CHG/IPA against skin prepared with CHG/IPA alone.

RESULTS

Demographic Characteristics

A total of 21 subjects entered the study and received product application, and 20 completed the study; 1 subject who began testing and received product withdrew from the study. Of the subjects who were recruited but did not enter the study, 4 had schedule conflicts, 3 failed to appear for testing, 1 voluntarily withdrew, 1 failed to meet qualification criteria, and 10 who met the criteria did not test because a sufficient number of subjects meeting the criteria had already entered testing. Of the 20 subjects who completed the study, 19 (95%) were white, and 1 was Latino (5%). A total of 55% of the subjects were female. Median age was 49 years (range 18-68 years).

Day 0 Baseline and Postpreparation Counts

The mean (SD) baseline skin flora count was 3.14 (0.931) $\log_{10}$ colony-forming units (CFU)/cm^2, with a minimum and maximum of 1.49 $\log_{10}$ CFU/cm^2 and 5.23 $\log_{10}$ CFU/cm^2, respectively (Table 1).

The mean (SD) microbial recovery in the Day 0 CHG/IPA postpreparation prep sample was 0.91 (0.832) $\log_{10}$ CFU/cm^2, with a minimum and maximum of 0 $\log_{10}$ CFU/cm^2 and 3.11 $\log_{10}$ CFU/cm^2, respectively (Table 1). The mean $\log_{10}$ reduction from baseline microbial population in the Day 0 CHG/IPA postpreparation sample was 2.23 (1.06) $\log_{10}$ CFU/cm^2 (Table 1).

$\log_{10}$ Counts at Days 3 and 7

Three days after application, the mean $\log_{10}$ reductions from baseline microbial populations recovered from the CHG/IPA sites, CHG/IPA plus GMLA sites, and CHG/IPA plus LAR sites were 2.22 (1.38) $\log_{10}$ CFU/cm^2, 2.38 (1.57) $\log_{10}$ CFU/cm^2, and 2.08 (1.34) $\log_{10}$ CFU/cm^2, respectively (Table 1).

The mean $\log_{10}$ reductions from baseline microbial populations on Day 7 obtained from the CHG/IPA sites,

TABLE 1

Statistical Summary of Day 0 Mean $\log_{10}$ Microbial Recoveries (CFU) at Baseline and Immediately After CHG/IPA Product Application, and Mean $\log_{10}$ Microbial Reductions From Baseline (CFU) for Day 0, 3, and 7 Samples on Sites Treated With CHG/IPA Alone, CHG/IPA Plus GMLA, and CHG/IPA Plus LAR

	Day 0 Recovery Results and Reduction From Baseline						
	N	Mean	SE Mean	SD	Minimum	Median	Maximum
Recovery: Baseline	40	3.137	0.147	0.931	1.494	3.04	5.231
Recovery: Immediate (CHG/IPA)	40	0.912	0.132	0.832	0	0.677	3.112
Reduction from baseline: Immediate (CHG/IPA)	40	2.225	0.168	1.06	−0.251	2.308	4.438
	Day 0 Recovery Results						
Baseline	40	3.137	0.147	0.931	1.494	3.04	5.231
Immediate (CHG/IPA)	40	0.912	0.132	0.832	0	0.677	3.112
	Day 3 Reductions From Baseline						
CHG/IPA	20	2.217	0.308	1.378	−0.062	2.654	5.231
CHG/IPA plus GMLA	20	2.377	0.35	1.567	−1.169	2.767	5.231
CHG/IPA plus LAR	20	2.082	0.299	1.337	−0.199	2.125	4.816
	Day 7 Reductions From Baseline						
CHG/IPA	20	1.988	0.317	1.416	−0.968	1.981	4.438
CHG/IPA plus GMLA	20	2.04	0.323	1.443	−0.56	2.1	4.592
CHG/IPA plus LAR	20	2.138	0.309	1.38	−0.894	2.233	4.438

Abbreviations: CFU, colony-forming units; CHG/IPA, 2% chlorhexidine gluconate/70% isopropyl alcohol; GMLA, gum mastic liquid adhesive; LAR, liquid adhesive remover; SD, standard deviation; SE, standard error.

CHG/IPA plus GMLA sites, and CHG/IPA plus LAR sites were 1.99 (1.42) $\log_{10}$ CFU/cm^2, 2.04 (1.44) $\log_{10}$ CFU/cm^2, and 2.14 (1.38) $\log_{10}$ CFU/cm^2, respectively (Table 1).

ANOVA Comparisons

A 2-factor ANOVA model was performed to compare product performance 3 and 7 days after application. The general linear model evaluated $\log_{10}$ CFU/mL reductions from baseline versus subject, product, and day (Table 2).

The effect of subject was statistically significant across the 3- and 7-day time points ($P < .0001$) (Table 2). The effects of product and day (Day 3 and Day 7) were not statistically significant ($P = .864$ and $P = .343$, respectively). Pooled across time points, the effect of product and day interaction also was not statistically significant ($P = .650$) (Table 2 and Figure 3).

There was no significant difference in reductions from baseline for sites prepped with CHG/IPA alone and sites prepped with CHG/IPA followed by applications of GMLA or LAR. There was also no significant difference between reductions from baseline or at 3 days or 7 days after test material application.

Adverse Events

No adverse events occurred during the study. There were no observations of skin conditions, such as erythema, edema, itching, maceration, contact dermatitis, allergic reaction, or skin damage, for any of the subjects.

Limitations

The limitations of this study included a small sample size, lack of racial diversity, and use of healthy volunteers. However, current evidence does not indicate that the compatibility of CHG with the products tested would be impacted by patient acuity, ethnicity, or altered microflora of hospitalized patients. Future research with a larger study cohort and inclusion of other patient populations (eg, critically ill patients) should be conducted to confirm these results.

DISCUSSION

Dressing detachment rates have been reported to be as high as 67% in critically ill patients[16]; in patient care wards, 31% of dressings were found to be suboptimal in 1 study,[25]

TABLE 2

General Linear Model: Log_{10} CFU/mL Reductions Versus Subject, Product, and Day

Factor	Type	Levels	Values
Subject	Random	20	1, 2, 3, 6, 7, 8, 9, 10, 11, 15, 17, 18, 20, 21, 22, 23, 25, 26, 27, 36
Product	Fixed	3	1, 2, 3
Day	Fixed	2	2, 3

	Analysis of Variance for log_{10} CFU/mL Reductions Using Adjusted Sum of Squares for Tests						
Source	Degrees of Freedom	Sequential Sum of Squares	Adjusted Sum of Squares	Adjusted Mean Square	F^a	P^b	Significant/Not Significant[c]
Subject	19	140.053	140.053	7.371	7.74	<.0001[d]	Significant[c]
Product	2	0.279	0.279	0.139	0.15	.864	Not significant[c]
Day	1	0.866	0.866	0.866	0.91	.343	Not significant[c]
Product × day	2	0.825	0.825	0.413	0.43	.65	Not significant[c]
Error	95	90.449	90.449	0.952			
Total	119	232.473					
$s = 0.976$		$R-Sq(adj) = 51.26\%$					

Abbreviations: CFU, colony-forming units; s, standard deviation of a sample.

Note: Product and day were selected and therefore fixed.

[a] $F = \frac{\text{Adjusted Treatment Square Mean}}{\text{Adjusted Error Square Mean}}$; F is the adjusted mean square item values divided by adjusted mean square error. The MS_E term is s^2, which was 0.952, and the standard deviation was $s = 0.976$. $R-Sq(adj) = 51.26\%$, which indicates an acceptable degree of reliability.

[b] P = Probability of an F value ≥F-calculated, given the H_0 hypothesis is true, as indicated by the P value.

[c] Significant/not significant at $\alpha = .05$. If $P \leq .05$, the test is significant. If $P > .05$, it is not significant.

[d] $P = .0000000000027557956$.

and a 44.8% failure rate with breeches in maintenance care of central catheter dressings and catheter caps was observed in another study.[26] In a randomized controlled trial, Timsit et al[18] found that the number of dressing disruptions was related to increased risk of colonization of the skin at the insertion site. In that study, the risk of major catheter-related infection and CR-BSI increased by more than 3-fold after the second dressing disruption and by more than 12-fold if the final dressing was disrupted.[18] These findings prompted further investigation to determine whether highly adhesive dressings compared with a standard dressing and a CHG gel pad dressing would affect dressing disruption and infection.[17] As expected, the CHG dressing significantly reduced the risk of both major catheter-related infection and CR-BSI compared with the nonantiseptic dressings. The rate of dressing disruption was significantly reduced in the highly adhesive dressing group compared with the standard and CHG gel dressing groups, but skin and catheter colonization were inadvertently increased. This emphasizes the importance of maintaining continuous active antisepsis at the insertion site with either a CHG disk or gel dressing while maintaining dressing adhesion for maximum protection during the 5- to 7-day dressing application. It is important that the CHG disk or gel pad remain in direct contact with the skin to maintain effectiveness. Lifting edges of the dressing may in time result in exposure of the insertion site or separation of the disk or pad from the skin, signaling the untimely requisite to replace the dressing when loosening occurs. Application of the GMLA maintains the antiseptic disk/pad in place and prevents premature detachment, reducing the risks and costs of early dressing replacement.

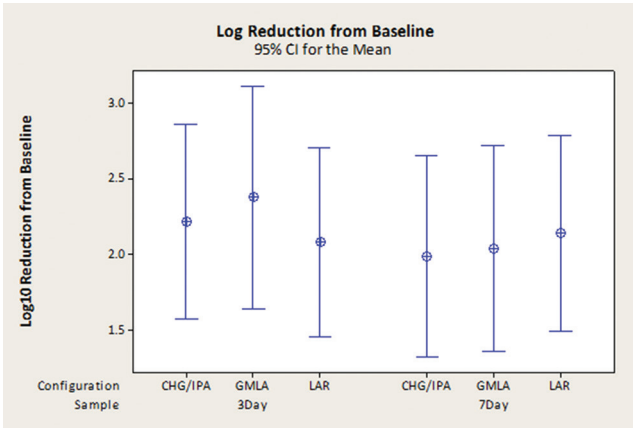

Figure 3 Listing of 95% confidence intervals for normal flora mean log_{10} reductions from baseline for sites treated with CHG/IPA alone, CHG/IPA plus GMLA, and CHG/IPA plus LAR for Days 3 and 7. *Abbreviations: CHG/IPA, 2% chlorhexidine gluconate/70% isopropyl alcohol; CI, confidence interval; GMLA, gum mastic liquid adhesive; LAR, liquid adhesive remover.*

The securement and protection of vascular access devices requires the use of adhesives to maintain the position of the catheter and placement of the dressing. Repeated application and removal of dressings, stabilization devices, and tape can result in skin damage. MARSI is now identified as a major complication of the use of medical adhesives.[20] The purpose of LAR is to prevent MARSI and painful adhesive removal.

In contradistinction to the benefits of a liquid adhesive and remover, the use of these products has been questioned with regard to potential incompatibility with CHG. The present study demonstrated that the tested GMLA and LAR products were compatible with CHG applied to the skin of healthy individuals, with no statistically significant differences in bacterial populations following use of the CHG/IPA product alone versus use of CHG/IPA product with either GMLA or LAR at both 3 and 7 days after application.

Despite the strong evidence-based recommendations of the CDC, SHEA/IDSA, and INS that dressings should be changed immediately if dressing integrity is impaired, dressings compromised by premature lifting and detachment are common, and the risks are often overlooked. The appropriate application of a CHG-compatible GMLA can help provide the highest likelihood of dressing adherence and mitigate risks and costs associated with premature lifting and detachment. The documented compatibility of the GMLA product with CHG ensures that use of this liquid adhesive will not compromise the antiseptic protection of the insertion-site wound against transient organisms and contamination. Furthermore, use of a CHG-compatible LAR can ensure that appropriate technique is used for dressing removal, without impairing antiseptic coverage, and may prevent patient discomfort and MARSI.[20-22,25] Consequently, it would be prudent to consider the combination of GMLA and LAR as an important addition to dressing management policies and maintenance care bundles.

CONCLUSION

Based on $\log_{10}$ reductions from baseline of normal flora on intact skin of healthy subjects in the present study, there was no significant difference in bacterial populations following use of CHG/IPA product alone compared with bacterial populations following use of CHG/IPA with either GMLA or LAR both 3 and 7 days after application. Both the GMLA and LAR products tested are compatible with CHG and do not impact the antiseptic effectiveness of CHG.

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Erratum

Extending Short Peripheral Catheter Dwell Time: A Best Practice Discussion: Erratum

In the May/June 2017 issue of *Journal of Infusion Nursing*, a reference was incorrect in the article by Ansel et al, "Extending Short Peripheral Catheter Dwell Time: A Best Practice Discussion." Reference 6 should have been listed as follows:

Webster J, Osborne S, Rickard C, Hall J. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database Syst Rev*. 2010;(3):CD007798. doi:10.1002/14651858.CD007798.pub2.

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Ansel B, Boyce M, Embree JL. Extending short peripheral catheter dwell time: a best practice discussion. *J Infus Nurs*. 2017;40(3):143-146.