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Microbiological effect of mupirocin and chlorhexidine for *Staphylococcus aureus* decolonization in community and nursing home based adults

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ABSTRACT

Objective: To compare the presence of *Staphylococcus aureus* and pathogenic Gram-negative rods (GNR) in the anterior nares, posterior pharynx and three skin sites in community-based adults and nursing home-based adults before and after treatment with nasal mupirocin and topical chlorhexidine.
Methods: *S. aureus*-colonized adults were recruited from the community ($n = 26$) and from nursing homes ($n = 8$). Eligible participants were cultured for *S. aureus* and GNR during two study visits and then received intranasal mupirocin and topical chlorhexidine for 5 days, with a 2-month follow-up period.
Results: After decolonization, we found sustained decreases of *S. aureus* colonization in nose, throat and skin sites over 4–8 weeks in both populations. Intranasal mupirocin did not increase GNR colonization in nose or throat. Chlorhexidine did not decrease GNR colonization in skin sites.
Conclusions: Decolonization with mupirocin and chlorhexidine leads to a sustained effect on *S. aureus* colonization without affecting GNR colonization.

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1. Introduction

"Decolonization" is a rapidly growing strategy to prevent methicillin-resistant *Staphylococcus aureus* infections fueled by new healthcare policy initiatives, such as mandated surveillance cultures and public reporting of healthcare associated infections. (Medicare; Weber et al., 2007) Decolonization involves the application of targeted or non-targeted antimicrobials to the skin or mucosal surfaces. Given the role of our microbiota as a barrier to infection, decolonization regimens could have unintended negative consequences. For example, a Cochrane meta-analysis showed that decolonization with intranasal mupirocin, a Gram-positive antimicrobial agent, increases the risk of infections due to organisms other than *S. aureus* including Gram-negative rods (van Rijen et al., 2008). Thus, interventions that shift infections from Gram-positive to Gram-negative pathogens could potentially have long-term negative consequences for patients.

In order to assess the effect of decolonization regimens on Gram-positive and Gram-negative pathogens over time, we conducted an interventional study. Our objective was to compare the presence of *S. aureus* and pathogenic Gram-negative rods (GNR) in community-based, *S. aureus*-colonized adults and nursing home-based, *S. aureus*-colonized adults before and after treatment with nasal mupirocin and topical chlorhexidine. We hypothesized that treatment with mupirocin and chlorhexidine would increase the presence of Gram-negative rods from the *Enterobacteriaceae* family, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* within individuals particularly in the nursing home environment.

2. Material and methods

This was a single-center, interventional study in community-based, *S. aureus*-colonized adults and nursing home-based, *S. aureus*-colonized residents. Participants were microbiologically characterized over two study visits, then the nose and skin were decolonized for 5 days with a 2-month follow-up period in which participants were seen weekly for 4 weeks, and then once 4 weeks later (see x-axis of Figs. 1–4). The two study visits prior to decolonization allowed each participant to serve as their own control. This convenience sample was recruited prospectively for this study from local VA primary care clinics and VA nursing homes and screened to document their eligibility and health status. Eligible participants were adults without: cancer treatment, HIV infection, immunosupressive medications, nasal steroids, antibiotic (including chlorhexidine or mupirocin) use or recent hospitalization within 3 months. The nursing homes did not use chlorhexidine bathing or mupirocin ointment as a part of infection control efforts. Noninvasive

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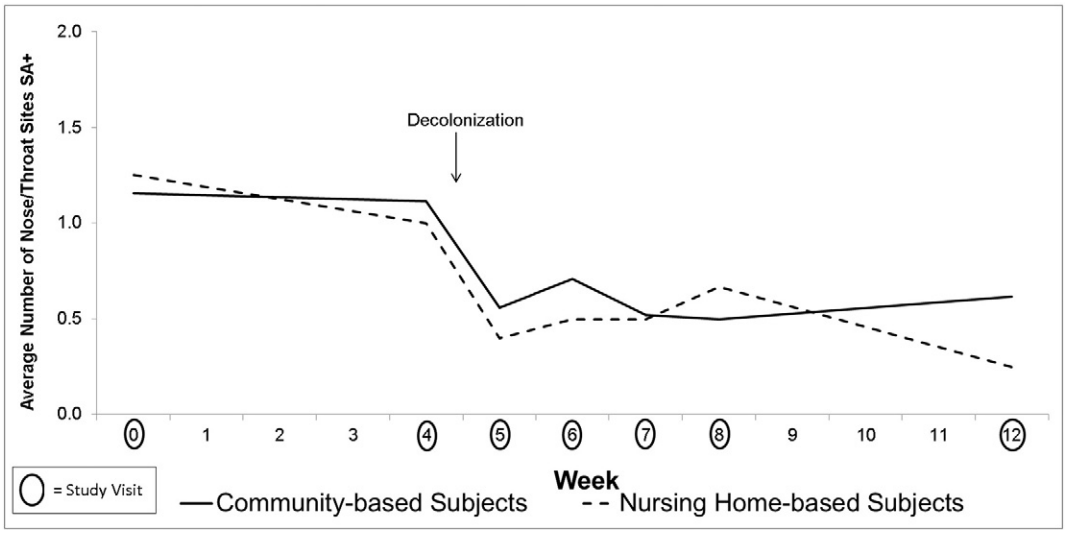

Fig. 1. Effect of Mupirocin on *S. aureus* Colonization in the Nose and Throat in Community ($n = 26$) vs Nursing Home ($n = 8$) Subjects.

samples from the nose, throat and three skin sites: subclavian, femoral and perianal areas were collected by research staff for culture at the following intervals: 2 months to 2 weeks before intervention, same day intervention begins, weekly after intervention for 4 weeks, and 2 months after intervention. After visit 2, participants received a 5-day course of nasal mupirocin ointment and topical chlorhexidine. Mupirocin 2% nasal ointment was applied by participants or nursing home staff twice a day. 2% Chlorhexidine impregnated cloths were used after bathing each day using a standard protocol. Community based participants filled out a subject diary. Nursing home based participants had their regimen provided by and documented by nursing staff. The study was approved by the University of Maryland, Baltimore Institutional Review Board and the VA Research and Development Committee.

Enriched samples in Tryptic soy broth with 6.5% NaCl and CHROMagar Staph aureus (Becton Dickenson; Sparks, MD) were used for the detection of *S. aureus*. Mauve colonies growing on CHROMagar Staph aureus were considered positive for *S. aureus*. Any suspicious colony morphology was confirmed by Gram staining and latex agglutination (Staphaurex: Remel, Lenexa, KS) for the detection of clumping factor and protein A. Methicillin resistance was determined by oxacillin screen agar and antibiotic susceptibilities performed following CLSI guidelines (CLSI, 2011).

Gram-negative rods were enriched in brain heart infusion broth and plated to MacConkey and Rambachrom Acinetobacter. All organisms were identified using Vitek compact (BioMerieux; Durham, NC).

All data were entered into study-specific centralized relational databases. Quality control was performed every 3 months via logic checks on the entirety of the databases and comparison of source documentation to the database values for 10% of the participants. The associations between dwelling and resident characteristics were measured using the chi square test or Fisher's exact test for categorical variables, or the Student *t* test for continuous variables. The associations between dwelling and bacterial colonization pre intervention were measured using the chi square test or Fisher's exact test.

Comparisons of the prevalence of body sites positive for *S. aureus* or Gram-negative rods at weeks post decolonization with the prevalence immediately pre decolonization were made. We combined the nose and throat sites and the three skin sites because intranasal mupirocin impacts the bacterial communities of nose and throat sites whereas topical chlorhexidine affect the skin flora. We used a GEE model for repeated measures to account for within patient correlation. Interactions were examined to assess whether the impact of the decolonization regimen was different between CB and NH patients; no significant differences were observed. The model used a binomial distribution error structure

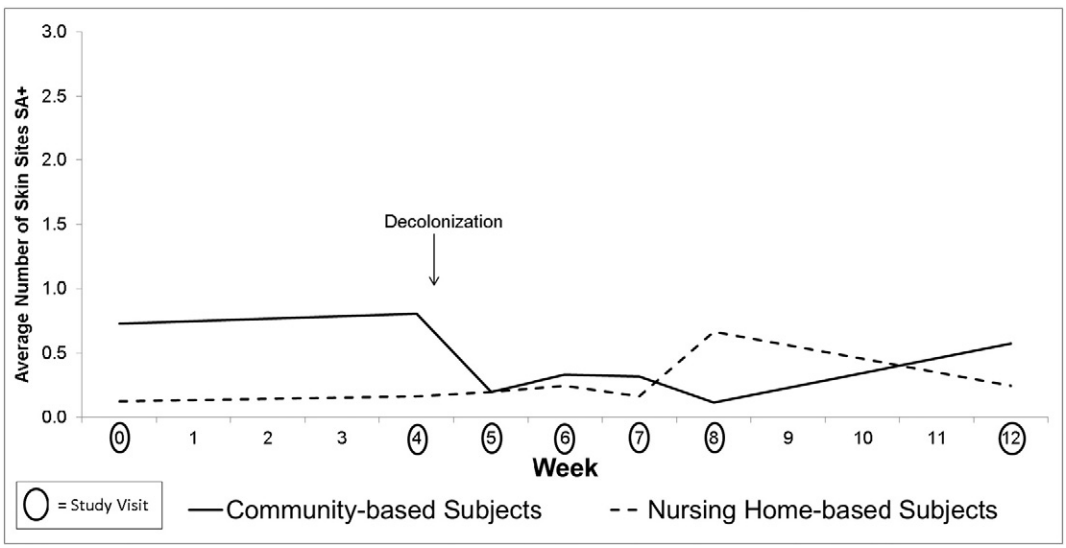

Fig. 2. Effect of Chlorhexidine on *S. aureus* Colonization on the Skin in Community ($n = 26$) vs Nursing Home ($n = 8$) Subjects.

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