Randomized Trial of “Bleach Baths” Plus Routine Hygienic Measures vs Routine Hygienic Measures Alone for Prevention of Recurrent Infections

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Children with probable community-associated Staphylococcus aureus skin and soft tissue or invasive infections were randomized to routine daily hygienic measures with or without “bleach baths” twice a week for 3 months. Within 12 months, a medically attended recurrence occurred in 84 of 495 (17%) children using bleach baths compared to 103 of 492 (21%) of control participants ($P = .15$).

Keywords. bleach bath; recurrent infections; Staphylococcus aureus.

Community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA) is a common pathogen recovered from patients with skin and soft tissue infection (SSTI) [1, 2]. Recurrent SSTIs are frequent in otherwise healthy individuals and occur in up to 50% of patients [3, 4]. Currently, there is no consensus regarding recommendations for preventing recurrent SSTIs [5].

Some dermatologists recommend that children with eczema bathe in water in which hypochlorite has been added (“bleach bath”) for prevention of recurrent skin infections [6]. We sought to determine if bleach baths plus hygienic measures were more effective than hygienic measures alone in preventing recurrence of SSTI in children. We also determined the frequency of S. aureus colonization at 3 different sites in patients at presentation.

METHODS

This was a randomized, single-blinded, controlled trial in children of routine hygienic measures compared with routine hygienic measures plus bleach baths in the prevention of recurrent SSTIs requiring medical attention. The study was approved by the Institutional Review Board of Baylor College of Medicine.

Patients

Otherwise healthy children aged 3 months to 18 years treated at Texas Children’s Hospital (TCH) for a suspected S. aureus SSTI or invasive infection were eligible for enrollment. Exclusion criteria included (1) immune deficiency or other underlying condition other than reactive airway disease or uncomplicated eczema; (2) history of $\geq 4$ previous SSTIs; (3) families already employing bleach baths; (4) families without a bathtub, running water, phone, or primary care physician; (5) families in which no one spoke or read English.

Prevention Groups

One of 2 prevention groups was randomly selected prior to approaching the family. Two separate consent forms and study materials were used. For the group randomized to routine hygienic measures only, consent was obtained using the hygienic measures only version, and written materials detailing the hygienic measures only version, and written materials detailing the hygienic measures were provided.

Patients enrolled in the bleach bath plus hygienic measures arm received a version of the consent form outlining the hygienic measures plus a description of the bleach bath procedures (Supplementary Data). The families were given 1 gallon of household bleach (Clorox-Regular 6.0% hypochlorite) and instructed to add 5 mL of bleach for every 1 gallon of bath water. (Sodium hypochlorite kills S. aureus in vitro at dilute concentrations [7]). Families were instructed to bathe their child in the bleach bath twice a week for 15 minutes and to apply a moisturizer following the bath.

Demographic and clinical information was recorded on standardized data collection forms. Data were entered into a secure computer database. Families were to follow instructions for 3 months and to call if their child had a medically attended (MA) recurrent SSTI or invasive infection. A medically attended infection was defined as one for which the family sought medical attention for their child by their primary care physician or other healthcare professional.

A second research nurse blinded to the prevention group contacted the families at 2 weeks and 3, 6, and 12 months after...
enrollment to obtain information about MA-SSTIs. Questions were also directed at adverse effects of the prevention procedures such as skin or eye irritation. Families were followed for up to 12 months or until the first MA-SSTI.

Cultures
Clinical cultures were processed in the TCH clinical microbiology laboratory and stored frozen in the infectious diseases laboratory [1]. Colonization cultures were obtained from the anterior nares, pharynx, and groin using separate Culturette swabs and plated directly to sheep blood tryptic soy agar, manitol salt agar, and MRSA select agar (MRSASelect, Bio-Rad Laboratories, Redmond, Washington). After overnight incubation, S. aureus isolates were identified using colony morphology and a rapid latex agglutination slide-card (StaphTEX Blue Kit, Hardy Diagnostics, Santa Maria, California).

Sample Size Calculation and Data Analysis
We needed to enroll 482 children in each arm to detect a 50% reduction in recurrences with 90% power, assuming a 12-month recurrence rate of 14% in the hygiene only group.

Baseline variables between groups were compared using the Student t test and χ² test. Time to reinfection was estimated using Kaplan-Meier curves and strata were compared using the log-rank test. A Cox proportional hazards model was used to estimate unadjusted and adjusted hazard rates for treatment group and age. Analysis was based on intention to treat. Children lost to follow-up were not considered to have had a MA-SSTI at 12 months. A multivariable Cox proportional hazards regression model was used to simultaneously estimate the risk of reinfection by treatment group and age. Analysis was based on intention to treat. SAS software for Windows, version 9.3 (SAS Institute, Cary, North Carolina) and True Epistat (Epistat [Sigma] Services, Richardson, Texas) were used for statistical analyses.

RESULTS
Patient Characteristics
From 16 June 2009 through 24 January 2012, 4238 children were screened and 987 children were enrolled. The majority of children were <2 years of age. More than 90% of the infections in each group were SSTIs; MRSA was isolated from clinical cultures in 63%–70% of children (Table 1). No isolate was identified in 50 children, and no culture of the primary site was obtained in 14 children. The distribution of abscess sites was similar between the 2 groups (Supplementary Table 1).

Colonization Results
Overall, 557 of 987 (56%) children were colonized with S. aureus at ≥1 site. The most common site colonized was the groin (379/987 [38%]), followed by the nose (215/987 [22%]) and throat (167/987 [17%]) (Supplementary Table 2). Colonization by MRSA was more common than methicillin-susceptible S. aureus (MSSA) for the groin and throat, but the opposite was true for the nose. Eighteen children were colonized with both MRSA and MSSA at ≥1 site.

Colonization rates decreased with age (P < .001; Supplementary Table 3). Children <6 years old were more likely (328/716 [46%]) than children >6 years old (69/253 [27%]) to be colonized with MRSA only (P < .001). Rates of S. aureus colonization at any site varied significantly among children whose clinical culture grew MRSA vs MSSA vs another organism or no isolate cultured (P < .001; Supplementary Figure 1).

Medically Attended Recurrence
Overall, 187 of 987 patients had an MA infection (19.0%, 95% confidence interval, 16.6%–21.5%) within 12 months. The risk of reinfection did not significantly differ between the bleach bath group (84/495 [17%]) and the hygiene group (103/492 [20.9%]) (P = .15). Results were similar if only children with S. aureus isolated from the clinical culture were analyzed. For those recurrences with culture results, S. aureus was recovered from 35 children in the hygiene only group and in 26 children

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Bleach Bath (n = 495)</th>
<th>Routine Hygienic Measures (n = 492)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y, median (range)</td>
<td>1.80 (0.27–17.9)</td>
<td>1.92 (0.26–18.8)</td>
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<tr>
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<tr>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Asian</td>
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<td>3</td>
</tr>
<tr>
<td>Other</td>
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<td>1</td>
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<tr>
<td>Type of infection, No.</td>
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<tr>
<td>SSTI</td>
<td>466 (94%)</td>
<td>457 (93%)</td>
</tr>
<tr>
<td>Invasive</td>
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<td>35</td>
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<tr>
<td>Isolate, No.</td>
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<tr>
<td>MRSA</td>
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<td>313 (64%)</td>
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<tr>
<td>MSSA</td>
<td>104</td>
<td>124</td>
</tr>
<tr>
<td>Other*</td>
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<td>21</td>
</tr>
<tr>
<td>None</td>
<td>30</td>
<td>34</td>
</tr>
</tbody>
</table>

Abbreviations: MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-susceptible Staphylococcus aureus; SSTI, skin and soft tissue infection.

* Other organisms were: Streptococcus pyogenes (n = 12), Eikenella corrodens (n = 3), Escherichia coli (n = 3), group C or G Streptococcus (n = 3), Pseudomonas aeruginosa (n = 1), Enterococcus faecalis (n = 1), and mixed flora (n = 1).
in the bleach bath group. Incision and drainage was performed in 35 and 37 children with MA-SSTI recurrences in the bleach bath and hygiene only groups, respectively.

The recurrence rate for children with MRSA (138/662 [21%]) compared with MSSA (44/228 [19%]) infections did not differ. Recurrence rates were significantly different (P = .018) among children when the number of sites colonized with S. aureus was compared (no site: 68/429 [15.9%]; 1 site: 86/376 [23%]; 2 sites: 26/121 [21%]; 3 sites: 10/30 [30%]).

The risk of reinfection among patients ≤ 1.86 years was about 2.1 times greater than that for patients > 1.86 years (median split) (P < .0001; Supplementary Figure 2). Recurrences occurred in 15.6% (46/294) of African American children, 19.6% (72/368) of Hispanic children, and 23.9% (72/301) of white children (P = .04).

No serious safety concerns were identified. Dry skin in a few children and burning eyes in 1 patient (likely allergies according to the parents) were the only adverse events reported.

DISCUSSION

CA-MRSA infections have been associated with an apparent increase in the number of children with recurrent SSTIs. In our study, almost 20% of children had a recurrent MA-SSTI within a year. Younger children with infection were more likely to be colonized with S. aureus as well as have a recurrent infection. Also the more sites colonized at enrollment, the more likely an MA recurrence would occur. It makes sense that an intervention that affects areas of the body below the waist would be required for a successful prevention strategy, considering that the groin is a common site colonized with S. aureus in children presenting with an SSTI [4].

Fritz et al [8] found that a 5-day regimen of intranasal mupirocin twice daily, daily body washes with 4% chlorhexidine solution baths, and hygiene education for all members of a family significantly decreased the incidence of a physician-documented recurrence by 12 months, to 36% of children compared with 55% of children (P = .03), if only the index child received these measures. This regimen is attractive, but S. aureus may develop resistance to these agents [9, 10].

In the present study, bleach baths twice weekly for 15 minutes for 3 months plus hygienic measures did result in a reduction of MA-SSTI recurrences (17%) compared with hygienic measures alone (21%) within a year of enrollment, although this difference was not statistically significant.

Our trial had several limitations. We were limited in detecting decreases in recurrent MA-SSTI < 50% because of the large sample size required. Loss to follow-up occurred but was equivalent in each arm of the study. We could not contact 21 patients after enrollment. The dilution of sodium hypochlorite may have been suboptimal but was based on recommendations by some dermatologists [6]. Medical visits for recurrent infections were confirmed, but in most instances culture results were not available. No safety concerns were identified, but we could not adequately assess compliance.

In summary, for normal children presenting to TCH for likely S. aureus infections, most infections were due to MRSA and almost 60% of children were colonized at ≥ 1 site with S. aureus. Younger age and multiple sites of colonization were associated with recurrence. Bleach baths plus hygiene education over a 3-month period were found to be associated with about a 20% decrease in recurrent MA-SSTI recurrences compared to hygiene education alone when employed for 3 months, but this was not a significant reduction. No adverse effects of bleach baths were identified.

Supplementary Data

Supplementary materials are available at Clinical Infectious Diseases online (http://cid.oxfordjournals.org). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyrighted. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

Notes

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