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## Brief report

## Laundering habits of student nurses and correlation with the presence of *Staphylococcus aureus* on nursing scrub tops pre- and postlaundering



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## Key Words:

Infection control  
Student nurse  
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Scrubs  
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Little is known about student nurse laundering practices. Student nurses swabbed their scrub tops after clinical and after laundering, and they completed a laundry survey; 13.5% of students wore the same scrub more than once, and few followed recommended guidelines by using hot water (20%) or bleach (5.6%) when laundering scrubs. After clinical shifts, 17% of swabs tested positive for *Staphylococcus aureus*; however, laundering eradicated it from 64.3% of positive samples. This was not statistically significant.

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Studies have indicated that nursing attire can be contaminated with methicillin-sensitive *Staphylococcus aureus* (MSSA), methicillin-resistant *S aureus* (MRSA), and other pathogens.<sup>1-4</sup> These studies have focused on hospital staff; student nurses are an as yet understudied population. Survey data for 2011 indicates that approximately 259,000 students were enrolled in baccalaureate degree nursing programs in the United States,<sup>5</sup> with many more in nursing associate degree and diploma programs.

Recent studies suggest that home laundering of health care worker scrubs is not as effective at reducing microbial contamination as facility and third-party laundering<sup>6</sup> and that home laundering cannot be relied on to appropriately decontaminate health care workers' uniforms.<sup>7</sup> Other studies suggest that the antimicrobial action of laundering decreases significantly when water temperatures drop from 60°C to 40°C (from 140°F to 104°F).<sup>8,9</sup>

The Centers for Disease Control and Prevention guidelines for home laundering of infected material state that temperatures <71°C (<160°F), together with the addition of the correct concentration of low-temperature laundry chemicals, are adequate for a satisfactory reduction of microbial contamination.<sup>10</sup> They also state that for patients at home, soiled linens can be laundered using normal washing and drying cycles, including either hot or cold cycles. A concern about domestic laundering practice in the United States is that many washers draw heated water from the household hot water tank rather than heating it internally, therefore it is impossible to accurately control wash water temperatures. The International Scientific Forum on Home Hygiene categorizes health care worker uniforms as higher risk for home laundering and advises a 60°C wash temperature together with the addition of bleach, followed by tumble drying and ironing.<sup>11</sup> In evidence-based reviews of the microbial significance of health care uniforms, other recommendations include wearing clinical attire once, replacing immediately if soiled, and using personal protective equipment if soiling is likely.<sup>12,13</sup>

It is difficult to find data on the levels of contamination of student nurses' scrubs. This understudied population has the potential to carry pathogens out of the clinical setting into the community and their own homes. The purpose of the current study was to collect survey data on student nurse scrub use and

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laundrying practices and to sample for *S aureus* contamination on student nurse scrub tops after a clinical shift and again after laundrying.

## METHODS

Participants were recruited from nursing students attending an urban baccalaureate degree program. Inclusion criteria included the following: current medical surgical clinical rotation or senior practicum in an acute care facility, direct patient contact, no scrub jacket use over the scrub top, use of college student nurse scrubs, and ability to take home and personally laundry their scrubs. Institutional review board approval was obtained from Simmons College, and informed consent was obtained prior to study activities.

Information was collected using 2 electronic surveys describing participants' clinical setting and laundry habits. Following detailed written and video sampling instructions, participants swabbed their scrub top twice, after a clinical shift and again after laundrying. A template (16.5 × 23 cm) was used to define the sampling area between the ribs and hips on the front of the scrub top.<sup>4</sup> A premoistened sterile swab (CultureSwab Amies Liquid; BD Diagnostics, Sparks, MD) was rolled across the entire area. Swabs were refrigerated until shipped to the University of Massachusetts Lowell Microbiology Laboratory. Samples with >28 days between collection and receipt were excluded. Within 24 hours of receipt, swabs were plated to mannitol salt agar, tryptic soy agar (Soybean-Casein Digest Agar), and *Staphylococcus* broth (SB) (BD Diagnostics, Sparks, MD) and incubated at 37°C for 24 hours. No or limited growth plates were reincubated for another 24 hours before interpretation as no growth. Positive SB with corresponding no growth plates were subcultured to mannitol salt agar and TSA. Colonies morphologically consistent with *S aureus* were identified with gram stain, catalase, and Sure-Vue SELECT Staph Latex Test Kit (Thermo Fisher Scientific, Pittsburgh, PA). To differentiate MSSA and MRSA, confirmed *S aureus* were subcultured to CHROMagar MRSA II (BD Diagnostics, Sparks, MD), Mueller Hinton Agar w/4% NaCl (Thermo Scientific Remel, Lenexa, KS), and Oxacillin MRSA Screen Agar (Thermo Scientific Remel, Lenexa, KS). Discrepant or ambiguous isolates were resolved using the Alere PBP2A kit (Alere, Waltham, MA). Carriage rates of MSSA and MRSA and laundrying effectiveness were calculated.

Recovery of *S aureus* from swabs was confirmed under refrigeration and room temperature for up to 28 days. Swabs were inoculated with approximately  $1.5 \times 10^6$  colony forming units (CFU)/mL of overnight growth of *S aureus* (ATCC 6538; American Type Culture Collection, Manassas, VA) and held at 24°C or 4°C. Swabs were removed periodically and subcultured to TSA and SB. *S aureus* was recovered from TSA or SB from all swabs regardless of storage temperature at all time points up to 28 days. Recovery of *S aureus* from fabric was determined by serially diluting overnight growth to approximately  $2 \times 10^{13}$  CFU/mL and spotting 10 µL of each dilution onto duplicate autoclaved fabric swatches cut from a college student nurse scrub top. Swatches were allowed to dry overnight and processed according to protocol. *S aureus* was recovered from at least 1 medium from all dilutions up to  $1 \times 10^{-11}$ , indicating a limit of detection of <10 CFU.

Data were analyzed using SPSS version 19 (IBM, Armonk, New York). Descriptive statistics including relative frequency for categorical measures were provided for laboratory and survey data. Laboratory data were categorized as MRSA positive or negative and MSSA positive or negative after the clinical shift and again after laundrying. To determine if clearance was statistically significant, the McNemar test was performed. Swabs without a matching postlaundry sample were excluded from this analysis but were included in laundry habit descriptions.

**Table 1**

Laundrying habits of student nurses (N = 89)

Laundrying habit	n (%)
Used dorm facilities for laundrying	26 (29.2)
No. of patient contacts per shift	
1	8 (9.0)
2	23 (25.8)
≥3	55 (61.0)
Wore scrubs to and from hospital	83 (93.3)
Wore scrubs on campus after clinical	33 (37.0)
Wore scrubs for ≥2 h after clinical	18 (20.2)
Wore scrubs for ≥2 d before laundrying	12 (13.5)
Scrubs left in hamper ≥2 d before laundrying	42 (48.8)
Scrubs washed with other items	77 (91)
Water temperature	
Hot water	18 (20.2)
Cold water	25 (28.1)
Warm water	41 (46.1)
Washing machine overloaded	13 (14.8)
Scrubs washed with bleach	5 (5.6)
Dryer used	79 (88.8)
Iron used	3 (3.4)

**Table 2**

Contamination of student nursing scrubs with methicillin-sensitive *Staphylococcus aureus* pre- and postlaundrying (n = 84)<sup>a</sup>

Prelaundrying	Postlaundrying	n (%)
Positive	Positive	5 (35.7)
Positive	Negative	9 (64.3)
Negative	Positive	4 (5.7)
Negative	Negative	66 (94.3)

<sup>a</sup>One sample without a matching swab was excluded from the analysis.

<sup>b</sup>McNemar test, P value = .27.

## RESULTS

Eighty-nine students were recruited from October 2013-April 2014, 31.5% of whom lived on campus. Most clinical placements were at academic medical centers (51.7%) on medical surgical units (34.8%). Most students (59.6%) spent 2 days at clinical per week, and approximately one-third of patients cared for by student nurses were on contact precautions. Almost all students wore their scrubs to and from clinical, and more than a third wore their scrubs on campus after their clinical shift. Most students (70.8%) lived off campus and did not use campus dormitory laundrying facilities. Laundrying habits are described in Table 1.

Culture results are shown in Table 2. Swabs were obtained from 85 students, but 1 failed to provide a postsample. MRSA was not detected on any of the swabs; however, 15 (17.3%) of prelaundry swabs tested positive for MSSA. Of those positive prelaundry, 9 (64.3%) cleared after laundrying, and more than a third survived the laundry process. There was no significant reduction in MSSA after laundrying (McNemar test, P = .27). Four scrubs that were MSSA negative prelaundrying tested positive after laundrying. There were no statistically significant differences in clearance of MSSA after laundrying by hot water use, dryer time, bleach use, or ironing.

## DISCUSSION AND CONCLUSION

To our knowledge, this study is the first to describe clinical attire use patterns and laundry habits of student nurses. This meets the recommendation of a recent expert guidance article on health care attire in nonoperating room settings to explore the behavioral determinants of laundrying practices among health

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