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Better Detection of *Staphylococcus aureus* Nasal Carriage by Use of Nylon Flocked Swabs[∇]

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Flocked swabs (Copan) were compared to rayon swabs (Copan) for the nasal detection of *Staphylococcus aureus* in 90 healthy volunteers sampled sequentially during a 5-week period. The use of flocked swabs improved the number of nasal carriers ($P = 0.026$), the number of positive specimens ($P = 0.01$), and the quantity of bacteria in positive samples ($P = 0.004$).

Staphylococcus aureus nasal carriage is a major risk factor for *S. aureus* infection, and the anterior nares are the primary reservoir of *S. aureus* in humans (19). Therefore, it is desirable to optimize *S. aureus* detection and to establish the carriage status, particularly in the aim of prophylactically decolonizing patients at risk of infection with this bacterium (4).

The detection of *S. aureus* carriage is usually carried out by nasal sampling. In comparison to the use of rayon swabs, the use of flocked swabs has been demonstrated to improve the uptake of epithelial cells and viruses (1, 7), to release more microorganisms *in vitro* (18), and to enhance the molecular detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* (6). Despite these apparent advantages, a recent study that compared flocked and rayon swabs after a 24-h broth culture enrichment did not show any difference in the rate detection of *S. aureus* nasal carriers (8). To further assess the utility of flocked swabs, we conducted a study similar to that mentioned just above, with the exception that no enrichment step was performed.

Ninety healthy health care workers from the University Hospital of Saint-Etienne, France, were included in the study from March to April 2010. Each volunteer was sampled 7 times with flocked and rayon swabs during a 5-week period (2 volunteers missed the seventh sampling). The study received the approval of our regional ethical research committee (Comité de Protection des Personnes Sud-Est I).

A total of 628 nylon swabs (regular flocked swabs, reference 552C; Copan, Brescia, Italy) and 628 rayon swabs (standard swabs with Amies agar gel, reference 108C; Copan) were used by a unique trained fellow by following a predefined protocol (5). Swabs were wetted in normal saline, introduced into the anterior nostril, and rotated 5 times. During each sampling episode, one nostril was randomly sampled with a flocked swab, and the other was sampled with a rayon swab. Each swab was immediately placed into 1 ml of phosphate-buffered saline before being Vortex mixed for 10 s, and 50 μ l of this solution was plated onto a chromogenic medium (BBL CHROMagar

Staph aureus; Becton Dickinson). After 24 h and 48 h of growth at 37°C, plates were read, and pink colonies were plated onto blood agar. Matrix-assisted laser desorption ionization–time of flight mass spectrometry (MALDI-TOF MS; Bruker Daltonics, Bremen, Germany) was used for bacterial identification (9). After 48 h of growth, the number of pink colonies present on the chromogenic medium was determined, according to standard counting procedure, and expressed in CFU/ml. SPSS software (version 16.0, Chicago, IL) was used for statistical analyses. Nonparametric tests were used for mean comparisons. *P* values below the 5% level were considered statistically significant.

A total of 35 of the 90 volunteers (38.9%) were positive for *S. aureus* in at least one of the nasal samples during the 5-week period. The nasal carriage rate of *S. aureus* was homogenous throughout the study, with an average of 28.1% \pm 1.7% for the 7 sampling episodes. The main results are summarized in Table 1. Among the 35 *S. aureus* nasal carriers, 25 carriers were detected by both of the swabs, 9 by the flocked swab only, and 1 by the rayon swab only (P of 0.026 by the McNemar chi-square test). Assuming that any positive culture result was indicative of positive *S. aureus* carriage, the sensitivity for the detection of *S. aureus* nasal carriers was 97.1% (95% confidence interval [CI], 93.6 to 100) with nylon flocked swabs and 74.3% (95% CI, 63.8 to 84.8) with standard rayon swabs. Among the 1,256 swabs taken during 628 samplings episodes, 300 swabs yielded positive cultures of *S. aureus*, including 160 flocked swabs (53.3%) and 140 rayon swabs (46.7%). The difference was statistically significant (P of 0.01 by the McNemar chi-square test). When considering only the positive samples, the mean loads for *S. aureus* were 3.41 \times 10⁶ CFU/ml with flocked swabs and 4.53 \times 10⁵ CFU/ml with rayon swabs (Fig. 1).

The cumulative prevalence of *S. aureus* nasal carriers of 38.9% that was found in the present study is in accordance with that described in one study applying repeated samplings (17). All the volunteers were sampled by a sole fellow in order to minimize sampling bias. A well-described procedure of nasal swabbing (5) was used, in accordance with other published studies (4). The prewetting of swabs in sterile saline has been shown to improve the detection of *S. aureus* nasal carriage (12). A chromogenic medium was chosen for the culture of *S.*

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TABLE 1. Screening of *Staphylococcus aureus* nasal carriage, according to the type of swab

Parameter	No. (%) of:	
	Volunteers	Sampling episodes
Total no.	90	628
Detection of <i>S. aureus</i> by:		
At least one swab	35 (38.8)	177 (28.2)
Both swabs	25 (27.7)	123 (19.6)
Nylon flocked swab only	9 (10)	37 (5.9)
Rayon swab only	1 (1.1)	17 (2.7)

aureus, since the reading is easy and the sensitivity is higher than that obtained with mannitol salt agar (11) and close to that obtained on mannitol salt broth (2). A possible bias of our protocol was that only one nostril was sampled with each type of swab at each sampling episode. However, this step was randomized, and we verified that no statistical difference was observed between the results obtained from each nostril (data not shown).

The results presented herein clearly show a better sensitivity of detection of *S. aureus* carriage using nylon flocked swabs than using rayon swabs (97.1% versus 74.3%); additionally, flocked swabs yielded a larger amount of bacteria than rayon swabs after quantitative cultures and globally improved the detection of *S. aureus* nasal carriers, particularly in the case of low bacterial loads. The higher sensitivity of nylon flocked swabs has already been reported for other bacterium species

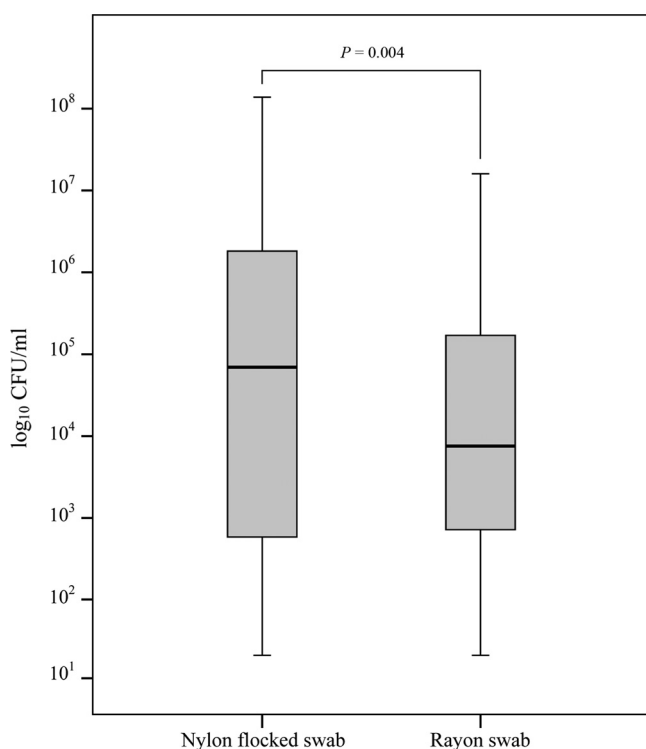


FIG. 1. Bacterial loads of *Staphylococcus aureus*, shown as the number of \log_{10} CFU/ml, according to the type of swab. The Wilcoxon test was used for statistical comparison.

(14, 16). Similarly, Van Horn et al. have demonstrated that nylon flocked swabs placed in Amies liquid medium yielded greater organism release (18). In contrast to these results, a recent study from De Silva et al. (8) did not find any difference in the determination of *S. aureus* nasal carriage when comparing flocked swabs to rayon swabs; however, those authors used a different microbiological procedure than ours, consisting of an overnight preenrichment broth step, followed by plating on chromogenic agar. The latter process is known to improve the sensitivity of bacterial detection (3, 10, 13, 15), but it is time-consuming since the results are delayed by 1 day, which may be a determinant for the detection of nasal carriers when decontamination treatment must be applied to prevent *S. aureus* infection, for instance, just before a surgical procedure (4) or the arrival of the patient in an intensive care unit. In addition, De Silva et al. provided no data relative to the amount of bacteria recovered by each type of swab (8).

The results of the present study unambiguously demonstrate that nylon flocked swabs are more accurate in routine practice than rayon swabs for the rapid screening of *S. aureus* nasal carriage.

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