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► **To cite this version:**

C. Ong, J-C. Lucet, C. Bourigault, G. Birgand, S. Aho, et al.. Staphylococcus aureus nasal decolonization before cardiac and orthopaedic surgeries: first descriptive survey in France. *Journal of Hospital Infection*, 2020, 106, pp.332 - 334. 10.1016/j.jhin.2020.08.008 . hal-03492031

**HAL Id: hal-03492031**

**<https://hal.science/hal-03492031v1>**

Submitted on 5 Sep 2022

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## **Title page**

*Staphylococcus aureus* nasal decolonization before cardiac and orthopedic surgeries: First descriptive survey in France.

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## **Summary**

The objective was to describe French hospital nasal screening and decolonization procedures before clean surgery procedures. Information to participate was sent to the French Society for Infection Control members in June 2018. Seventy hospitals participated to the survey; 40% (n=28) declared having institutional decolonization procedures: 64% (n=18) in orthopedic and 56% (n=15) in cardiac surgeries. All hospitals use of mupirocin for nasal decolonization and body decolonization with chlorhexidine (n=16) or povidone iodine (n=10). This study is the first one performed in France giving information in this field. Screening/decolonization procedures are heterogeneous and their clinical impact remains complexed to evaluate.

## **Introduction**

Despite the publication of national and international guidelines in recent years related to nasal *Staphylococcus aureus* decolonization in surgical patients [1-3], no evaluation of practices has been carried out in French hospitals performing surgery activity. Particularly, the French 2013 guidelines recommended preoperative nasal decolonization by mupirocin to be started as a last resort the day before surgery only for cardiac surgery, with or without prior nasal screening for *S. aureus* colonization. The objective of the survey was to describe French hospital protocols of decolonization strategies with or without systematic screening for *S. aureus* nasal colonization in patients undergoing cardiac and prosthetic orthopedic surgeries.

## **Methods**

We performed a survey using Google® form online file with questions chosen for their relevance according to the previous recommendations. Information to participate to the survey and specific website link was sent to the members of the French Society for Infection Control by a web letter in June for a 4-month period (June-September 2018). One required questionnaire response by healthcare facility according to the profession (medical officer,

nurses, pharmacist, hygienist, etc.). The survey included 10 questions concerning the participants (type of institution, existence of decolonization practices, specialties, etc.), five questions related to screening strategy, 14 questions related to decolonization strategy and five questions related to epidemiology trends. No distinction between private and public institutions was made for the analysis.

## **Results**

Seventy hospitals with cardiac or orthopedic surgery activities participated to the survey. Among them, 40% (n=28) declared having institutional decolonization procedures: 64% (N=18) in orthopedic surgeries and 56% (N=15) in cardiac surgeries (of which five hospitals decolonized in both surgical procedures).

Amongst those 28 hospitals the majority (22/28; 79%) reported using simple microbiological culture for *S. aureus* screening concerning diagnostic methods (Table I). To screen patients, Copan ESwabs with liquid Amies transport medium for maintenance of viability of aerobic and anaerobic bacteria were the main type of swabs used (N=25). The other types were single carded cotton swabs or Stuart liquid swab (LQs).

All hospitals (N=28) used mupirocin for nasal decolonization (Table I). Twenty-six of them also used body decolonization with chlorhexidine (n=16) or povidone iodine (n=10). Nasal decolonization started usually on the day before surgery and was continued for 3 days after (N=22) (Table I).

Nine hospitals had implemented SA nasal screening/decolonization strategies before guidelines' publication, 15 hospitals after the publication of the French guidelines (2013) and one after WHO guidelines (2016). Thirteen (46%) hospitals have observed significant decrease of *S. aureus* surgical site infection (SSI) after implementing such strategies, seven

hospitals observed no change, two hospitals observed an increase of SSI caused by Gram negative bacilli and six were not able yet to measure any trend.

In orthopaedic surgery, 18 hospitals declared screening patients before surgery using sample culture (N=15), PCR (N=2) or both (N=1). Screening was performed during (N=9) or after (N=6) the preoperative surgical consultation. *S. aureus* nasal screening and decolonization strategies were heterogeneous: Metcillin-susceptible *S. aureus* positive (MSSA) patients only (N=12/18), methicillin-resistant *S. aureus* (MRSA) positive patients only (2) and universal decolonization without prior screening (4). All hospitals used mupirocin for nasal decolonization in association with bath or shower with chlorhexidine (N=8) or povidone iodine scrub (N=4).

In cardiac surgery, 15 hospitals screened patients before surgery using sample culture (N=12) or PCR (N=3). Screening was prescribed and performed during the preoperative surgical consultation (N=10) or at hospital admission in cardiac surgery ward (N=5). *S. aureus* screening and decolonization strategies were also heterogeneous: MSSA positive patients only (N=7), MRSA positive patients only (N=1), universal decolonization with (N=2) or without prior screening (N=5). All hospitals used mupirocin for nasal decolonization (N=15) in association with bath or shower with chlorhexidine (N=5) or povidone iodine scrub (N=6).

## Discussion

This study is the first in France describing screening and nasal decolonization practices for *S. aureus* in patients undergoing cardiac or orthopedic prosthetic surgery. No French data were available on this subject previously. Although the sample size is small, only 63 public or private hospitals in France are authorized to perform cardiac surgery.

Through our hospital sample our study shows that despite national and international guidelines 60% of French studied hospitals have not implemented *S. aureus* decolonization in patients undergoing cardiac or orthopedic surgery. The results of the survey, despite the small sample of hospitals, show heterogeneous practices, although they are generally inspired by the same guidelines [1-3]. Thus, our results and interpretation must be analyzed with caution.

However, the most commonly used decolonization strategy was universal mupirocin decolonization without prior screening, particularly in cardiac surgery, in association with cutaneous decolonization. This strategy has previously been described as successful, with the same clinical success as targeted decolonization of screen-positive patients [4]. When screening was done, it was prescribed and realized during or after the consultation before surgery. Concerning microbiological diagnostic techniques, most of hospitals used culture methods rather than PCR.

The decolonization of *S. aureus* positive patients previously screened is more targeted and does not expose *S. aureus* negative patients to mupirocin. However, this strategy needs pre-surgery organization, usually during the medical or surgical consultations, and confirmation of results from the laboratory. Decolonization measures performed at home also need also to be checked at hospital admission; low compliance with showering with antiseptic scrub and with nasal decolonization has been described before hospital admission [5]. The advantage of targeted strategies is that they contribute to limiting the emergence and spread of mupirocin-

resistant strains; however the costs of testing need to be weighed against the costs of universal decolonization [6].

The choice of the strategy (decolonization with or without screening, diagnostic methods) must be discussed by a multidisciplinary approach and adapted to the financial and logistical capacities of each institution [7]. Mupirocin is the main product used by French institutions. Other products do exist but are not well studied or efficient [8]. There is a risk of resistance of *S. aureus* to mupirocin emerging and spreading, related to increased or extensive use of mupirocin [9]. However, studies suggest that targeted use of mupirocin in nasal decolonization of positive surgical patients is not significantly associated in the short term with the development of high rates of mupirocin resistance in *S. aureus* [10].

Concerning the decolonization treatment, no study has evaluated the superiority of one scheme over another in terms of date of implementation, duration and dosage. The results of this survey showed heterogeneous mupirocin treatment schedules, but most hospitals applied the five-day scheme published by Bode in 2010 [4]. This scheme has the advantage of having proven its effectiveness and allowing hospital compliance with treatment.

In conclusion, despite the relatively small size of our hospital sample, our study is the first performed in France on this topic, six years after the French guideline publication [3]. Whilst French hospitals have implemented perioperative *S. aureus* nasal decolonization, strategies of screening/decolonization are heterogeneous and their clinical impact remains to be evaluated.

Further cohort studies in cardiac and orthopedic surgeries are needed to evaluate the clinical and economic impacts of such preventive strategies in France.

## **Declaration**

**Compliance with Ethical Standards:** We declared that compliance with ethical standard was followed during the study period.

**Funding:** No specific funding has been received.

**Conflict of Interest:** Authors have declared that no potential conflict of interest exists.

## **Contribution**

CO, JCL and DL designed the study.

CO, JCL, CB, GB, SA, and DL screened the literature for relevancy

CO and DL did the quality appraisal.

CO, JCL and DL drafted the manuscript.

CO, JCL, CB, GB, SA, and DL revised the manuscript.



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**Table I.** Description of French hospital protocols for *Staphylococcus aureus* nasal decolonization before cardiac and orthopedic surgeries

<b>Infection control Strategies</b>	<b>French hospitals N=28 (100%)</b>
Systematic screening for <i>S. aureus</i> nasal carriage before surgery	28 (100)
Microbiological method	
Simple culture	22 (79.0)
Rapid test (PCR)	2 (7.0)
Both methods	4 (14.0)
Prophylactic regimen	
Mupirocin alone	2 (7.0)
Mupirocine with antiseptic body wash	26 (93.0)
Decolonization daily strategy*	
The day before surgery / 3 days after	22 (79.0)
Two days before / 2 days after	4 (14.0)
Three days before / 1 day after	1 (3.5)

\*One hospital declared to start the nasal decolonization at patient admission and to stop it if the nasal screening for *S. aureus* colonization is negative.