

# Impact clinique du portage de *Staphylococcus aureus*

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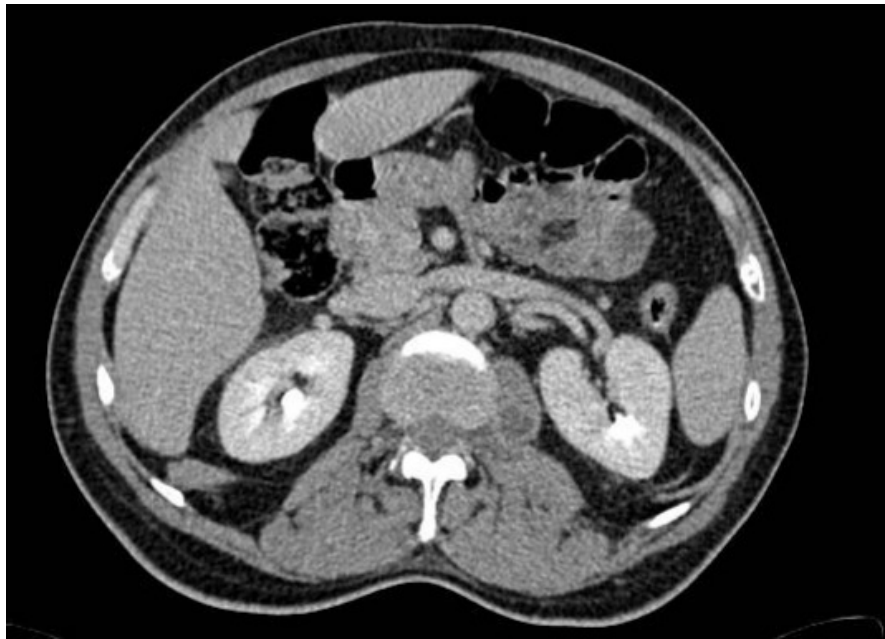
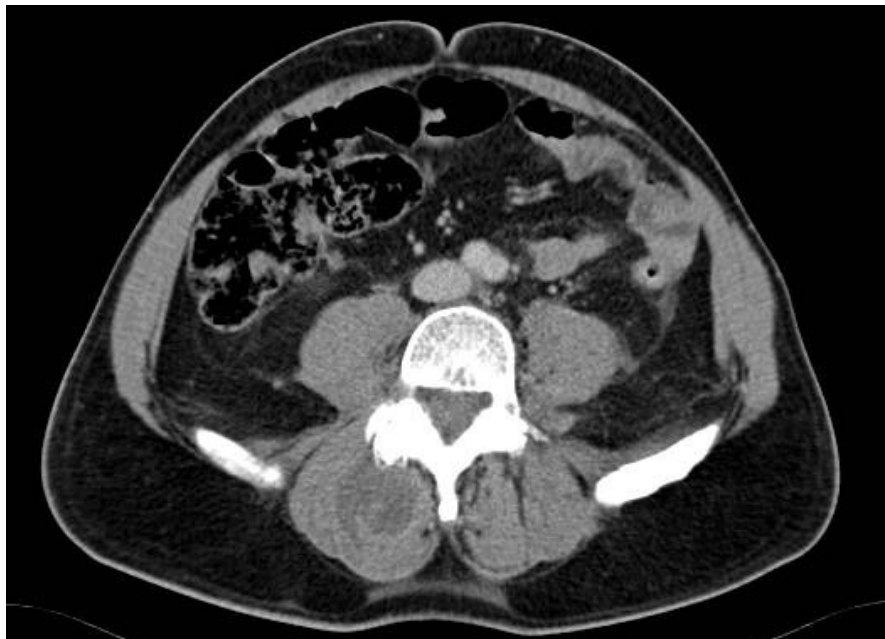
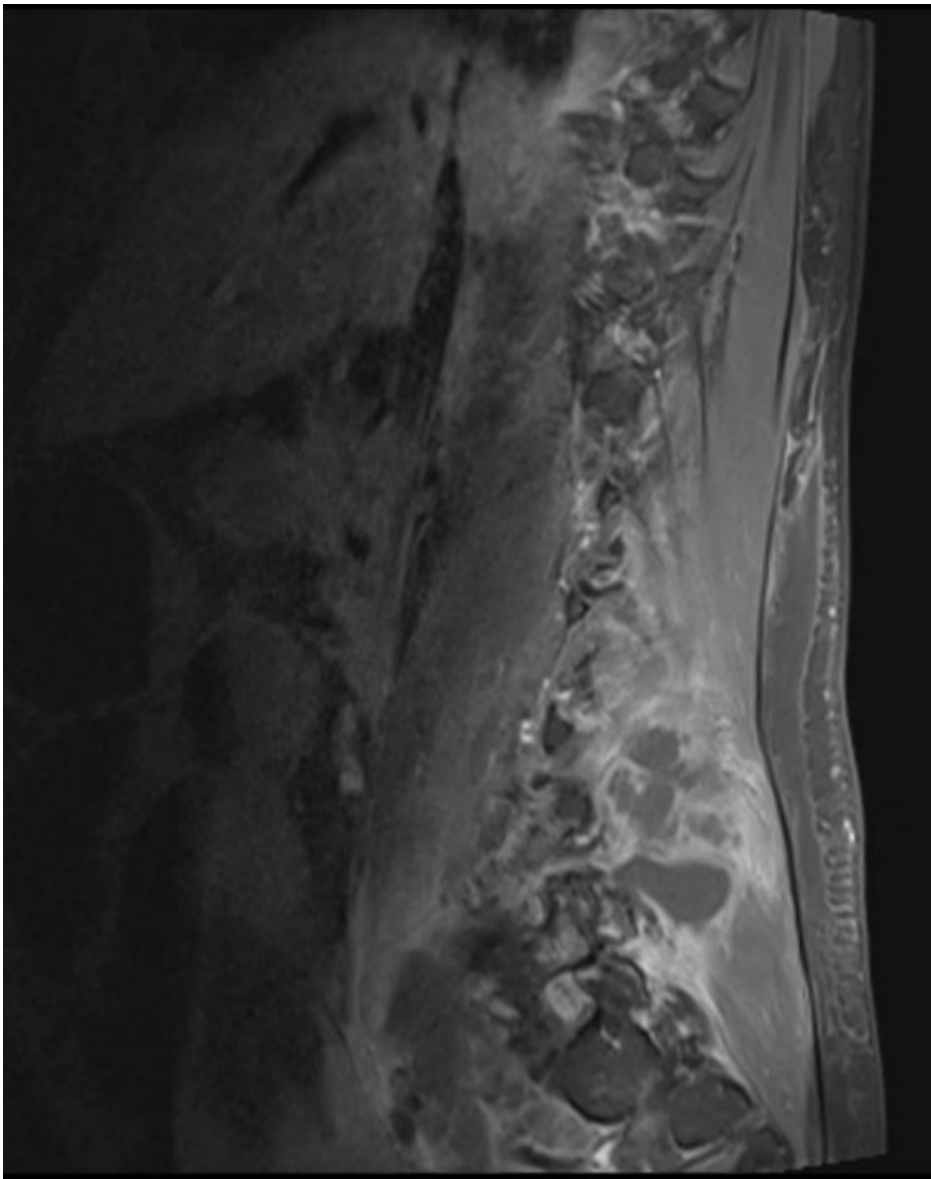


FACULTÉ DE MÉDECINE  
JACQUES LISFRANC • SAINT-ÉTIENNE



# Cas clinique

- Mr L. agriculteur, 54 ans, hospitalisé pour fièvre et douleurs lombaires basses, prédominant à droite. Dysurie récente. Signe de Babinski à Droite
  - TDM abdopelvien: abcès rétropéritone, paravertébraux Dt et psoas G
  - ETT/ ETO négative
  - IRM: épidurite

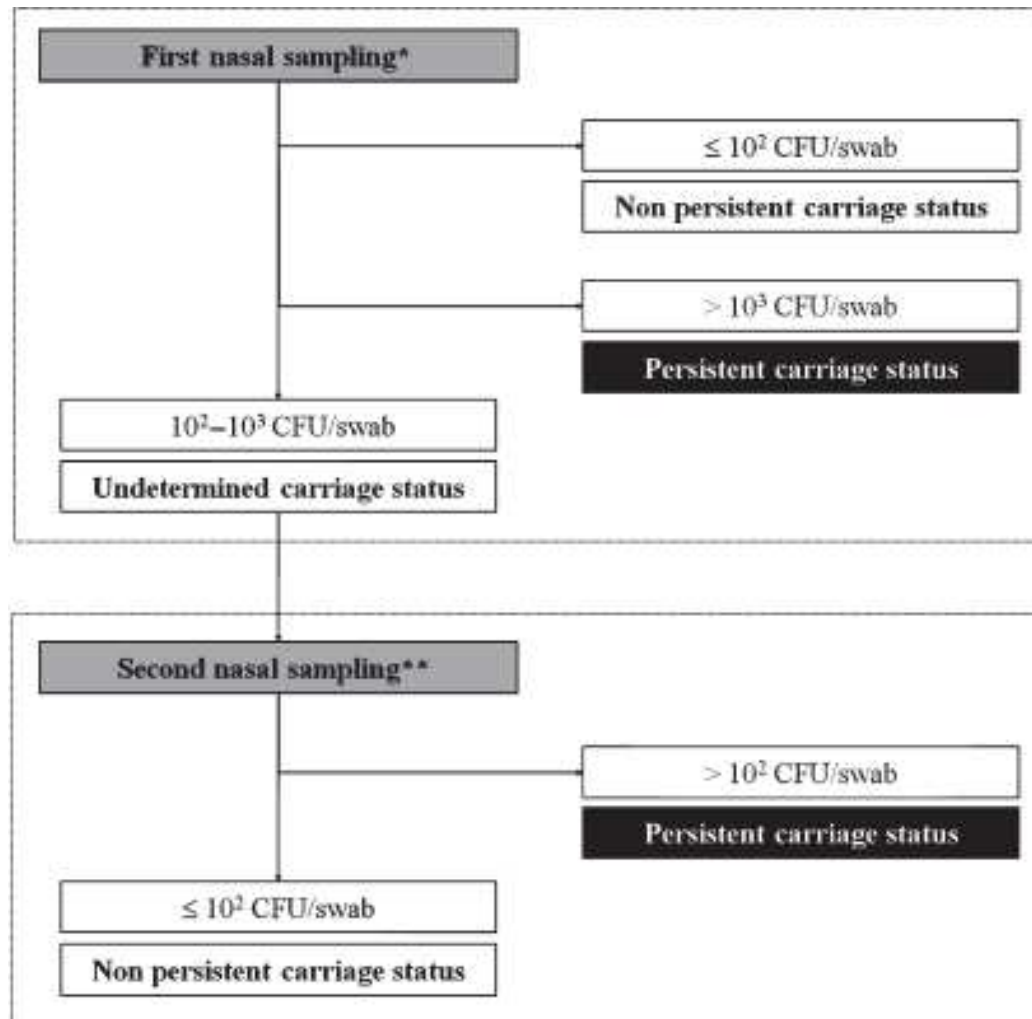


# Cas clinique

- Hémocultures positives à SAMS, sauvage
- Recherche de toxines: négative
- CC398
- Porte d'entrée?
  - Non retrouvée
  - Par contre: portage de *S. aureus* (SAMS) sauvage
    - Nez
    - Gorge
    - périnée
- Pas d'autres infections à *S. aureus* rapportée
- Pas de furoncles

# Portage de *S. aureus* et infection

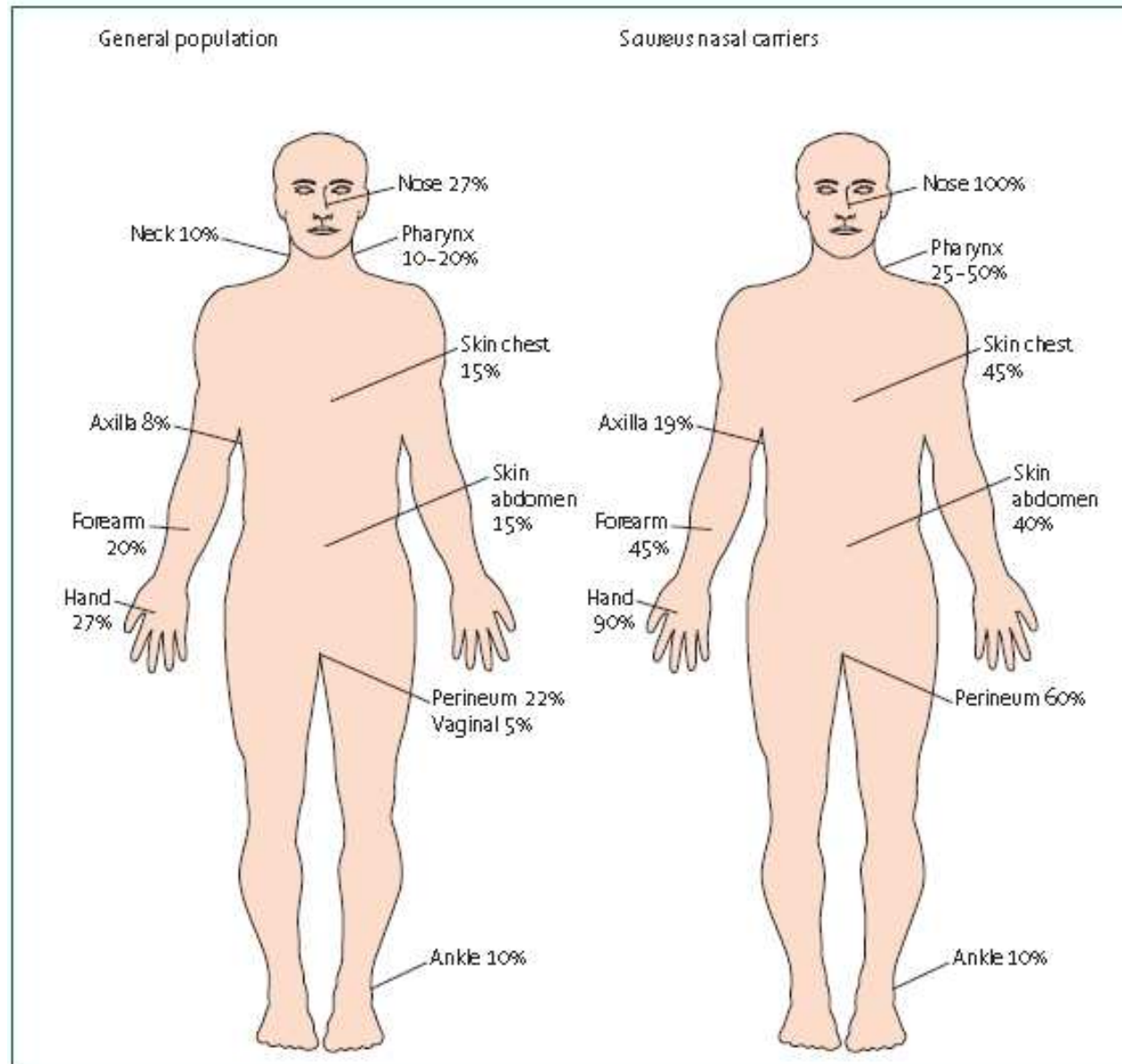
# Dépistage des porteurs de *S. aureus*



\* Sensitivity = 83.1% [95% CI, 61.5-95.2%], Specificity = 95.6% [95% CI, 69.1-99.7%],  
AUC = 0.89 [95% CI, 0.75-0.97]

\*\* Sensitivity = 95.5% [95% CI, 77.4-99.8%], Specificity = 94.9% [95% CI, 68.1-99.6%],

# Portage de *S. aureus*



# Portage de *S. aureus*

	Swabs tested (n)	Prevalence of <i>S.aureus</i> nasal carriage (% [95% CI])		
		Unadjusted	Adjusted* (all ages †)	Adjusted* (aged ≥18 years only ‡)
Austria	3309	16.6% (15.4-17.9)	16.2% (13.2-19.8)	15.7% (12.7-19.2)
Belgium	3025	19.3% (17.9-20.8)	19.4% (15.9-23.4)	18.8% (15.3-22.9)
Croatia	3960	20.0% (18.8-21.2)	10.4% (16.0-22.2)	18.5% (15.1-22.5)
France	3858	Dont 1,8% (16) de SARM		
Hungary	3847	14.1% (13.0-15.2)	12.7% (10.3-15.6)	12.1% (9.7-15.1)
Netherlands	3847	27.9% (26.5-29.3)	27.3% (22.9-32.1)	26.3% (22.0-31.3)
Spain	3990	19.3% (18.2-20.6)	18.8% (15.6-22.6)	17.3% (14.2-21.0)
Sweden	3214	29.8% (28.2-31.4)	29.4% (24.7-34.5)	29.4% (24.6-34.8)
UK	3156	25.8% (24.3-27.3)	..§	25.4% (21.0-30.3)

Table 2: Unadjusted and adjusted *Staphylococcus aureus* prevalence by country

-32206 patients vus en médecine générale

-9 pays d'Europe

-portage > chez les ↑ (OR 1,38: 1,31-1,46) et les enfants

denHeijer *et al.*, Lancet Infect Dis 2013; 13: 409-15

Dans la littérature plus ancienne, portage nasal varie de 20,9... à 65,9%

Kluytmans *et al.*, Clin Microbiol Rev 1997; 10: 505-20

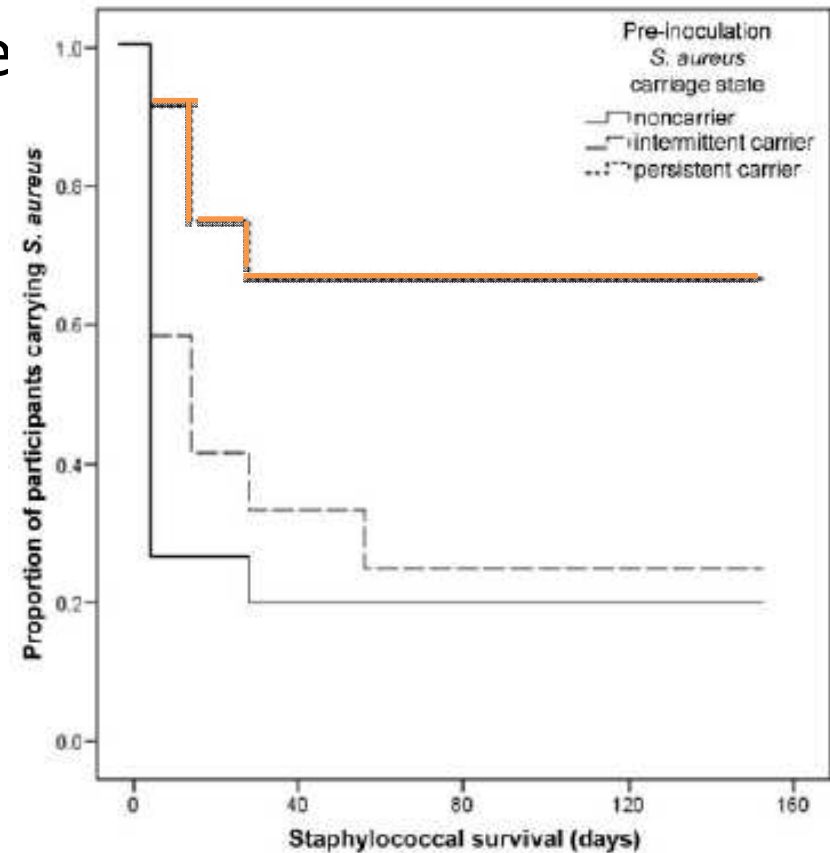
•Dépendant de la population étudiée+++ :

- Population générale : 37,2% [19-55,1]
- Soignants : 26,6% [16.8-56,1] (38,9% dont 24,4% persistants à St-Etienne, Verhoeven *et al.*, CMI 2012)
- Diabétiques insulino dépendants : 56,4% [24.1-76,4]
- Patients dialysés :
  - Hémodialyse : 51,5% [30,1-84,4]
  - dialyse péritonéale : 43,3% [16,8-51,4]
- Infections cutanées à *S. aureus* : 65,9% [42-100]
- HIV + > 30%, FR d'infections à *S. aureus* , dans le passé en Europe, toujours le cas aux USA
- Obésité (BMI>30): 32,4% vs 25,8%



# Portage de *S. aureus*

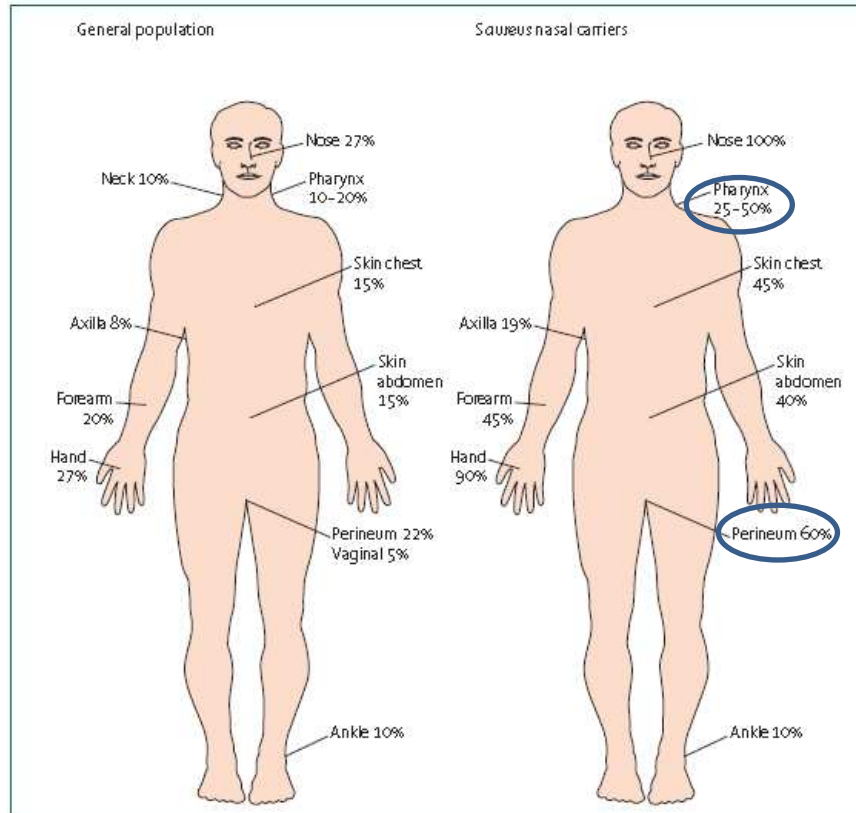
- Différents statuts de portage
  - Non porteur  $\approx 50\%$
  - Intermittent  $\approx 30\%$
  - **Persistant** :  $\approx 20\%$ 
    - Affinité particulière pour un clone \*
    - Charge bactérienne plus élevée
    - Colonisation prolongée



\*Récemment discuté Muthukrishnan BMC Infect Dis 2013

**Figure 1.** Kaplan-Meier survival curves showing proportions of individuals with culture-positive nasal swab samples after artificial inoculation of a mixture of *Staphylococcus aureus* strains in the nasal cavities.

# Portage de *S. aureus*



Wertheim *et al.*, Lancet 2005; 5: 751-62

- ∃ d'autres sites de portage associé
- Portage pharyngé, 20% [4-63]
- Portage digestif, 20% [8-31]

- Parfois exclusifs+++ :

- Portage pharyngé : 12,8 % [7-13]
- Portage digestif : 8 % [4-10]

Mertz *et al.*, Arch Intern Med (2009) 169: 172-8

Acton *et al.*, Eur J Clin Microbiol Infect Dis (2009) 28:115-127

➔ Nécessité de dépister différents sites anatomiques de portage

- Notamment pour le SARM

Senn *et al.*, Clin Microbiol Infect 2012; 18: E31-E33

## Signification de ce portage?

## Portage nasal de *S. aureus*: facteur de risque d'infection de X 2 à 12

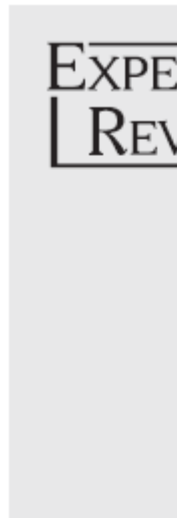
Simor *et al.*, Lancet Infect Dis 2011; 11: 952-62

Facts

**Table 1. Human host factors increasing *Staphylococcus aureus* nasal carriage.**

Categories	Human host factors	Ref.
General	Age: young people (<30 years), elderly people (>60 years) <sup>†</sup>	[14,37,44,110,112,117,123–125]
	Sex: male	[3,44,112,117,126]
	White people	[3,3,112,127]
	Country of residence	[10,128,129]
	Promiscuity and hospital crowding	[17,18]
	Colonized household member (peoples and pets) and contaminated environment	[3,17,117,130]
Behavior	Tobacco use <sup>*</sup>	[20–22,44,117,123]
	Nose picking	[131]
	Contraception <sup>‡</sup>	[40]
	Occupation: health care workers, livestock workers, pig farmers, sportsmen	[3,132,133]
	IV drugs use	[112,133,134]
	Male having sex with male <sup>¶</sup>	[133,135]
Diseases and medical history	Obesity	[3,117]
	Chronic wounds or skin lesions	[3,112]
	HIV patients	[3,44,112,136]
	Diabetes	[44,112]
	Chronic illness, severity of illness <sup>*,¶</sup>	[44,133]
Health care exposure	Previous antibiotic use	[112,133,137]
	History of hospitalization, exposure to health care facilities (surgery, intensive care units etc.)	[14,18,47,110,112,117,133,138]
	Medical devices (urinary or IV catheter, dialysis, tracheotomy, mechanical ventilation)	[3,47,112,133,138,139]
Genes	HLA-DR3 (no adjustment for underlying disease)	[140]
	Polymorphisms or haplotypes in genes coding for:	
	– Vitamin D receptor (in type 1 diabetics) <sup>*</sup>	[15,24,27]
	– IL-4 (524 C/C and 524 C/T genotypes)	[50,141]
	– C-reactive protein (haplotype C–C–G)	[50,141]
	– Glucocorticoid receptor <sup>‡</sup> (haplotype combination)	[94]
	– $\beta$ -defensin-1/3 <sup>§</sup> (DEF1 5'-UTR)	[32]
	– Mannose-binding lectin (WT 54 and 57)	[29]
	– TLR2 (R753Q) <sup>**</sup>	[142]
– Serine protease C1 inhibitor (V480M)	[15,143]	
Antimicrobial peptides	High level of $\alpha$ -defensins (HNP 1–3) and $\beta$ -defensin-2	[23,51]
	Low level of mRNA-encoding $\beta$ -defensin-1/3 <sup>§</sup>	[52,53]
Others	Low level of vitamin D (in nonsmoker men) <sup>§</sup>	[22]
	Hemoglobin in nasal secretion	[144]

*aureus*



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*aureus*

# Facteurs de risque du portage de *S. aureus*

Table 2. Bacterial factors involved in <i>Staphylococcus aureus</i> nasal carriage.			
Factors	Mechanisms	Evidences	Ref.
WTA	Binds to human nasal epithelial cells	Essential for nasal colonization of cotton rat (during the early stages of the colonization)	[145]
ClfB <sup>†</sup>	Major adhesion factors associated with nasal carriage. Binds to fibrinogen, cytokeratin 10, cytokeratin 8 and loricrin	ΔClfB mutant was defective for nasal colonization in rodents and humans. Vaccination with ClfB prevented <i>S. aureus</i> colonization in rodents	[31,146,147]
IsdA <sup>†</sup>	Major adhesion factors associated with nasal carriage expressed under iron-limited conditions. Binds to fibronectin and fibrinogen, involucrin, loricrin, cytokeratin 10	ΔIsdA mutant was associated with decrease of <i>S. aureus</i> nasal carriage in rodents. Vaccination with IsdA prevented <i>S. aureus</i> colonization in rodents	[32,33,147]
SasG <sup>†</sup>	Binds to epithelial cells	Promote adhesion to hDNECs	[148]
SdrC/D <sup>†</sup>	Binds to epithelial cells	Promote adhesion to hDNECs	[148]
FnBPs <sup>†</sup>	Binds to fibronectin, fibrinogen and elastin	Essential for the internalization of <i>S. aureus</i> in non-phagocytic cells and expressed during nasal colonization in humans	[33,147,149]
Spa <sup>†</sup>	Binds Fc fragment of Ig	Not associated with persistent carriage	[150]
Coa	Binds prothrombin	Not associated with persistent carriage	[150]
IEC	Located on β-hemolysin-converting bacteriophages carrying <i>scrI</i> , <i>chip</i> , <i>sea</i> and <i>sak</i> genes	Not required for early stage of colonization in humans but expressed during nasal colonization in humans	[33,151]
KatA	Increase the H <sub>2</sub> O <sub>2</sub> tolerance	Associated with nasal carriage in a cotton rat model	[143]
AhpC	Increase the H <sub>2</sub> O <sub>2</sub> tolerance	Associated with nasal carriage in a cotton rat model	[143]
Genetic lineages	No specific genetic lineage was associated with carriage isolates	Nasal carriage and clinical isolates belonged to the same genetic clusters	[44,56]

# Portage et Infection

- Le plus souvent, le portage est asymptomatique
- Environ 80% des infections à *S. aureus* sont endogènes Von Eiff C et al., NEJM 2001



## Evolutionary dynamics of *Staphylococcus aureus* during progression from carriage to disease

Bernadette C. Young<sup>a</sup>, Antonina A. Votintseva<sup>a</sup>, Andrew J. Rimmer<sup>a</sup>, Tim E. Peto<sup>a,c</sup>, Derrick W. Crook<sup>a</sup>, Rory Bowden<sup>a</sup>, and Daniel J. Wilson<sup>a</sup>, Larner-Svensson<sup>d</sup>, et al.<sup>a</sup>, Zamin Iqbal<sup>d</sup>, et al.<sup>a</sup>, and Peter Donnelly<sup>b,d</sup>

Uniquement 8 mutations entre les 2 souches, mais induit protéine tronquée

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- Souches de portage et d'infections sont très proches d'un point de vue génétique

Lamers et al., Plos One 2011

J.R Fitzgerald, Infection, Genetics and Evolution 2013

# Portage de *S. aureus* et impact clinique

- « Self-Infection in carriers »: cutanées, post-chirurgicales

R.E.O Williams, Bacteriol. Rev vol 27, 1963

- Patients de chirurgie
- Patients dialysés chroniques
- Patients ayant des infections cutanées chroniques
- Autres: bactériémies nosocomiales
- ....
- Portage MRSA risque > d'infection MSSA

N. Safdar et al., Am. J Med., (2008) 121, 310-315

# Portage de *S. aureus*: FR d'infections

- **CHIRURGIE**
  - **ORTHOPEDIE**

RISK FACTORS FOR SURGICAL-SITE INFECTION ([SSI] UNIVARIATE ANALYSIS)

Risk Factor	N= 272	RR	CI <sub>95</sub>
Any SSI			
Male gender		4.1	1.5-10.9
Underlying illness		2.6	0.9-7.7
Removing hair with razor blade		2.4	0.5-11.3
Surgeon 1		3.4	1.3-8.8
<i>Staphylococcus aureus</i> nasal carriage (any)		2.3	0.8-6.4
<i>S aureus</i> nasal carriage (high level)		3.1	1.1-9.0
<i>S aureus</i> SSI			
Male gender		3.0	0.8-11.5
Underlying illness		4.4	1.1-17.0
Removing hair with razor blade		2.6	0.3-22.1
Surgeon 1		3.1	0.8-12.2
<i>Staphylococcus aureus</i> nasal carriage (any)		8.9	1.7-45.5
<i>S aureus</i> nasal carriage (high level)		16.0	3.1-82.2

Abbreviations: CI<sub>95</sub>, 95% confidence interval; RR, relative risk.

En analyse multivariée:

• Any SSI:

<i>S. aureus</i> nasal carriage (high level)	p= 0.04
Male gender	p=0.005
Surgeon 1	p=0.006

• *S. aureus* SSI:

<i>S. aureus</i> nasal carriage (high level)	p= 0.002
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Risks factors	Univariate analysis	Multivariate analysis	
	p-value	p-value	Exp (B) 95% CI
N= 3908			
For SSI overall			
Centre	<0.01	0.0379	Adjustment factor
Age	0.03		
BMI	<0.001		
Tobacco use	0.003	0.0018	2.244 [1.352–3.726]
Diabetes	0.04		
Cancer	0.06		
Corticosteroids	0.1		
First implantation	0.07		
Duration of surgery	0.004		
Haematoma	0.002	0.0026	4.665 [1.714–12.695]
Nasal carriage of <i>S. aureus</i>	0.3		
NNIS	<0.001	<0.0001	3.073 [1.874–5.038]
ASA score >2	<0.01		
For SSI due to <i>S. aureus</i>			
Centre	NS	0.9978	Adjustment factor
ASA score >2	<0.01		
BMI	0.2		
Tobacco use	0.005	0.0024	3.907 [1.621–9.420]
Diabetes	0.025		
Cancer	0.02		
Duration of surgery	0.02		
Nasal carriage of <i>S. aureus</i>	0.02	0.0208	2.786 [1.169–6.640]
NNIS	<0.001	0.0007	5.205 [2.013–13.455]

## • Portage de MRSA en orthopédie

- ✓ 2473 patients
  - 79 (3.2%) MRSA carriers at the time of admission
  - MRSA SSI:
    - 7 of 79 carriers, 8.8%
    - vs 54 of 2394 non-carriers, 2.2%,
    - $p < 0.001$

Shukla *et al.*, J. Bone Joint Surg Br.2009

- ✓ 2423 patients, étude prospective Japon

Variable	Surgical site infection		Crude		Adjusted <sup>a</sup>	
	n / N	(%)	OR (95% CI)	p-value	OR (95% CI)	p-value
Culture of nasal MRSA	–	11 / 2360 (0.5)	1		1	
	+	4 / 63 (6.3)	15 (4.5–47)	<0.001	11 (3.0–37)	<0.001
Sex	M	9 / 1272 (0.7)	1		1	
	F	6 / 1151 (0.5)	1.4 (0.5–3.8)	0.6	1.7 (0.5–5.4)	0.4
Age per 10-year increase			1.2 (0.9–1.6)	0.3	1.1 (0.7–1.5)	0.8
Length of surgical procedure per 10-minute increase			1.0 (1.0–1.1)	0.1	1.0 (1.0–1.1)	0.2
ASA class	1	3 / 1059 (0.3)	1		1	
	2	7 / 1079 (0.7)	2.3 (0.6–8.9)	0.2	2.2 (0.5–10)	0.3
	3, 4	5 / 285 (1.8)	6.3 (1.5–27)	0.01	4.2 (0.6–27)	0.1
Trend			p=0.04		p=0.1	
BMI			1.0 (0.9–1.1)	0.7	1.0 (0.9–1.1)	0.8

<sup>a</sup> model included usage of prosthesis, site of infection, open fracture, history of diabetes mellitus, and history of rheumatoid arthritis, and all variables in the table.

Yano *et al.*, Acta Orthopaedica 2009



# Portage de *S. aureus* : FR d'infections

## – CARDIOTHORACIQUE

- Kluytmans *et al.*, J Infect Dis 1995 : étude cas/contrôles  
1980 patients, 40 cas d'infections du site opératoire  
portage nasal: OR 9,6 (95% IC, 3,9-23,7)
- Munoz *et al.*, J Hosp Infect 2008;68 :25-31:  
chirurgie cardiaque, 357 patients, 96 cas d'ISO: RR 3,1; 95% IC: 1,4-7,3; p=0,009
- Bode *et al.*, NEJM 2010: diminution du taux d'ISO de 60% en cas de décolonisation

## – VASCULAIRE

- Donker JMW, PLoS ONE 2012; 7: e38127  
224 patients, portage nasal de *S. aureus* = FR d'infection X 10 dans les chirurgies de reconstruction centrale

## – AUTRES CHIRURGIES

- Générale, digestive.....

Table 5. Infection incidence rates by *S. aureus* nasal carriage patterns

	Non	95% CI	Intermittent	95% CI	Persistent	95% CI	Total	95% CI	P value <sup>a</sup>	IRR <sup>b,c</sup>	95% CI
Follow-up (months at risk)											
Mean	41.1	[28.1-54.1]	41.9	[15.3-68.6]	46.9	[26.0-67.7]	43.5	[33.3-53.7]	0.87		
Total N	904		419		937		2260				
Patients in follow-up N											
CPD-related infections N	22		10		20		52				
All	41		16		126		183				
Exit site infections	17		8		81		106				
Peritonitis	24		8		45		77				
CPD-related infections incidence (nr/person months at risk)											
All	0.05	[0.03-0.08]	0.04	[0.02-0.08]	0.13	[0.11-0.16]	0.08	[0.07-0.09]	<0.001	3.52	[2.56-4.85]
Exit site infections	0.02	[0.01-0.04]	0.02	[0.01-0.05]	0.09	[0.07-0.11]	0.05	[0.04-0.06]	<0.001	5.59	[3.50-8.92]
Peritonitis	0.03	[0.01-0.06]	0.02	[0.01-0.05]	0.05	[0.04-0.06]	0.03	[0.03-0.04]	0.019	2.19	[1.39-3.45]
<i>S. aureus</i> CPD-related infections N											
All	12		2		78		92				
Exit site infections	9		2		65		76				
Peritonitis	3		0		13		16				
<i>S. aureus</i> CPD-related infections incidence (nr/person months at risk)											
All	0.01	[0.01-0.03]	0.01	[0.00-0.02]	0.08	[0.07-0.10]	0.04	[0.03-0.05]	<0.001	9.54	[5.25-17.33]
Exit site infections	0.01	[0.00-0.03]	0.01	[0.00-0.02]	0.07	[0.05-0.09]	0.03	[0.03-0.04]	<0.001	10.75	[5.45-21.19]
Peritonitis	0.00	[0.00-0.02]	0		0.01	[0.01-0.02]	0.01	[0.00-0.01]	0.026	6.54	[1.83-23.31]
<i>CoNS</i> CPD-related infections N											
Peritonitis	5		3		18		26				
<i>CoNS</i> CPD-related infections incidence (nr/person months at risk)											
Peritonitis	0.01	[0.00-0.02]	0.01	[0.00-0.04]	0.02	[0.01-0.03]	0.01	[0.01-0.02]	0.018	3.37	[1.45-7.83]

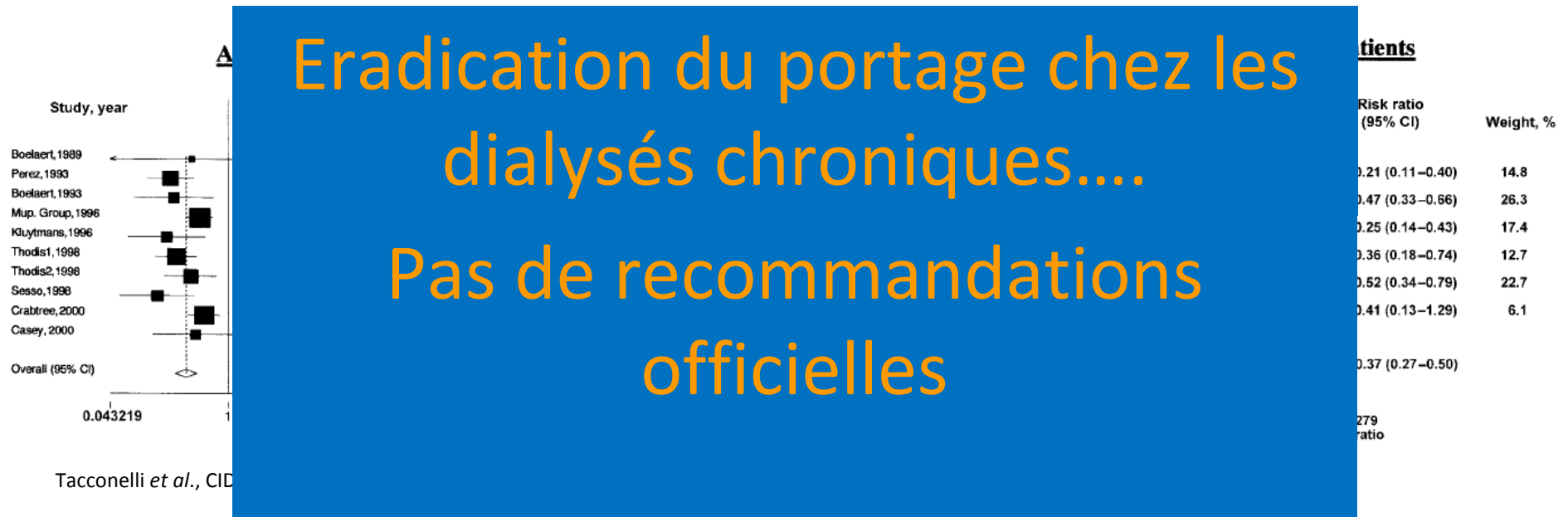
<sup>a</sup>P value for the univariate comparison of incidence rates in non-, intermittent and persistent carriers using Poisson regression.

<sup>b</sup>Incidence rate ratio.

<sup>c</sup>Comparing incidence rates in persistent carriers vs in non- or intermittent carriers in a Poisson regression model adjusting for age, sex, and diabetes mellitus.

# Portage de *S. aureus*: FR d'infections

- **DIALYSE**



- Nécessité de répéter les cures de décolonisation+++

Simor, *Lancet Infect Dis* 2011; 11: 952-62

# Portage de *S. aureus*: FR d'infections

- **INFECTIONS CUTANÉES A REPETITION**

- Hedstrom SA *Scand J Infect Dis* 1981; 13: 115–19; Durupt F *et al.*, *Br J Dermatol* 2007; 157:1161–7 :
- ≈60% portage nasal si furoncles récidivant. Moins fréquent si unique (88 vs 29%;  $p < 0.007$ )
- Impetigo

- **Infections cutanées récidivantes à SARM: ERADICATION du PORTAGE**

**Attitude pratique en fonction de la situation épidémiologique**

	Dépistage du (des) cas	Décontamination du (des) cas	Dépistage du foyer	Décontamination du foyer	Dépistage de la collectivité	Décontamination de la collectivité
Cas isolé d'infection, 1er épisode	Non	Non	Non	Non	Non	Non
Cas isolé d'infection : épisode suivant	Non	Oui	Non	Oui	Non	Non
Cas isolé d'infection : échec de décontamination, rechute ou récurrence	Oui, élargi à d'autres sites que le nez	Oui	Parfois	Oui	Non	Non
Cas groupés en foyer	Non	Oui	Non	Oui	NA	NA
Cas groupés en collectivité	Non	Oui	Non	Oui	Oui	Uniquement les porteurs

**RECOMMANDATIONS SUR LA PRISE EN CHARGE ET LA PRÉVENTION DES INFECTIONS CUTANÉES LIÉES AUX SOUCHES DE *STAPHYLOCOCCUS AUREUS* RÉSISTANTS À LA METICILLINE COMMUNAUTAIRES (SARM CO)**  
 HCSP Décembre 2009

**Recommandations IDSA 2011: Décolonisation MRSA, CIII**

- **Infections cutanées récidivantes à SAMS: idem mais pas de recommandations officielles**

# Portage de *S. aureus*: FR d'infections

- BACTERIEMIES

## NASAL CARRIAGE AS A SOURCE OF *STAPHYLOCOCCUS AUREUS* BACTEREMIA

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N Engl J Med, Vol. 344, No. 1 · January 4, 2001

- Clonalité des souches 80% (souche portage nasal et souche « bactériémie ») environ 1/2 d'infections communautaires en retrospectif
- Idem en prospectif, bcp de bactériémies nosocomiales

# Portage de *S. aureus*: FR d'infections

- BACTERIEMIES NOSOCOMIALES

## Risk and outcome of nosocomial *Staphylococcus aureus* bacteraemia in nasal carriers versus non-carriers

Heiman FL Wertheim, Margreet C Vos, Alewijn Ott, Alex van Belkum, Andreas Voss, Jan A J W Kluytmans, Peter H J van Keulen, Christina M J E Vandenbroucke-Grauls, Marlene H M Meester, Henri A Verbrugh

*Staphylococcus aureus* is the second most frequent cause of nosocomial blood infections. We screened 14 008 non-bacteraemic, non-surgical patients for *S aureus* nasal carriage at admission, and monitored them for development of bacteraemia. Nosocomial *S aureus* bacteraemia was three times more frequent in *S aureus* carriers (40/3420, 1.2%) than in non-carriers (41/10588, 0.4%; relative risk 3.0, 95% CI 2.0–4.7). However, in bacteraemic patients, all-cause mortality was significantly higher in non-carriers (19/41, 46%) than in carriers (seven/40, 18%,  $p=0.005$ ). Additionally, *S aureus* bacteraemia-related death was significantly higher in non-carriers than in carriers (13/41 [32%] vs three/40 [8%],  $p=0.006$ ). *S aureus* nasal carriers and non-carriers differ significantly in risk and outcome of nosocomial *S aureus* bacteraemia. Genotyping revealed that 80% of strains causing bacteraemia in carriers were endogenous.

Lancet 2004; 364: 703–05

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— Echec des tentatives de décolonisation Wertheim HF, Ann. Intern. Med. 139(6), 419–

425 (2004).

# Portage de *S. aureus*: FR d'infections

- **Patients VIH+** Kluytmans et al., CMR 1997
  - Porteurs > à risque de bactériémies à *S. aureus* que les non porteurs. SIDA plus à risque Weinke T, [Eur J Clin Microbiol Infect Dis.](#) 1992 Nov;11(11):985-9.
  - Plus de portage de MRSA, plus associé à des infections des parties molles Shet A, [J Infect Dis.](#) 2009 Jul 1;200(1):88-93
- **Autres** Kluytmans et al., CMR 1997
  - Greffés (foie+++, rein)
  - Cirrhotiques
  - Patients admis en soins intensifs Wertheim et al., Lancet Infect Dis 2005; 5: 751-62
- **Portage de MRSA:**
  - Nombre important de réhospitalisations dans l'année pour des infections à MRSA, dont 17% mortalité Huang et al., PlosOne 2011

# Infections et statut de portage de *S. aureus*

- Porteurs persistants:
  - risque plus élevé d'infection:
    - Kalmeidjer *et al.* 2000, en orthopédie
    - Nouwen *et al.*, 2005, en dialyse péritonéale
    - Datta *et al.*, 2008, porteur persistant de MRSA ont un pronostic plus péjoratif