Epidémiologie et physiopathologie des infections sur prothèses articulaires

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Espèces bactériennes isolées d'IPA

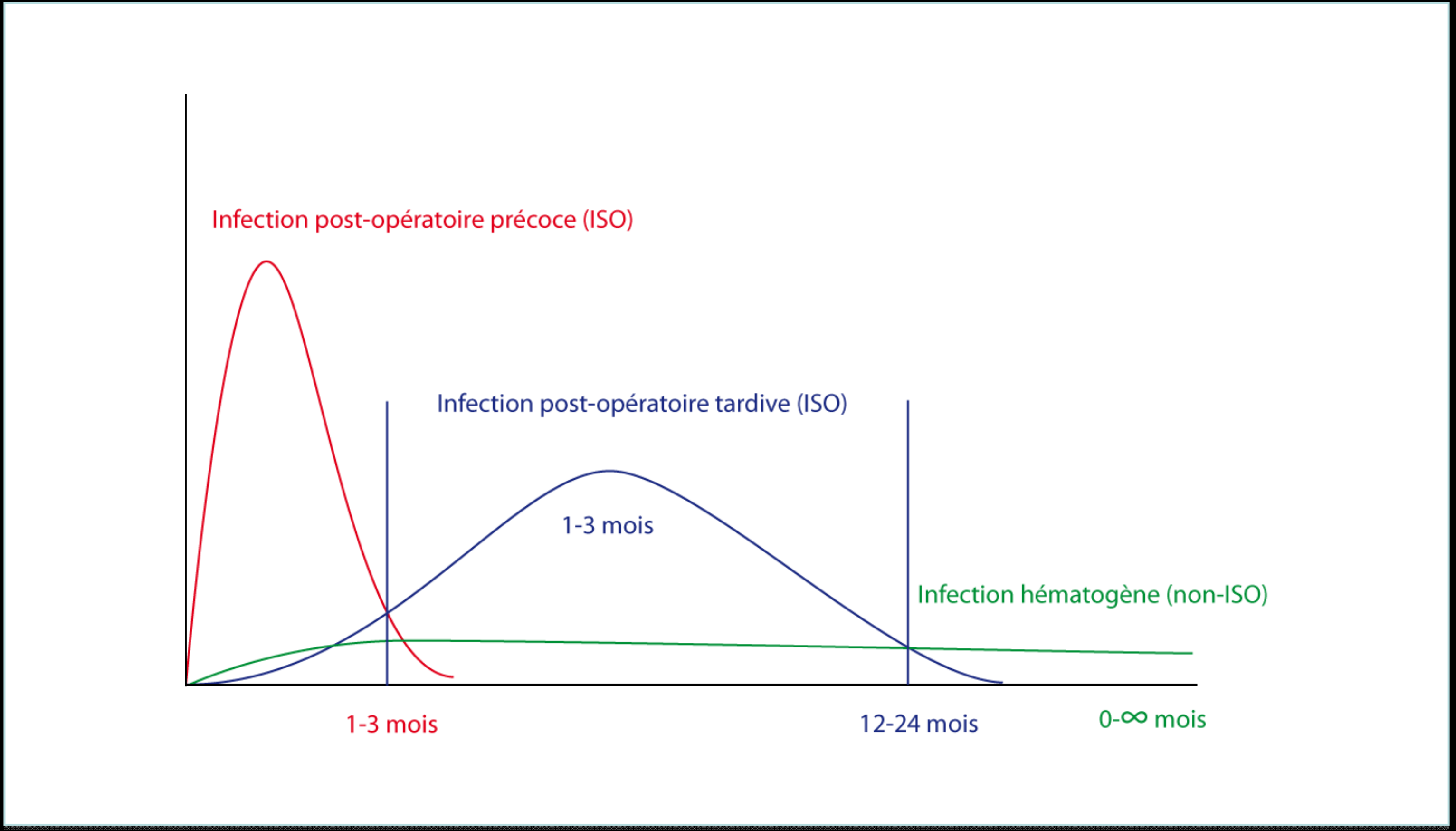
- 70% flore cutanée
- 30% digestive/urinaire

- 15% polymicrobien
- 15% non documenté

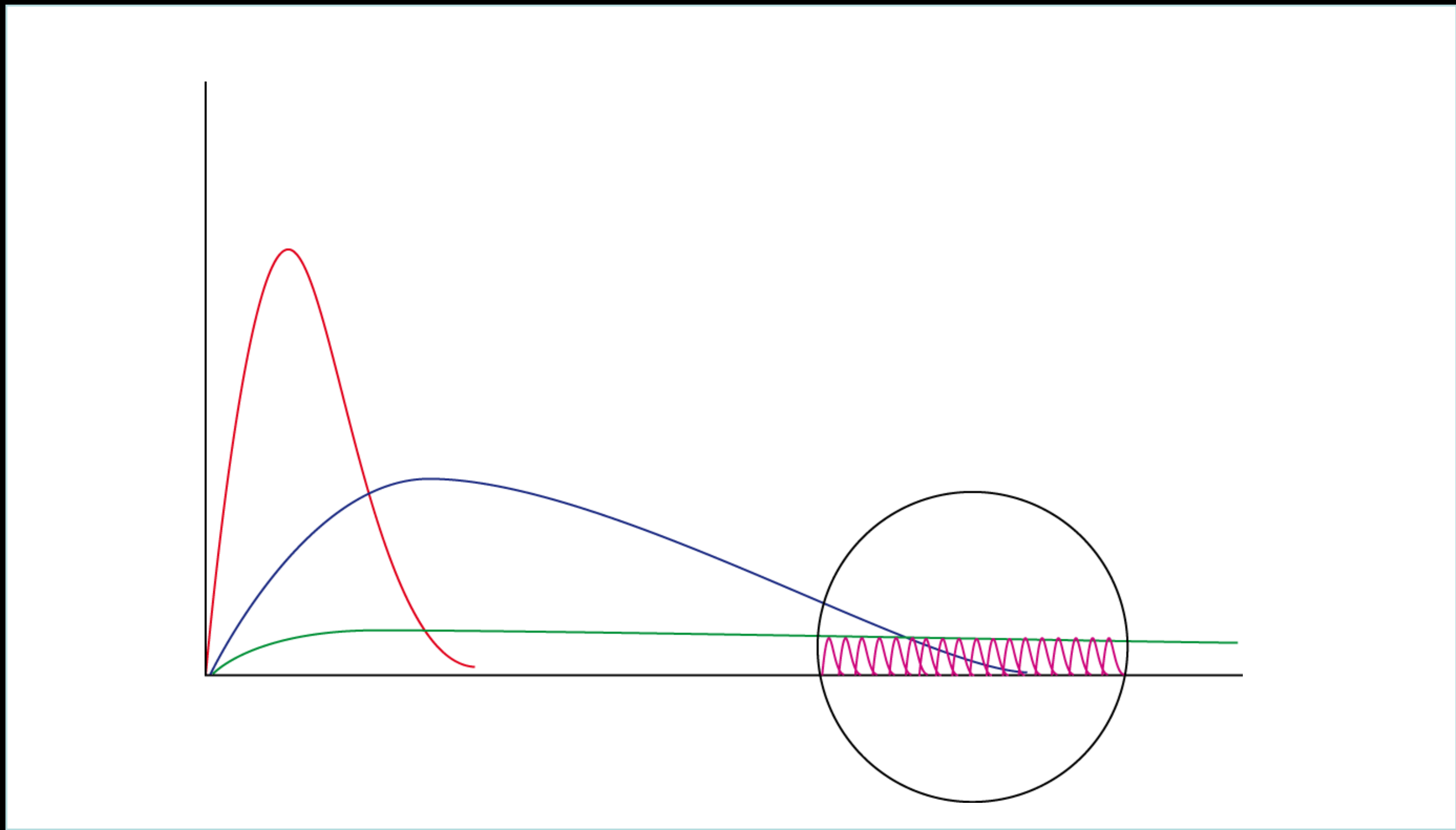
Patient characteristics		
Number of cases of PJI	92	
Patient age	64,2	
Location (hip/knee)	54/38	
Sex ratio (M/F)	0,7	(38/54)
Number of samples	495	
Mean nb of samples per patient	5.34	(±1.4)
Microbiological findings	**n**	**%**
Microbiological documentation	77	83,7%
Polymicrobial infections	16	17,4%
Negative culture	7	7,6%
Contaminant	8	8,7%
Time and media securing the final diagnosis		
24h COS agar	40	51,9%
48h COS agar	9	11,7%
48h BHI broth	13	16,9%
5d anaerobic COS agar	4	5,2%
7d Rosenow broth	11	14,3%

Identification of significant isolates		
Staphylococci	**52**	**67,5%**
S. aureus	20	26,0%
S. capitis	4	5,2%
S. caprae	1	1,3%
S. epidermidis	23	29,9%
S. lugdunensis	1	1,3%
S. simulans	1	1,3%
S. warnerii	2	2,6%
Streptococcaceae	**14**	**18,2%**
Enterococcus faecalis	6	7,8%
Streptococcus agalactiae	5	6,5%
Streptococcus equisimilis	1	1,3%
Streptococcus bovis	1	1,3%
Streptococcus sanguinis	1	1,3%
Gram negative bacilli	**16**	**20,8%**
Pseudomonas aeruginosa	8	10,4%
Enterobacter cloacae	2	2,6%
Proteus mirabilis	2	2,6%
Escherichia coli	1	1,3%
Klebsiella oxytoca	1	1,3%
Morganella morganii	1	1,3%
Serratia marcescens	1	1,3%
Coryneforms	**2**	**2,6%**
Anaerobes	**9**	**11,7%**
Propionibacterium sp.	4	5,2%
Bacteroides sp.	2	2,6%
Actinomyces europaeus	1	1,3%
Anaerococcus sp.	1	1,3%
Finegoldia magna	1	1,3%
Yeasts	**2**	**2,6%**
Candida albicans	2	2,6%

Classification chronologique des infections

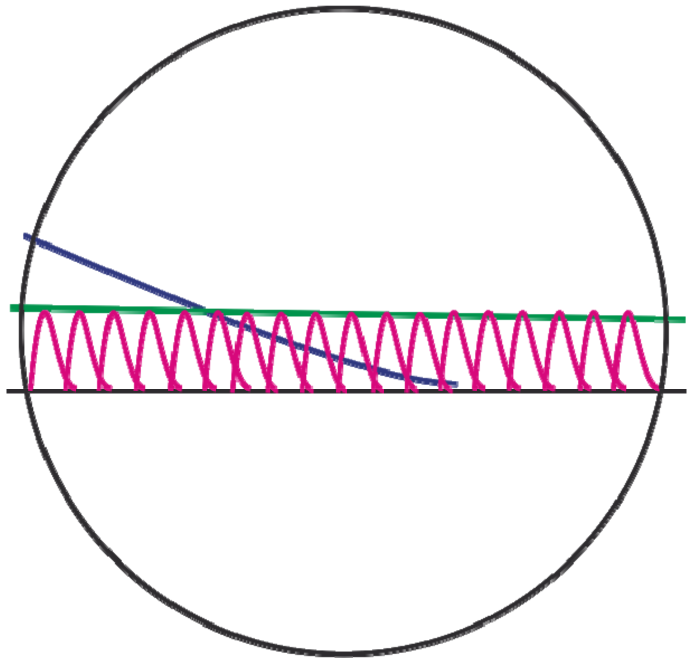


Classification chronologique des infections

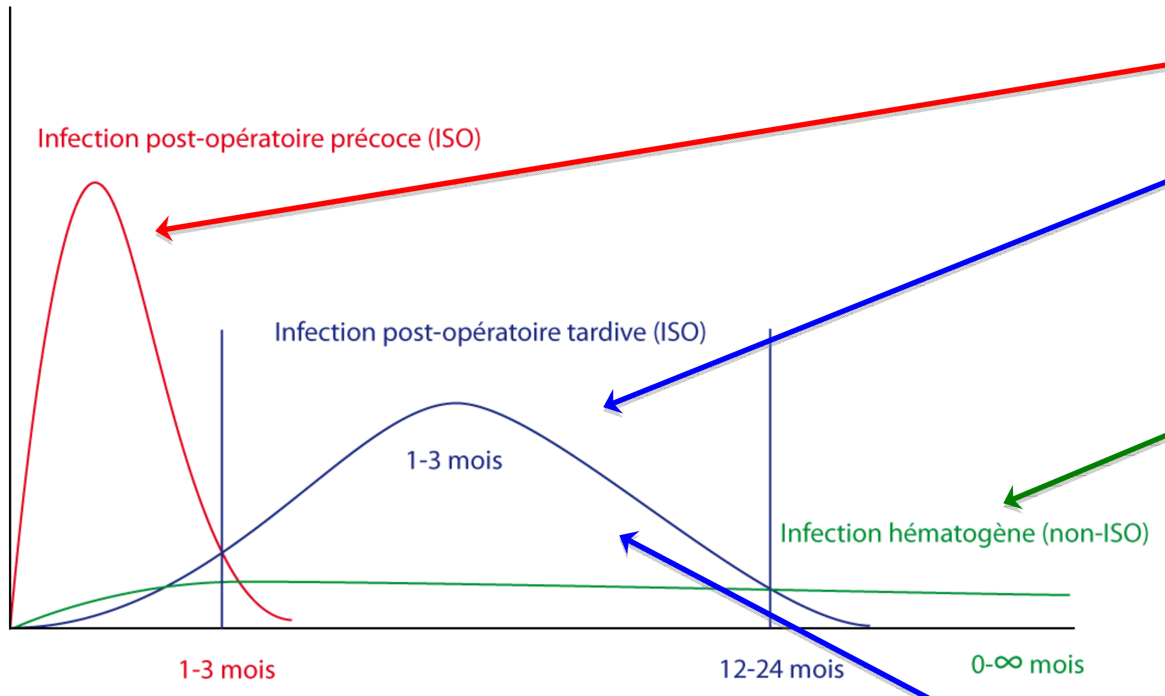


Classification chronologique des infections

Infections « à distance » :
Infections hématogènes pendant la durée de vie de l'implant



Classification chronologique des infections



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Sources microbiennes au bloc opératoire

IPA
Spécificité microbiologique selon le site

Propionibacterium acnes Postoperative Shoulder Arthritis: An Emerging Clinical Entity

Pierre Yves Levy,[1,4] Florence Fenollar,[1] Andreas Stein,[2] Frederic Borrione,[4] Emile Cohen,[3] Bernhard Lebail,[4] and Didier Raoult[1]

Table 1. Clinical investigation and systematic microbiological analysis of *Propionibacterium acnes* infection.

Site of infection	No. of patients (*n* = 276)	No. of patients with positive culture (*n* = 247)	No. of patients with infection due to *P. acnes*[a]
Shoulder	19	16	9
Lower limb	257	233	1

[a] *P* value for comparison of shoulder infection versus lower limb infection was <.001.

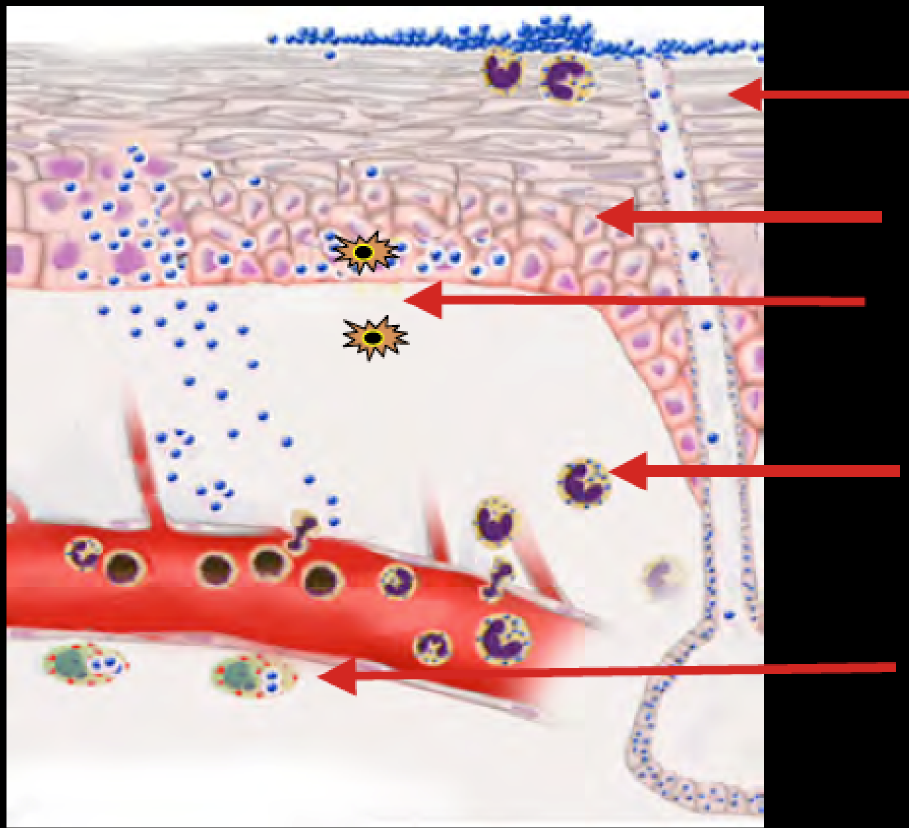
Postoperative Joint Infections Due to *Propionibacterium* Species: A Case-Control Study

Zeina A. Kanafani,[1] Daniel J. Sexton,[2] Brian C. Pien,[2] Jay Varkey,[2] Carl Basmania,[2] and Keith S. Kaye[3]

Results. A total of 146 patients with positive results for *Propionibacterium* wound cultures were identified. Of these patients, 40 met the inclusion criteria for surgical site infection (there were 30 shoulder, 1 elbow, 5 hip, 3 knee, and 1 ankle infections). During the study period, 24,143 procedures involving these 5 joints were performed at Duke University Medical Center. The highest incidence of *Propionibacterium* infection occurred after shoulder surgery (6.63 infections/1000 procedures; 95% confidence interval [CI], 4.48–9.45 infections/1000 procedures), followed by hip (0.89 infections/1000 procedures; 95% CI, 0.29–2.07 infections/1000 procedures) and elbow surgeries (0.89 infections/1000 procedures; 95% CI, 0.02–4.92 infections/1000 procedures).

La barrière cutanée

Multiple active layers



Cartographie de la flore cutanée

Bacterial Community Variation in Human Body Habitats Across Space and Time

Elizabeth K. Costello,[1] Christian L. Lauber,[2] Micah Hamady,[3] Noah Fierer,[2,4] Jeffrey I. Gordon,[5] Rob Knight[1,6]*

Elucidating the biogeography of bacterial communities on the human body is critical for establishing healthy baselines from which to detect differences associated with diseases. To obtain an integrated view of the spatial and temporal distribution of the human microbiota, we surveyed bacteria from up to 27 sites in seven to nine healthy adults on four occasions. We found that community composition was determined primarily by body habitat. Within habitats, interpersonal variability was high, whereas individuals exhibited minimal temporal variability. Several skin locations harbored more diverse communities than the gut and mouth, and skin locations differed in their community assembly patterns. These results indicate that our microbiota, although personalized, varies systematically across body habitats and time; such trends may ultimately reveal how microbiome changes cause or prevent disease.

The human body hosts complex microbial communities whose combined membership outnumbers our own cells by at least a factor of 10 (*1*, *2*). Together, our ~100 trillion microbial symbionts (the human microbiota) endow us with crucial traits; for example, we rely on them to aid in nutrition, resist pathogens, and educate our immune system (*1*, *3*). To understand the full range of human genetic and metabolic diversity, it is necessary to characterize the factors influencing the diversity and distribution of the human microbiota (*4*, *5*).

Determining our microbiota's role in disease predisposition and pathogenesis will depend critically upon first defining "normal" states (*5*). Prior studies of healthy individuals have focused on particular body habitats including the gut (*6*, *7*), skin (*8*–*10*), and oral cavity (*11*, *12*), and have revealed microbial communities that were highly variable both within

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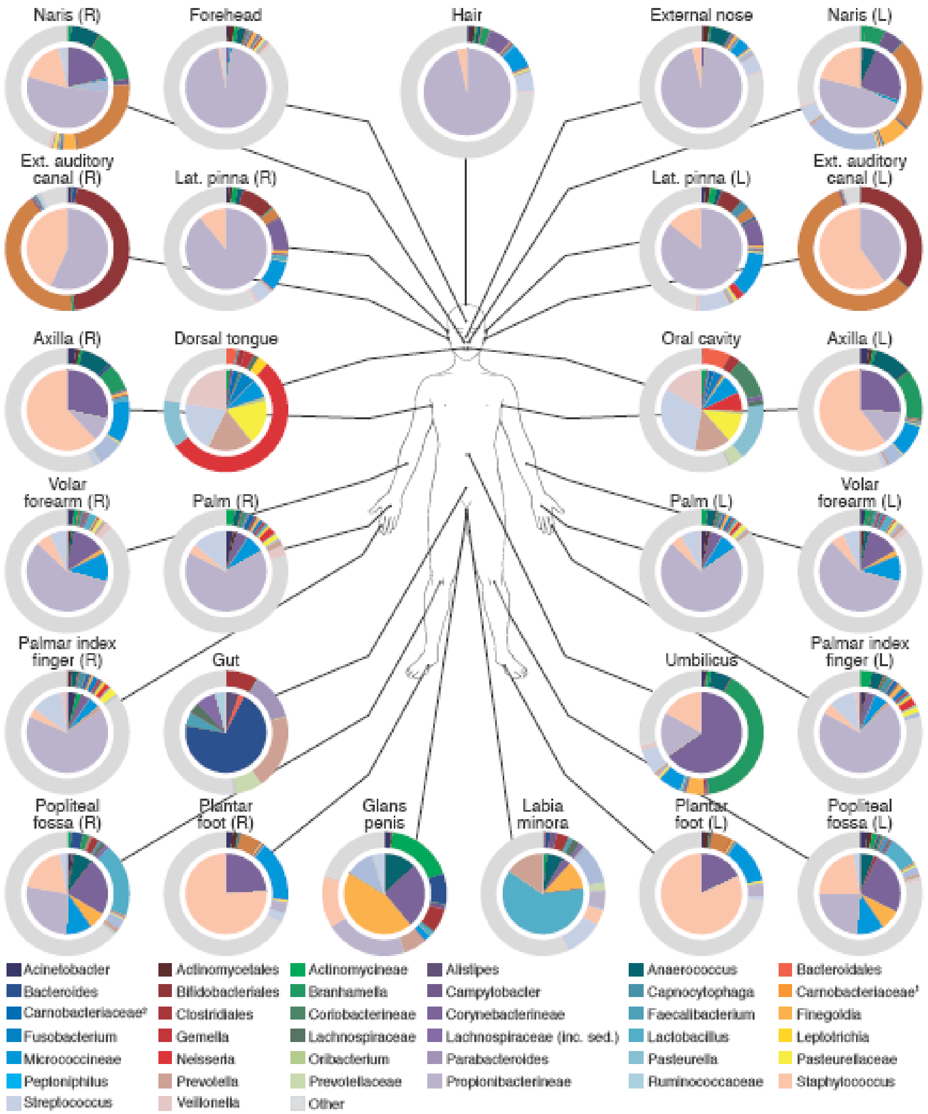
*To whom correspondence should be addressed. E-mail: rob.knight@colorado.edu

Chaque site cutané possède sa flore propre



La flore de la main

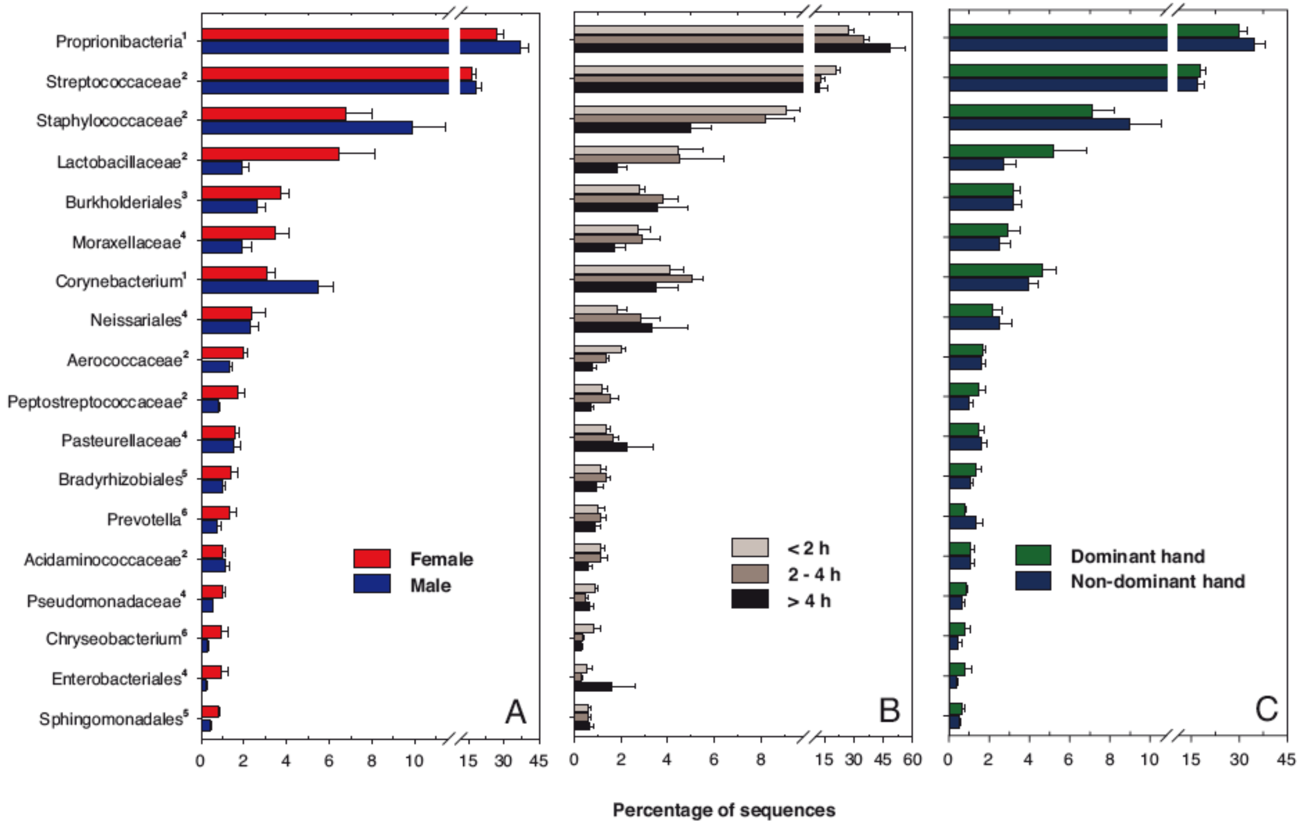
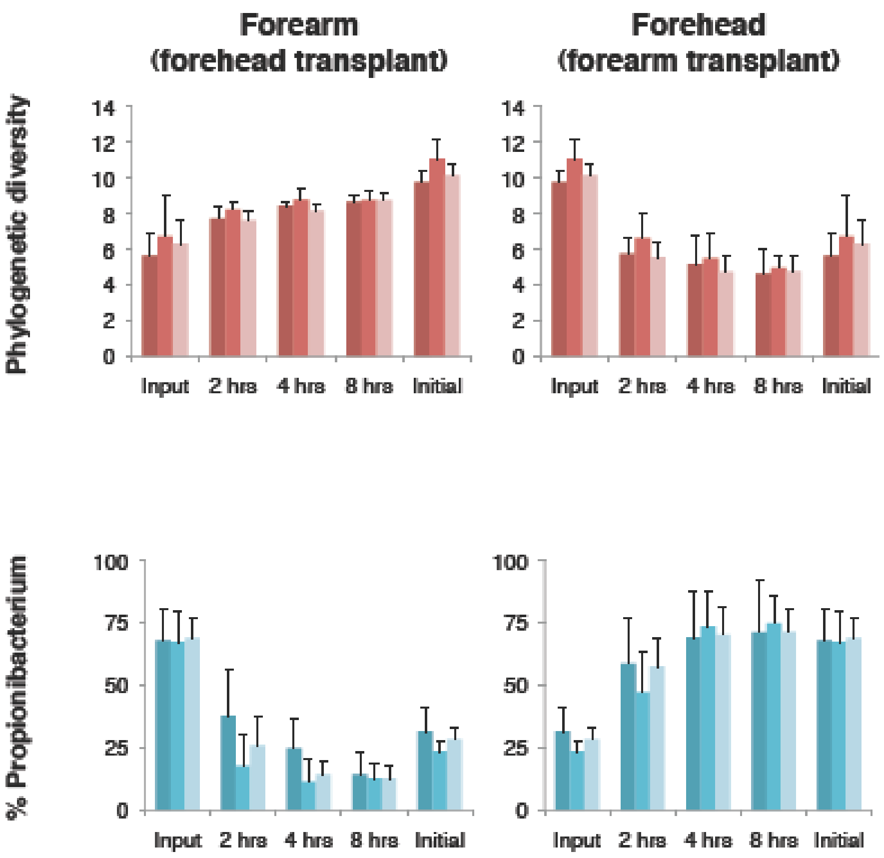


Fig. 1. Relative abundances of the most abundant bacterial groups on the hand surfaces, with the hand samples divided into categories of sex (*A*), time since last hand washing (*B*), and the dominant versus the nondominant hand (*C*). Error bars are 1 standard error of the mean. For the number of sequences and number of samples included in each category and the full taxonomic description of the hand surface bacterial communities see Table S1. Superscripts on the taxon name indicate the phylum or subphylum: 1, Actinobacteria; 2, Firmicutes; 3, Betaproteobacteria; 4, Gammaproteobacteria; 5, Alphaproteobacteria; 6, Bacteroidetes.

Fierer *et al.* PNAS | **November 18, 2008** | vol. 105 | no. 46 | **17995**

Stabilité de la flore cutanée



La flore cutanée résidente

- Stable pour chaque individu
- Composée de plusieurs centaines d'espèces différentes
- Une minorité des espèces est cultivable
- dont
  - *Staphylococcus epidermidis* 90% des aérobies
  - *Propionibacterium acnes* 70% du total

Rôle positif de la flore « commensale »

- Occupe la face « non-immune » de la peau
- Compétition avec des pathogènes transitoires
- Secrète des peptides antibactériens
- Inhibe la croissance de pathogènes
- Inhibe la production de facteurs de virulence

La flore transitoire

- *S.aureus*
- *Enterococci*
- *Enterobacteriaceae*

- Origine digestive
- Origine urinaire

- Porte d’entrée cutanée ?
- Souillure post-opératoire
- Rôle de l’antibioprophylaxie

Le patient et sa flore endogène

- Chirurgie contaminée
  - Détersion mécanique / chimique
  - Débridement des foyers infectieux
- Chirurgie propre
  - incision : brèche cutanée
  - Flore cutanée
  - Flore viscérale / dissémination hématogène
- Recommendations
  - Quel est le niveau de preuve?
  - Comment choisir un protocole plutôt qu'un autre?

Contrôle de la flore du patient

- 2 directions fructueuses
  - Antibioprophylaxie
  - Préparation cutanée de l'opéré

- Peu d'études documentent la relation entre préparation cutanée et
  - Protocole de préparation cutanée
  - Réduction de l'incidence des ISO

- Causalité entre incision et ISO ?

Sources microbiennes au bloc opératoire

Mains gantées : vectrices d'ISO ?

Surgical Glove Perforation and the Risk of Surgical Site Infection

Heidi Misteli, MD; Walter P. Weber, MD; Stefan Reck, MD; Rachel Rosenthal, MD; Marcel Zwahlen, PhD; Philipp Fueglistaler, MD; Martin K. Bolli, MD; Daniel Oertli, MD; Andreas F. Widmer, MD; Walter R. Marti, MD

Hypothesis: Clinically apparent surgical glove perforation increases the risk of surgical site infection (SSI).

Design: Prospective observational cohort study.

Setting: University Hospital Basel, with an average of 28 000 surgical interventions per year.

Participants: Consecutive series of 4147 surgical procedures performed in the Visceral Surgery, Vascular Surgery, and Traumatology divisions of the Department of General Surgery.

Main Outcome Measures: The outcome of interest was SSI occurrence as assessed pursuant to the Centers of Disease Control and Prevention standards. The primary predictor variable was compromised asepsis due to glove perforation.

Results: The overall SSI rate was 4.5% (188 of 4147 procedures). Univariate logistic regression analysis showed a higher likelihood of SSI in procedures in which gloves were perforated compared with interventions with maintained asepsis (odds ratio [OR], 2.0; 95% confidence interval [CI], 1.4-2.8; $P < .001$). However, multivariate logistic regression analyses showed that the increase in SSI risk with perforated gloves was different for procedures with vs those without surgical antimicrobial prophylaxis (test for effect modification, $P = .005$). Without antimicrobial prophylaxis, glove perforation entailed significantly higher odds of SSI compared with the reference group with no breach of asepsis (adjusted OR, 4.2; 95% CI, 1.7-10.8; $P = .003$). On the contrary, when surgical antimicrobial prophylaxis was applied, the likelihood of SSI was not significantly higher for operations in which gloves were punctured (adjusted OR, 1.3; 95% CI, 0.9-1.9; $P = .26$).

Conclusion: Without surgical antimicrobial prophylaxis, glove perforation increases the risk of SSI.

Arch Surg. 2009;144(6):553-558

Population de l’étude

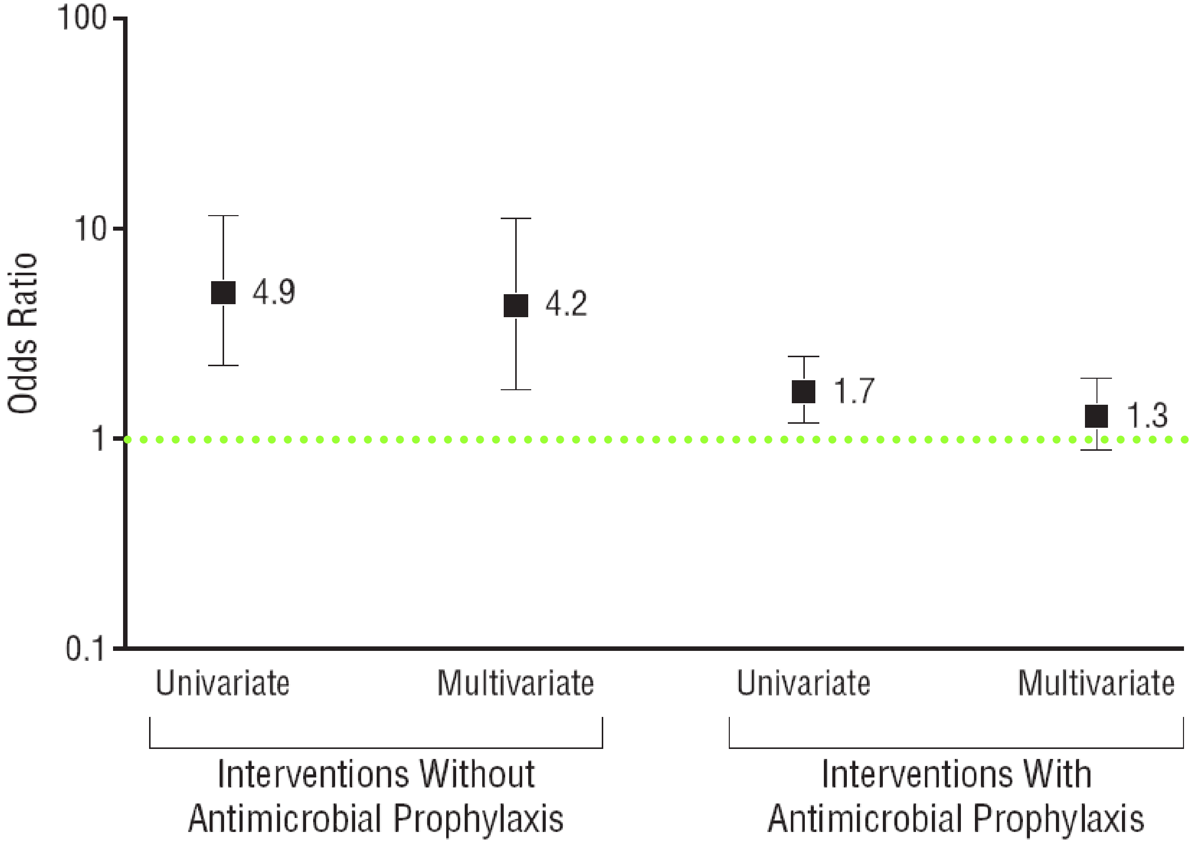
Table. Patient and Procedure Characteristics and Incidence of SSI by Glove Integrity

Characteristic	No. (%) of Interventions[a] With Perforated Gloves	With Intact Gloves	P Value
Total	677 (100.0)	3470 (100.0)	<.001
SSIs	51 (7.5)	137 (3.9)	<.001
Surgical antimicrobial prophylaxis			<.006
Yes	605 (89.4)	2628 (75.7)	
No	72 (10.6)	842 (24.3)	
Sex			<.001
Female	292 (43.1)	1791 (51.6)	
Male	385 (56.9)	1679 (48.4)	
Age, y			.40
<30	56 (8.3)	284 (8.2)	
30-39	69 (10.2)	421 (12.1)	
40-49	89 (13.2)	490 (14.1)	
50-59	103 (15.2)	560 (16.1)	
60-69	137 (20.2)	597 (17.2)	
70-79	123 (18.2)	607 (17.5)	
80-89	87 (12.9)	417 (12.0)	
≥90	13 (1.9)	94 (2.7)	

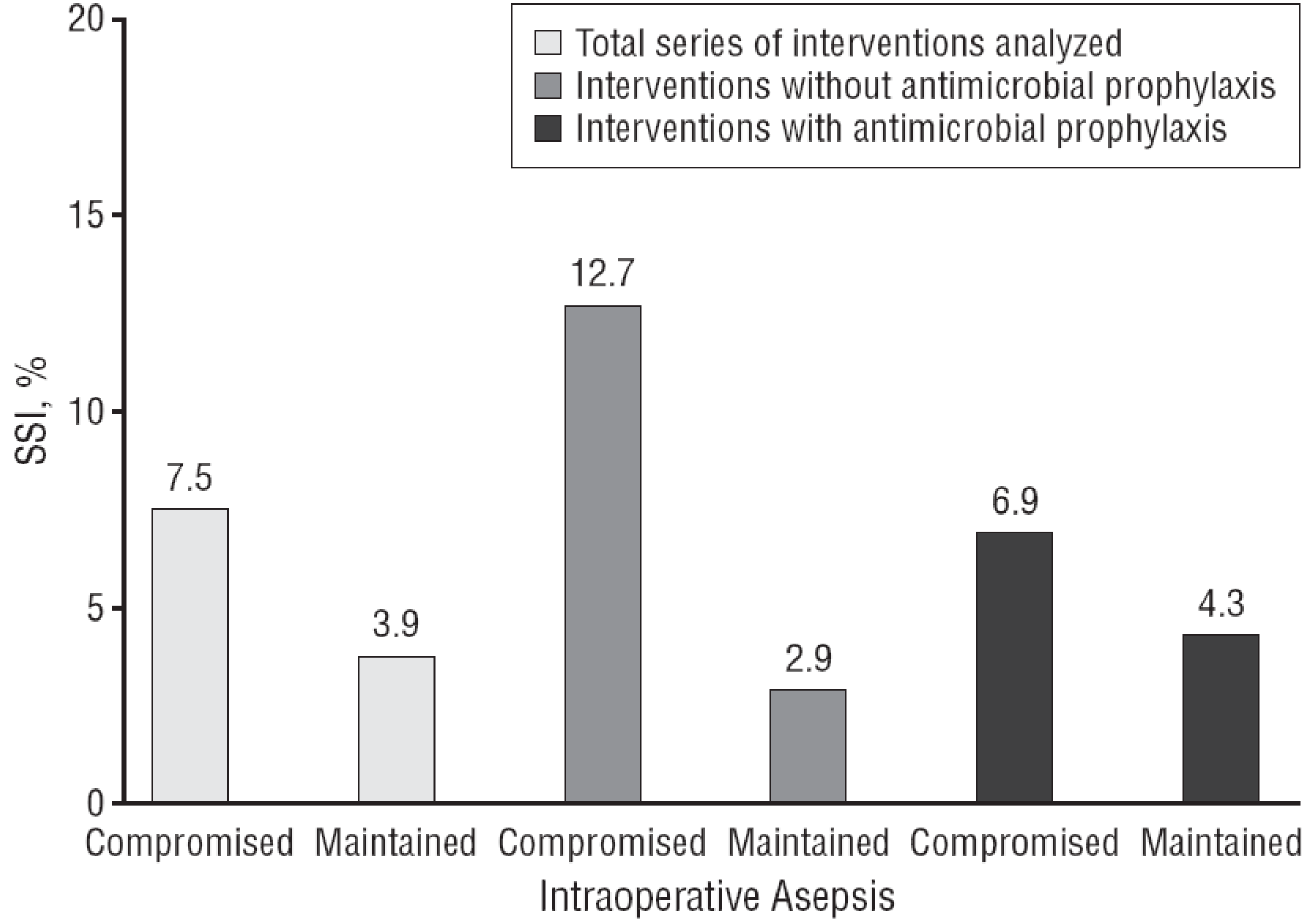
Table. Patient and Procedure Characteristics and Incidence of SSI by Glove Integrity

Characteristic	No. (%) of Interventions[a] With Perforated Gloves	With Intact Gloves	P Value
Division			.85
Visceral surgery	285 (42.1)	1501 (43.3)	
Traumatology	273 (40.3)	1377 (39.7)	
Vascular surgery	119 (17.6)	592 (17.1)	
ASA score			<.001
I	75 (11.1)	512 (14.8)	
II	281 (41.5)	1704 (49.1)	
III	263 (38.8)	1112 (32.0)	
IV	53 (7.8)	140 (4.0)	
V	5 (0.7)	2 (0.1)	
Wound class (class No.)			.51
Clean (1)	459 (67.8)	2372 (68.4)	
Clean contaminated (2)	133 (19.6)	625 (18.0)	
Contaminated (3)	85 (12.6)	473 (13.6)	
T time exceeded			<.001
Yes	286 (42.2)	553 (15.9)	
No	391 (57.8)	2917 (84.1)	
Duration of surgery, h			<.001
≤2	279 (41.2)	2697 (77.7)	
>2	398 (58.8)	773 (22.3)	

Odds Ratio : perforations vs %ISO



% ISO vs perforation des gants

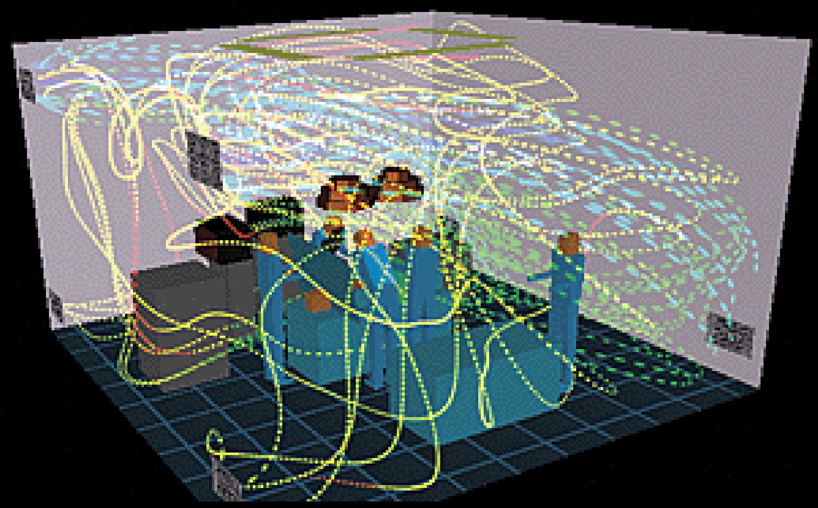


La contamination par les mains des opérateurs ?

- La friction hydro-alcoolique n'éradique pas les bactéries
- Les gants –même doubles- deviennent perméables
- Cette perméabilité est associée
  - A un taux d'ISO supérieur
  - A une exposition du personnel

Toute différence est abolie par l'antibioprophylaxie

Air quality control : basic concepts



- Positive pressure room
- HEPA filtered air
  - turbulent flow (non directionnal)
  - vertical laminar flow
    - suggested in the '60s
    - evaluated prior to the establishment of antibiotic prophylaxis
    - expensive and fragile
    - sole mean of keeping ISO 5 air purity level during use (microbiological superiority)
- Body exhaust suits

Air quality control : evidence based

TABLE 1. Studies Evaluating the Association Between the Presence of Laminar Airflow Systems (LAS) and Body Exhaust Suits (BES) and Infectious Outcomes After Total Knee Replacement (TKR) and Total Hip Replacement (THR)

Study	Study period	No. of subjects	Design	Follow-up period	Outcome studied	Findings	Relative risk (95% CI)	Notes
Nelson[1]	1971-1976	4,000	Comparison before and after installation of LAS and BES; all clean orthopedic surgical procedures were analyzed	≥1 year	Deep infection	Reduction in infection risk from 7.6% to 1.6% with LAS, further decrease to 0% with use of helmet aspirator	LAS, 0.25 (0.09-0.66); BES, NA, no infections	Use of prophylactic antibiotics became more common after LAS and BES were installed
Lidwell et al.[2]	1974-1979	8,055	Multicenter; LAS use was randomized within centers, and BES use was not formally randomized and varied between centers; TKR and THR were analyzed	Variable, mean of 2.0-2.5 years	Deep sepsis requiring subsequent operation	Use of LAS reduced infection risk from 1.5% to 0.6%; use of BES reduced infection risk from 1.5% to 0.8%	LAS, 0.38 (0.24-0.61); BES, 0.57 (0.38-0.84)	Did not control for antibiotic use (in approximately two thirds of procedures)
Salvati et al.[3]	1972-1978	3,175	Single center; 1 operating room had horizontal LAS, 2 did not; methods were not randomized; TKR and THR were analyzed	Variable, 1-7 years	Culture-positive drainage from wound	LAS reduced THR infection risk from 1.4% to 0.9% but increased TKR infection risk from 1.4% to 3.9%	LAS: THR, 0.64 (0.32-1.2); TKR, 2.0 (0.91-4.6)[a]	BES not used; antibiotic use not reported
Fitzgerald[4]	1981-1990	7,305	Randomized use of horizontal LAS; TKR and THR were analyzed	Variable, <1 year to 8 years	Deep sepsis	LAS did not improve infection risk of 0.5%	LAS, 1.1 (0.60-2.1)	BES not used; all subjects received prophylactic antibiotics
Marotte et al.[5]	1974-1985	2,384	Single center; sterile enclosure was compared with a turbulent airflow system; methods were not randomized; THR was analyzed	≥18 months	Deep sepsis	Infection risk improved from 1.89% to 1.11%; not statistically significant	LAS, 0.59 (0.33-1.03)	Prophylactic antibiotics used after 1979

NOTE. CI, confidence interval.
[a] The effects of LAS were analyzed separately for TKR and THR.

Miner, et al.. 2007. Deep Infection After Total Knee Replacement: Impact of Laminar Airflow Systems and Body Exhaust Suits in the Modern Operating Room. Infection Control and Hospital Epidemiology **28:**222-226.

Air quality control : evidence based

TABLE 2. Frequency of Deep Infection After Total Knee Replacement in 4 US States, According to the Presence or Absence of Laminar Airflow Systems and Body Exhaust Suits

Infection control method	No. of hospitals	No. of procedures	No. of infections	90-Day cumulative incidence, % (95% CI)	Risk ratio (95% CI)
Laminar airflow system					
Without	178	4,775	13	0.27 (0.12-0.42)	1.0
With	78	3,513	15	0.43 (0.21-0.64)	1.57 (0.75-3.31)
Body exhaust suit					
Without	152	4,750	18	0.38 (0.20-0.55)	1.0
With	104	3,538	10	0.28 (0.11-0.46)	0.75 (0.34-1.62)

NOTE. CI, confidence interval.

Miner, et al.. 2007. Deep Infection After Total Knee Replacement: Impact of Laminar Airflow Systems and Body Exhaust Suits in the Modern Operating Room. Infection Control and Hospital Epidemiology **28:**222-226.

Une hypothèse physiopathologique ?

- L'antibioprophylaxie administrée est confinée au compartiment sérique
- La bactériémie peropératoire cutanée serait majeure,
- D'origine cutanée ou digestive
- Toutes les infections seraient bactériémiques
- Précoces, tardives, retardées…

- Mais pas de preuve clinique ou microbiologique !

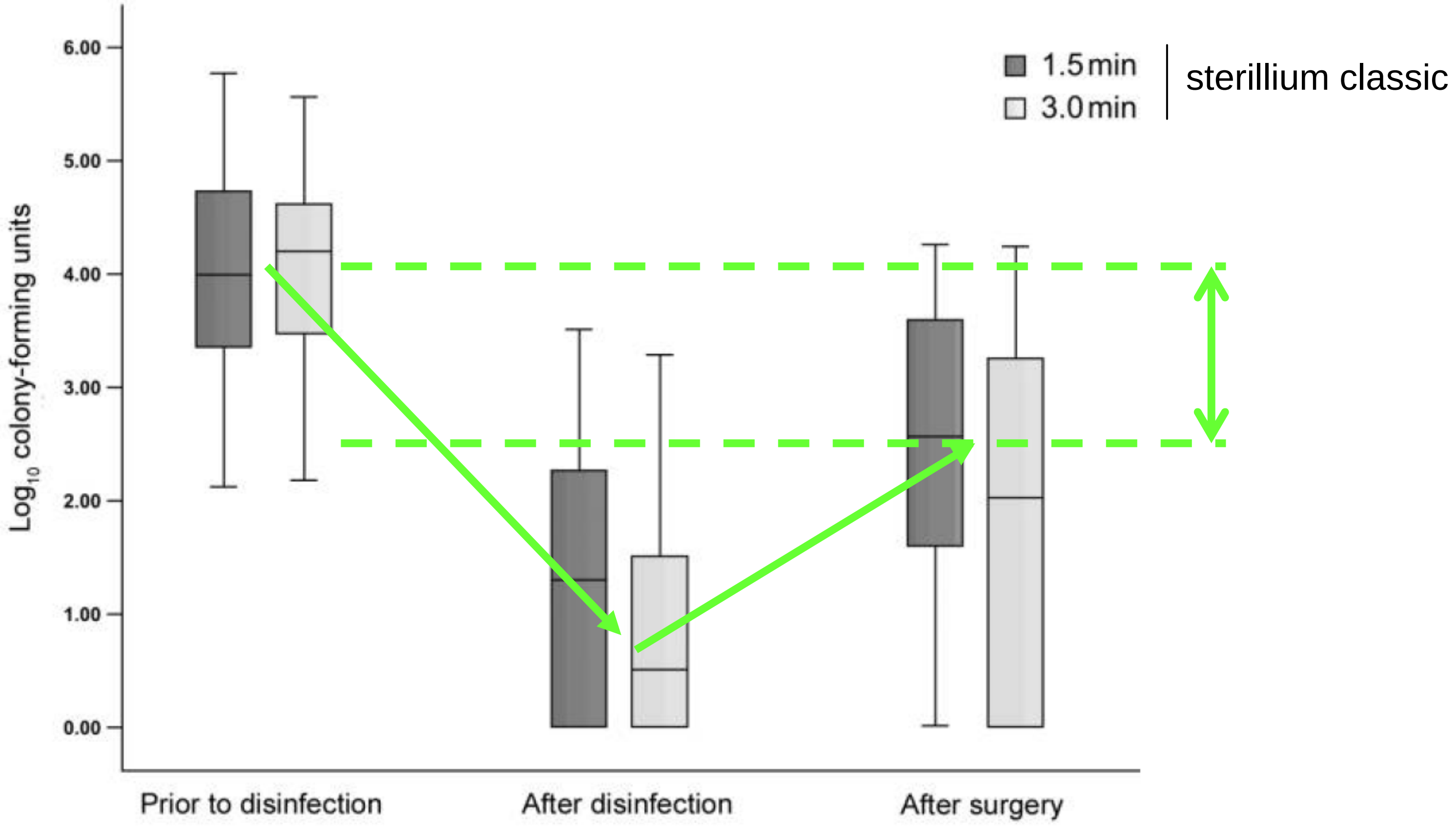
Remerciements

- Services d’orthopédie-traumatologie
  - Hôpital Raymond Poincaré
  - Hôpital Ambroise Paré
- Equipe opérationnelle d’hygiène
  - Hôpital Raymond Poincaré
  - C. Lawrence

Lavage chirurgical des mains

- Des années de « scrubbing » avec iodophores
- Equivalence ou supériorité de la friction hydro-alcoolique
  - Efficacité sur la flore transitoire
  - Efficacité moindre sur la flore résidente

Friction hydro-alcoolique 1,5’ vs 3’ avant-après chirurgie



Vers une réponse technologique ?

- Le gluconate de chlorhexidine n’est pas utile en friction
- Mais en application prolongée ?
- Les gants AMT peuvent ils diminuer le risque d’ISO ?

- Nécessité d’études cliniques en arthroplastie ???
- Contrôle de l’activité bactériostatique sur les mains

Friction hydro-alcoolique 1' vs 3' vs 5'
effet immédiat et à 3h

Table 1. Influence of the length of surgical hand antisepsis with n-propanol 60% (vol/vol) and isopropanol 70% (vol/vol) on the *immediate* effects

Alcohol and concentration % (vol/vol)	Mean (N = 21) log reduction (standard deviation)						Trend 1 → 3 → 5
	Length of application (min)						
	1	1 vs 3	3	3 vs 5	5	5 vs 1	
n-propanol 60	1.05 (0.65)	$P \leq .01$*	2.03 (0.99)	n.s.	2.30 (1.30)	$P \leq .01$*	<.001
isopropanol 70	0.74 (0.65)	$P \leq .01$*	1.48 (0.88)	n.s.	2.12 (0.96)	$P \leq .01$*	<.001

ns, Not significant ($P > .01$).
*Significant ($P \leq .01$).

Table 2. Influence of the length of surgical hand antisepsis with n-propanol 60% (vol/vol) and iso-propanol 70% (vol/vol) on the 3-hours effects

Alcohol and concentration % (vol/vol)	Mean (N = 21) log reduction (standard deviation)						Trend 1 → 3 → 5
	Length of application (min)						
	1	1 vs 3	3	3 vs 5	5	5 vs 1	
n-propanol 60	0.45 (0.49)	$P \leq .01$*	1.01 (0.52)	n.s.	1.60 (0.99)	$P \leq .01$*	<.001
isopropanol 70	0.19 (0.59)	$P \leq .01$*	0.79 (0.56)	n.s.	1.03 (0.67)	$P \leq .01$*	<.001

n.s., Not significant ($P > .01$).
*Significant ($P \leq .01$).

Am J Infect Control. 2009 May;37(4):289-93.

Ajout de Chlorhexidine à la friction
peu de bénéfices immédiat ou retardé

TABLE. Effects of 3-Minute Applications of Surgical Hand Rubs With 3 Alcohol-Based Preparations (A, B, C) and a Reference Disinfection Formulation (R) on the Microbial Population Kinetics of Gloved Hands

		Mean log reduction factor ± SD, by time after application			
Preparation	Active ingredient(s)	Hour 0	Hour 1	Hour 3	Hour 6
A	1-propanol 60% vol/vol	3.1 ± 0.9	2.9 ± 1.2	2.2 ± 0.9	1.1[a] ± 1.0[b]
B	2-propanol 70% + CHG 0.5% wt/wt	2.7 ± 1.2	2.3 ± 1.1[c]	1.7 ± 1.2[c]	1.1 ± 0.8[b]
C	1-propanol 30% + 2-propanol 45% + MES 0.2% wt/wt	3.5 ± 1.2	3.4 ± 1.1	2.8 ± 1.3[d]	1.5[a] ± 1.0[b]
R	1-propanol 60% vol/vol	3.3 ± 1.0	2.6 ± 1.3	1.8[a] ± 0.8	0.9[a] ± 0.7[b]

Rotter et al. Infect Control Hosp Epidemiol. 2007 Mar;28(3):346-50

Le lavage chirurgical des mains

- Permet de diminuer la charge bactérienne (1/100)
- Les différentes solutions sont équivalentes
- L'effet s'estompe avec le temps

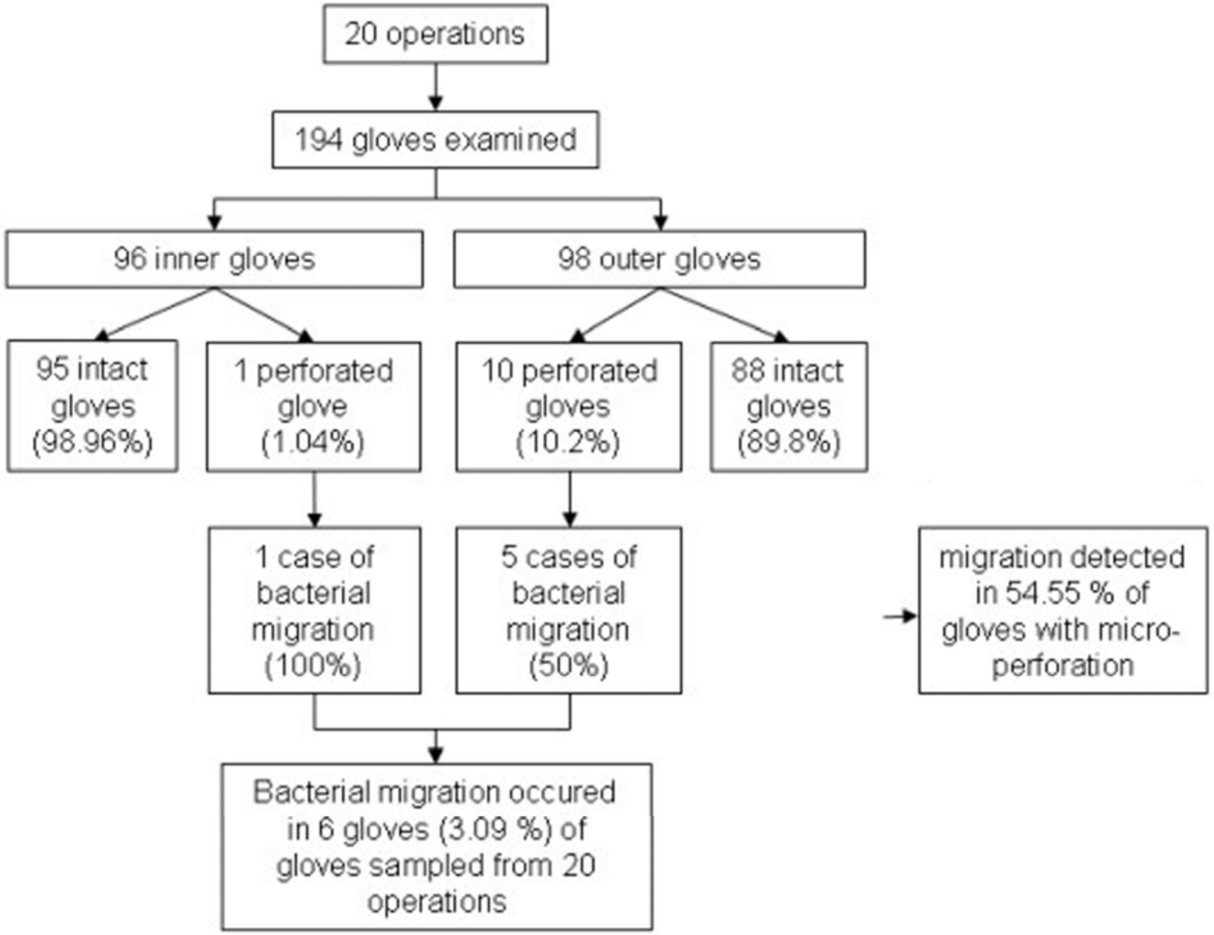
- En fin d'intervention, la diminution n'est plus que de 1/10

Etudes des perforations des gants

- pas d'étude clinique vs ISO
- études microbiologiques

- Etude avec indicateur de perforation

Detection du passage bactérien dehors en dedans



Detection du passage bactérien dehors en dedans

Table 2: Migration of bacteria from the operation site through punctures in surgical gloves

Number	Surgical team member	Duration of wear (minutes)	Location/site of perforation	organisms found in the glove	organisms found in the wound
1	surgeon	72	Index finger, right*	CNS	CNS, Strep. spp.
2	surgeon	65	between ring and little finger, left*	E. coli, Proteus penneri	E. coli, Proteus penneri, CNS
3	surgeon	90	Index finger, left*	CNS	CNS
4	surgeon	62	Thumb, left*	E. coli strain A and B	E. coli strain A, B and C
5	surgeon	70	Index finger, left*	Enterococcus cloacae	Enterococcus cloacae
6	surgeon	72	Thumb, left**	M. luteus	CNS, Strep. spp.

Number 1-5: bacterial migration through puncture of outer glove; 6: bacterial migration from surgeon's hand through puncture of inner glove; * outer glove punctured, ** inner glove punctured

Detection du passage bactérien dehors en dedans

Concentration of bacteria passing through puncture holes in surgical gloves

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Background: The reasons for gloving-up for surgery are to protect the surgical field from microorganisms on the surgeon's hands and protect the surgeon from the patient's microorganisms. This study measured the concentration of bacteria passing through glove punctures under surgical conditions.

Methods: Double-layered surgical gloves were worn during visceral surgeries over a 4-month period. The study included 128 outer gloves and 122 inner gloves from 20 septic laparotomies. To measure bacterial passage though punctures, intraoperative swabs were made, yielding microorganisms that were compared with microorganisms retrieved from the inner glove layer using a modified Gaschen bag method.

Results: Depending on the duration of glove wear, the microperforation rate of the outer layer averaged 15%. Approximately 82% of the perforations went unnoticed by the surgical team. Some 86% of perforations occurred in the nondominant hand, with the index finger being the most frequently punctured location (36%). Bacterial passage from the surgical site through punctures was detected in 4.7% of the investigated gloves.

Conclusion: Depending on the duration of wear, surgical gloves develop microperforations not immediately recognized by staff. During surgery, such perforations allow passage of bacteria from the surgical site through the punctures. Possible strategies for preventing passage of bacteria include strengthening of glove areas prone to punctures and strict glove changing every 90 minutes.

Key Words: Surgical glove; double-gloving; (micro-) perforation; bacterial transmission; crossinfection.

Detection du passage bactérien dehors en dedans

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Table 1. Correlation between duration of glove wear and frequency of glove perforation

Duration of wear, minutes	Examined gloves	Inner gloves	Outer gloves	Perforated gloves, n (%)	Perforated inner layers, n (%)	Perforated outer layers, n (%)
<90 minutes (group 1)	86	40	46	4 (4.7%)	0	4 (8.7%)
91 to 150 minutes (group 2)	84	42	42	20 (23.8%)	8 (19.0%)	12 (28.6%)
>151 minutes (group 3)	80	40	40	21(26.3%)	10 (25.0%)	11 (27.5%)
Total	250	122	128	45 (18.0%)	18 (14.8%)	27 (21.1%)

Perméabilité des gants

- Jusqu'à ¼ de gants perforés en chirurgie viscérale
- La majorité des perforations concernent les 2 gants
- Un passage bactérien est documenté
  - du dehors vers le dedans
  - dans les laparotomies septiques