

# DU DIAGNOSTIC MICROBIOLOGIQUE À LA DÉFINITION DES IOA SUR MATÉRIEL

AURÉLIEN DINH

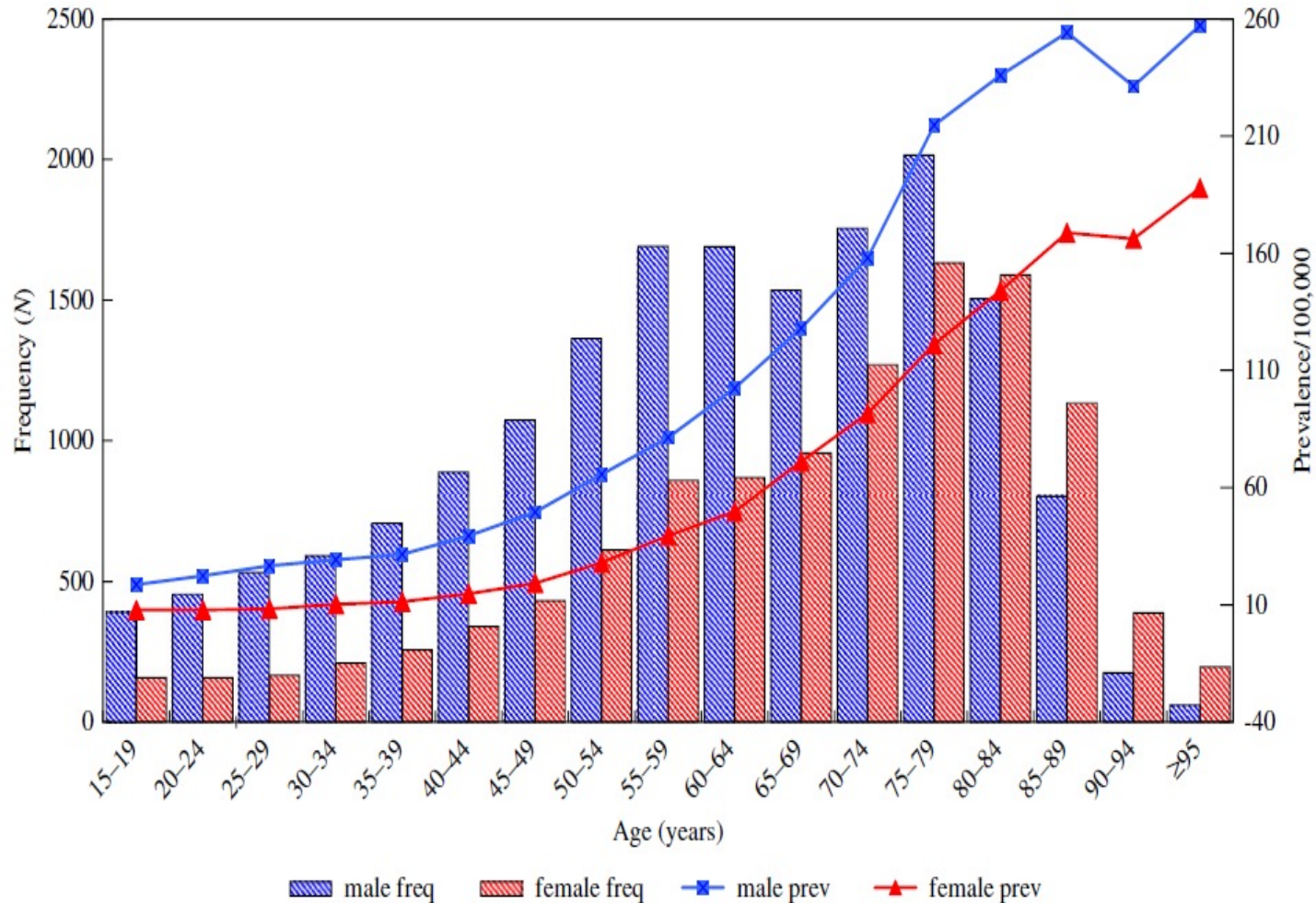
Maladies Infectieuses Et Tropicales

Hôpital Raymond-Poincaré, AP-HP

Université Paris Saclay

# ÉPIDÉMIOLOGIE

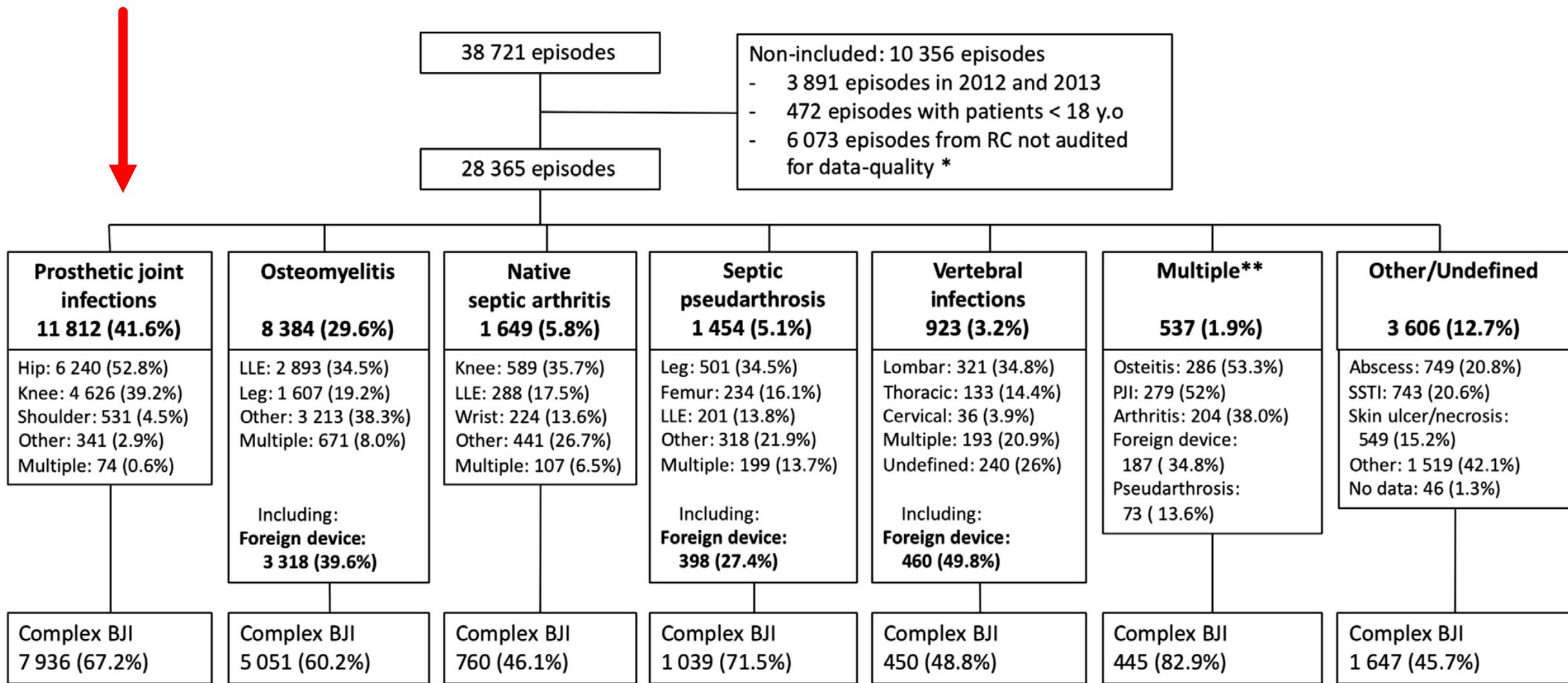
L. Grammatico-Guillon et al. / Journal of Hospital Infection 82 (2012) 40–48



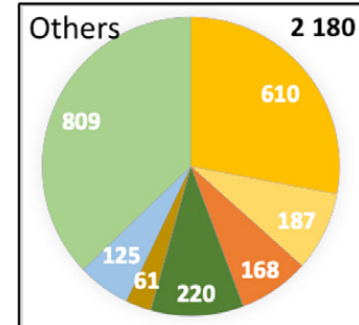
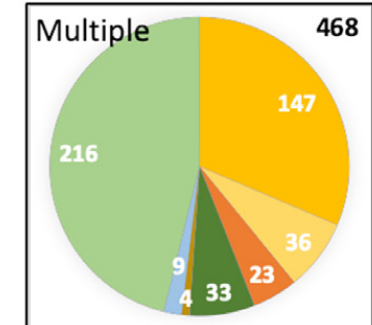
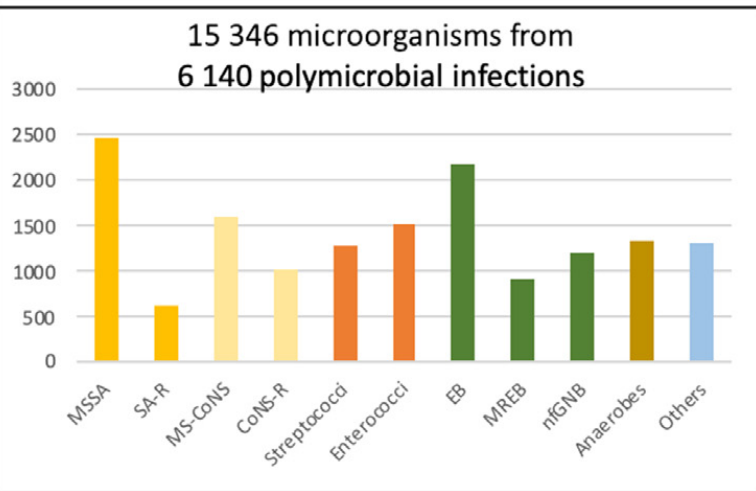
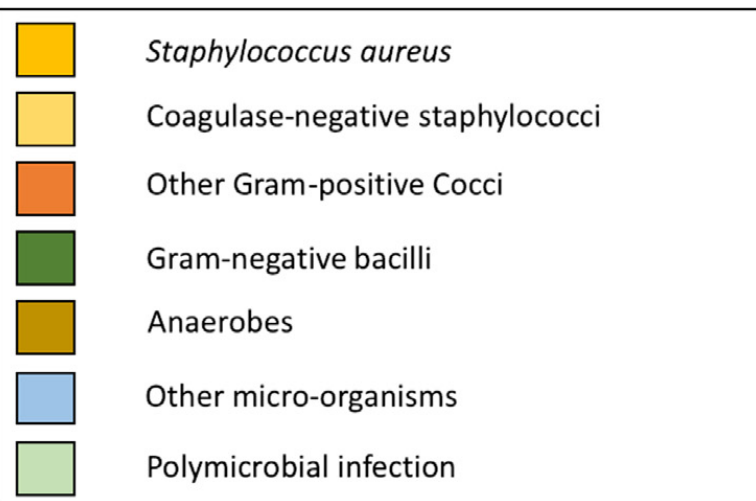
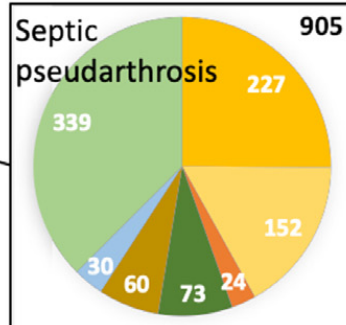
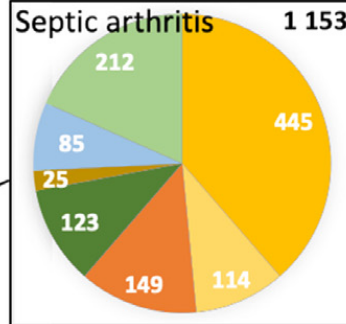
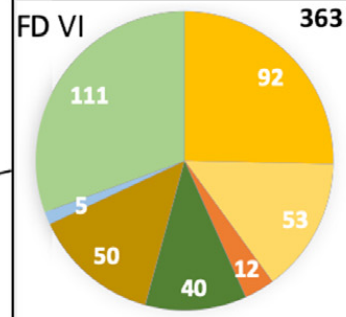
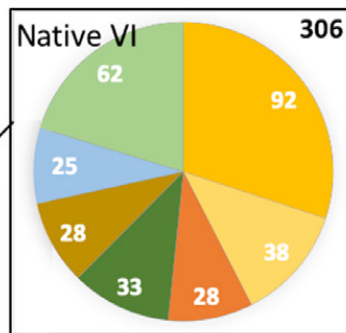
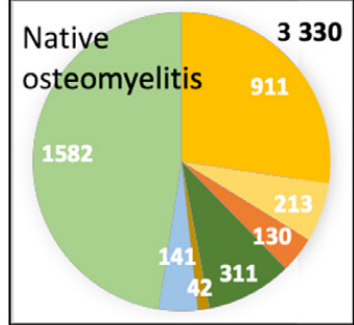
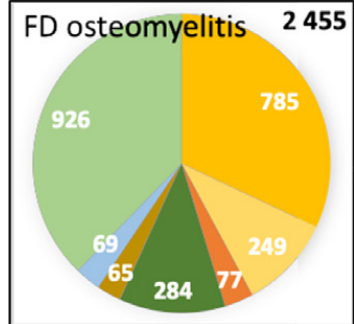
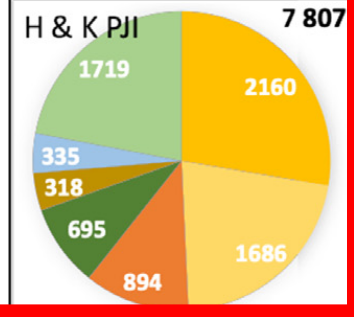
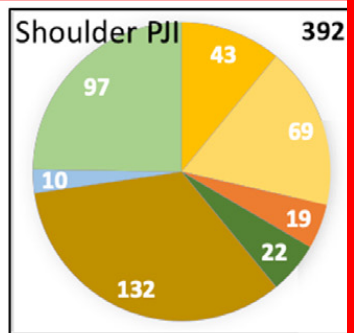
■ IOA en France : 36 000 séjours en 2008

■ Matériel étranger augmente

- Durée hospitalisation
- Nombre de réhospitalisations
- Mortalité



19 574 documented infections



# Does This Adult Patient Have Septic Arthritis?

Mary E. Margaretten, MD  
Jeffrey Kohlwes, MD, MPH  
Dan Moore, PhD  
Stephen Bent, MD



**Table 3.** Sensitivity of Symptoms and Signs\*

Variable	No. of Studies	Sensitivity, % (95% CI)
Joint pain	2	85 (78-90)
History of joint edema	2	78 (71-85)
Fever	7	57 (52-62)
Sweats	2	27 (20-34)
Rigors	4	19 (15-24)

Abbreviation: CI, confidence interval.

\*With the exception of the study by Kortekangas et al,<sup>47</sup> the studies reviewed only included patients with septic arthritis, which permits calculation of only sensitivity and not specificity or likelihood ratios.

## Box 1. Differential Diagnosis for Acute Monoarthritis\*

Infection (bacterial, fungal, mycobacterial, viral, spirochete)  
Rheumatoid arthritis  
Gout  
Pseudogout  
Apatite-related arthropathy  
Reactive arthritis  
Systemic lupus erythematosus  
Lyme arthritis  
Sickle cell disease  
Dialysis-related amyloidosis  
Transient synovitis of the hip  
Plant thorn synovitis  
Metastatic carcinoma  
Pigmented villonodular synovitis  
Hemarthrosis  
Neuropathic arthropathy  
Osteoarthritis  
Intra-articular injury (fracture, meniscal tear, osteonecrosis)

\*Adapted from Klippel et al.<sup>18</sup>

# TSUKUYAMA CLASSIFICATION

Infection type/features	I. Positive intraoperative culture	II. Early postoperative infection	III. Acute hematogenic infection	IV. Late chronic infection
Symptoms start after baseline surgery	_____	Up to 4 weeks	After an asymptomatic period	After 4 weeks
Mechanism	_____	Exogenous	Hematogenic	Exogenous or hematogenic
Most common etiological agent	Coagulase-negative Staphylococci (epidermidis)	Staphylococci (Coagulase-positive and negative), Gram-negative Bacilli	Coagulase-positive Staphylococci +, Streptococci	Staphylococci (Coagulase-positive and negative), Gram-negative Bacilli
Clinical presentation	Painful arthroplasty	Fever, inflammatory signs, persistent drainage, no sinus tract	Fever, inflammatory signs, no sinus tract	Fever, sinus tract, drainage, pus accumulation, local edema



## Twenty common errors in the diagnosis and treatment of periprosthetic joint infection

Cheng Li<sup>1</sup> · Nora Renz<sup>1</sup> · Andrej Trampuz<sup>1</sup> · Cristina Ojeda-Thies<sup>2</sup>

	Acute PJI (immature biofilm)	Chronic PJI (mature biofilm)
Pathogenesis		
- Peri-operative	< 4 weeks after surgery	≥ 4 weeks after surgery (typically 3 months–3 years)
- Haematogenous or contiguous	< 3 weeks of symptoms	≥ 3 weeks of symptoms
Clinical features	<i>Acute pain</i> , fever, red/swollen joint, prolonged postoperative discharge (> 7–10 days)	<i>Chronic pain</i> , loosening of the prosthesis, sinus tract (fistula)
Causative micro-organism	<i>High-virulent: Staphylococcus aureus</i> , gram-negative bacteria (e.g., <i>Escherichia coli</i> , <i>Klebsiella</i> , <i>Pseudomonas aeruginosa</i> )	<i>Low-virulent: coagulase-negative staphylococci</i> (e.g., <i>Staphylococcus epidermidis</i> ), <i>Cutibacterium acnes</i>
Surgical treatment	<i>Debridement and retention of prosthesis</i> (change of mobile parts)	<i>Complete removal of prosthesis</i> (exchange in one or two stages)

# DÉFINITION IDSA

## **2013 Infectious Diseases Society of America (IDSA) definition**

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### **PJI: at least one criterion needs to be fulfilled**

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1. Communicating sinus tract
  2. Visible purulence surrounding the prosthesis
  3. Positive histological analysis of periprosthetic tissue
  4.  $\geq 2$  positive tissue cultures or a combination of positive synovial fluid culture and tissue culture with phenotypically identical microorganisms
  5.  $\geq 1$  virulent microorganism (e.g. *Staphylococcus aureus*) of tissue culture or synovial fluid culture
-



## 2018 International Consensus Meeting (ICM) definition

### Major criteria (PJI: at least one criterion needs to be fulfilled)

1. Two positive cultures of the same organism
2. Sinus tract with evidence of communication to the joint or visualization of the prosthesis

### Minor criteria

#### Preoperative diagnosis

##### Serum

- |  | <b>Score</b> | <b>Decision</b> |
|--|--------------|-----------------|
| 1. Elevated CRP (> 10 mg/l) or D-dimer (> 860 ng/ml) | 2            |                 |
| 2. Elevated ESR (> 30 mm/h)                          | 1            | ≥ 6: infected   |

##### Synovial

- |  |   |                            |
|--|---|----------------------------|
| 3. Elevated synovial WBC (> 3,000 cells/μl) or LE (++)   | 3 | 2 to 5: possibly infected* |
| 4. Positive alpha-defensin (signal-to-cut-off ratio > 1) | 3 | 0 to 1: not infected       |
| 5. Elevated synovial PMN% (> 80%)                        | 2 |                            |
| 6. Elevated synovial CRP (> 6.9 mg/l)                    | 1 |                            |

#### Intraoperative diagnosis

- |                            |   |                            |
|----------------------------|---|----------------------------|
| 1. Preoperative score      | - | ≥ 6: infected              |
| 2. Positive histology      | 3 | 2 to 5: possibly infected† |
| 3. Positive purulence      | 3 | 0 to 1: not infected       |
| 4. Single positive culture | 2 |                            |

## EBJIS criteria for the diagnosis of clinically suspected periprosthetic joint infection

	<b>Infection unlikely (all findings negative)</b>	<b>Infection likely (two positive findings)<sup>a</sup></b>	<b>Infection confirmed (any positive finding)</b>
<b>Clinical and blood workup</b>			
Clinical features	Clear alternative reason for implant dysfunction (e.g. fracture, implant breakage, malposition, tumour)	<ol style="list-style-type: none"> <li>1. Radiological signs of loosening within the first 5 yrs after implantation</li> <li>2. Previous wound healing problems</li> <li>3. History of recent fever or bacteraemia</li> <li>4. Purulence around the prosthesis<sup>b</sup></li> </ol>	Sinus tract with evidence of communication to the joint or visualization of the prosthesis
CRP		> 10 mg/l (1 mg/dl) <sup>c</sup>	
<b>Synovial fluid cytological analysis<sup>d</sup></b>			
Leukocyte count (cells/ $\mu$ l) <sup>c</sup>	$\leq$ 1,500	> 1,500	> 3,000
PMN% <sup>c</sup>	$\leq$ 65%	> 65%	> 80%
<b>Synovial fluid biomarkers</b>			
Alpha-defensin <sup>e</sup>			Positive immunoassay or lateral-flow assay
<b>Microbiology<sup>f</sup></b>			
Aspiration fluid		Positive culture	
Intraoperative (fluid and tissue)	All cultures negative	Single positive culture <sup>g</sup>	$\geq$ 2 positive samples with the same microorganism
Sonication <sup>h</sup> (CFU/ml)	No growth	> 1 CFU/ml of any organism <sup>g</sup>	> 50 CFU/ml of any organism
<b>Histology<sup>c,i</sup></b>			
HPF (400 $\times$ magnification)	Negative	Presence of $\geq$ 5 neutrophils in a single HPF	Presence of $\geq$ 5 neutrophils in $\geq$ 5 HPF Presence of visible microorganisms
<b>Others</b>			
Nuclear imaging	Negative 3-phase Isotope Bone Scan <sup>c</sup>	Positive WBC scintigraphy <sup>i</sup>	

# TESTS PRÉOPÉRATOIRES

Test	Joint(s)	Threshold value or finding	Sensitivity (%)	Specificity (%)	+ LR	− LR	Diagnostic odds ratio	Cost	Description (reference)
Peripheral blood									
WBC	Hip and knee	11,000 × 10 <sup>9</sup> cells/liter <sup>a</sup>	45	87	3.5	0.6	5.5	\$	MA of 1,796 patients in 15 studies (253)
CRP	Hip and knee	10 mg/liter <sup>a</sup>	88	74	3.4	0.2	20.9	\$	MA of 3,225 patients in 23 studies (253)
ESR	Hip and knee	30 mm/h <sup>a</sup>	75	70	2.5	0.4	7.0	\$	MA of 3,370 patients in 25 studies (253)
IL-6	Hip and knee	10 pg/ml <sup>a</sup>	97	91	10.8	0.0	326.9	\$	MA of 432 patients in 3 studies (253)
Procalcitonin	Hip and knee	0.3 ng/ml	33	98	16.5	0.7	24.1	\$	Single study with 78 patients (262)
Imaging									
Plain radiograph	Hip	Lucency or periosteal new bone formation	75	28	1.0	0.9	1.2	\$	Single study with 65 patients (264)
Triple-phase bone scan	Late hip	Increased uptake in all 3 phases	88	90	8.8	0.1	66.0	\$\$\$	Single study with 46 patients (268)
Bone scan/labeled leukocyte scan	Late hip and knee	Incongruent images	64	70	2.1	0.5	4.1	\$\$\$	Single study with 166 patients (270)
FDG-PET scan	Hip and knee	Various	82.1	86.6	6.1	0.2	29.6	\$\$\$\$\$	MA of 11 studies with 635 patients (272)
Synovial fluid analysis									
Cell count	Knee	1,100 cells/μl	90.7	88.1	7.6	0.1	72.2	\$\$	Single study with 429 patients (273)
Neutrophil percentage	Knee	64%	95.0	94.7	17.9	0.1	339.5	\$\$	Single study with 429 patients (273)
Cell count	Hip	4,200 cells/μl	84.0	93.0	12.0	0.2	69.8	\$\$	Single study with 201 patients (276)
Neutrophil percentage	Hip	80%	84.0	82.0	4.7	0.2	23.9	\$\$	Single study with 201 patients (276)
Cell count	Knee (<6 wk after implantation)	27,800 cells/μl	84.0	99.0	84.0	0.2	519.7	\$\$	Single study with 146 patients (257)
Neutrophil percentage	Knee (<6 wk after implantation)	89%	84.0	69.0	2.7	0.2	11.7	\$\$	Single study with 146 patients (257)
Culture	Hip and knee		72.0	95.0	14.4	0.3	48.9	\$\$	MA of 34 studies with 3,332 patients (293)

## Diagnosing Periprosthetic Joint Infection

### Has the Era of the Biomarker Arrived?

Carl Deirmengian MD, Keith Kardos PhD,  
Patrick Kilmartin, Alexander Cameron, Kevin Schiller,  
Javad Parvizi MD

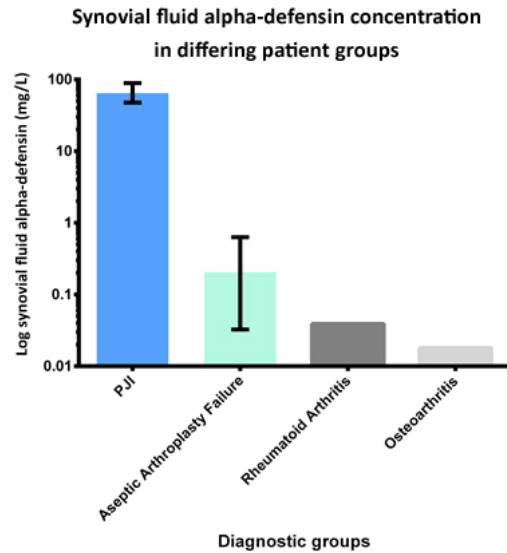
**Table 4.** Diagnostic characteristics of synovial fluid biomarkers

Biomarker	AUC	Cutoff	Specificity (%)	95% CI (%)	Sensitivity (%)	95% CI (%)
$\alpha$ -Defensin	1.000	4.8 $\mu$ g/mL	100	95–100	100	88–100
ELA-2	1.000	2.0 $\mu$ g/mL	100	95–100	100	88–100
BPI	1.000	2.2 $\mu$ g/mL	100	95–100	100	88–100
NGAL	1.000	2.2 $\mu$ g/mL	100	95–100	100	88–100
Lactoferrin	1.000	7.5 $\mu$ g/mL	100	95–100	100	88–100
IL-8	0.992	6.5 ng/mL	95	87–99	100	87–100
SF CRP	0.987	12.2 mg/L	97	90–100	90	73–98
Resistin	0.983	340 ng/mL	100	95–100	97	82–99
Thrombospondin	0.974	1061 ng/mL	97	90–100	90	73–98
IL-1 $\beta$	0.966	3.1 pg/mL	95	87–99	96	82–100
IL-6	0.950	2.3 ng/mL	97	89–100	89	71–98
IL-10	0.930	32.0 pg/mL	89	79–96	89	72–98
IL-1 $\alpha$	0.922	4.0 pg/mL	91	81–97	82	63–94
IL-17	0.892	3.1 pg/mL	99	92–100	82	63–94
G-CSF	0.859	15.4 pg/mL	92	82–97	82	62–94
VEGF	0.850	2.3 ng/mL	77	65–87	75	55–89

AUC = area under the curve;  $\alpha$ -defensin = human  $\alpha$ -defensin 1-3; ELA-2 = neutrophil elastase 2; BPI = bactericidal/permeability-increasing protein; NGAL = neutrophil gelatinase-associated lipocalin; SF = synovial fluid; CRP = C-reactive protein; G-CSF = granulocyte colony-stimulating factor; VEGF = vascular endothelial growth factor.

# TEST SYNOVASURE™

- Test qualitatif – immunochromatographie



- Réalisable au bloc ou en consultation sur liquide articulaire sans prétraitement

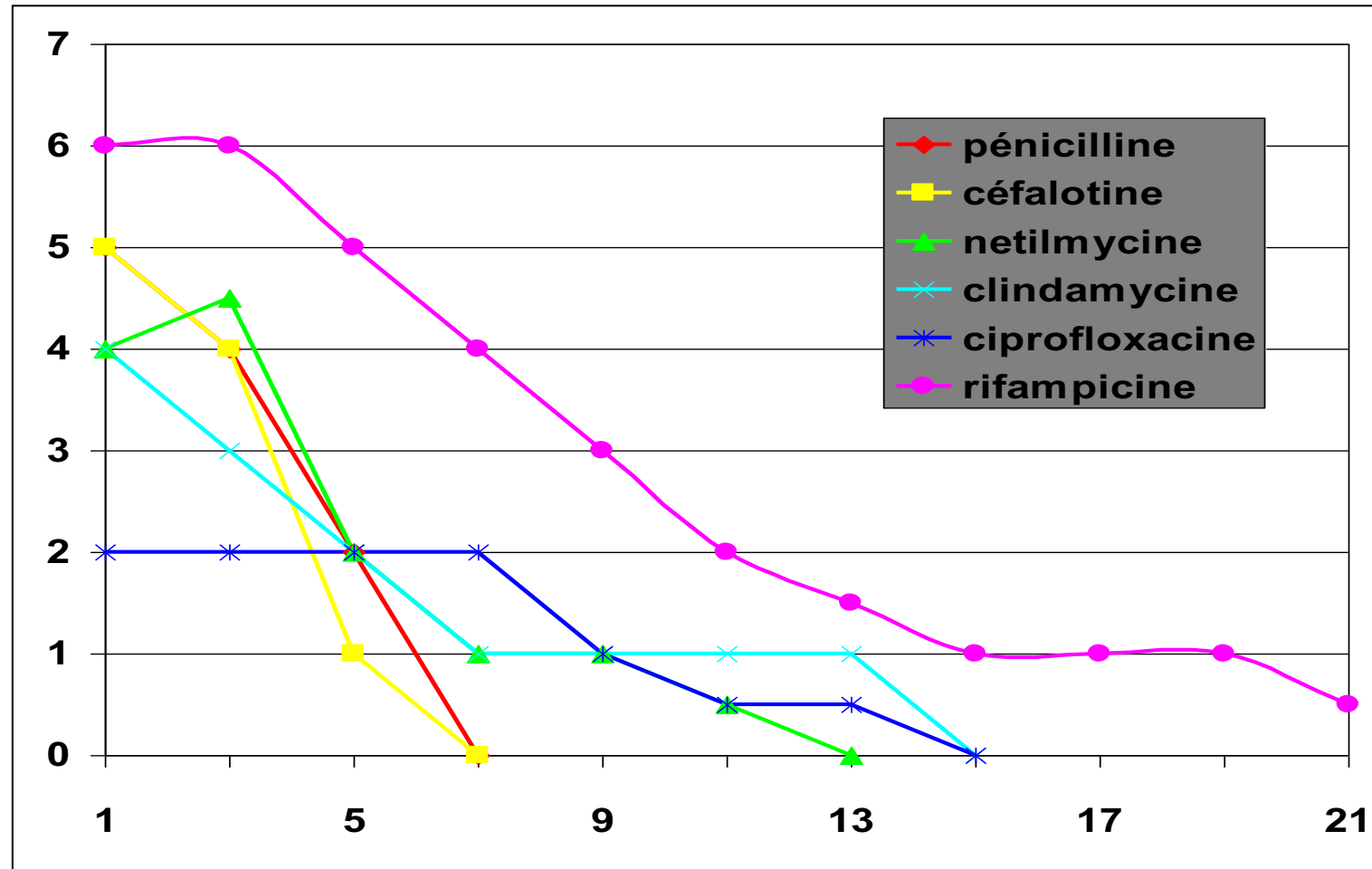
## IDENTIFICATION MICROBIOLOGIQUE = ESSENTIELLE

### ■ Car

- Traitement prolongé avec forte dose ATB/parfois IV
- Chez sujets âgés
- Taux d'effets indésirables

### ■ Fait partie du diagnostic (infection chronique)

# FENÊTRE ANTIBIOTIQUE AVANT BIOPSIE OSSEUSE



# CE QU'ON VEUT ÉVITER

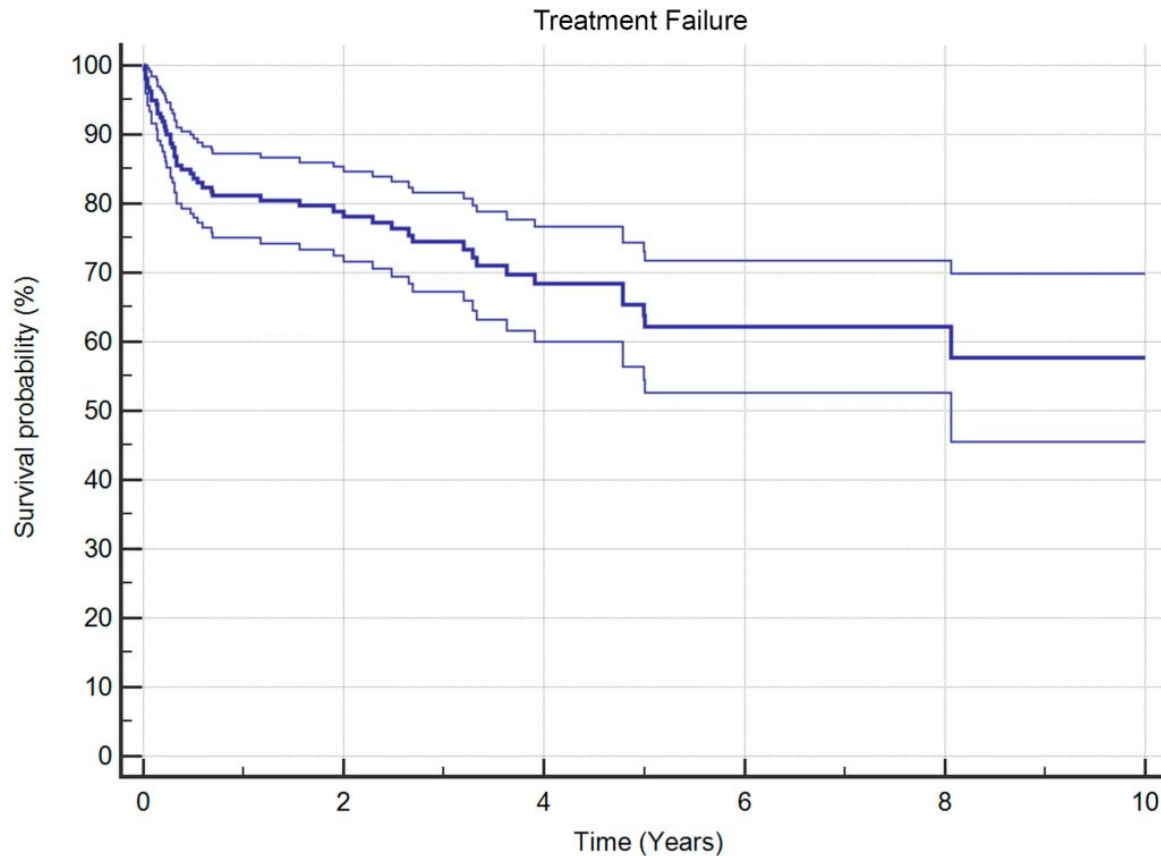
Infection	% of patients with prosthetic joint infection					
	Hip and knee					
	All time periods <sup>a</sup>	Early infection <sup>b</sup>	Hip <sup>c</sup>	Knee <sup>c</sup>	Shoulder <sup>d</sup>	Elbow <sup>e</sup>
<i>Staphylococcus aureus</i>	27	38	13	23	18	42
Coagulase-negative <i>Staphylococcus</i>	27	22	30	23	41	41
<i>Streptococcus</i> species	8	4	6	6	4	4
<i>Enterococcus</i> species	3	10	2	2	3	0
Aerobic Gram-negative bacilli	9	24	7	5	10	7
Anaerobic bacteria	4	3	9	5		
<i>Propionibacterium acnes</i>					24	1
Other anaerobes					3	0
Culture negative	14	10	7	11	15	5
Polymicrobial	15	31	14	12	16	3
Other	3					



# Culture-Negative Periprosthetic Joint Infection

An Update on What to Expect

Timothy L. Tan, MD, Michael M. Kheir, MD, Noam Shohat, MD, Dean D. Tan, BS, Matthew Kheir, BS,  
Chilung Chen, MD, and Javad Parvizi, MD, FRCS



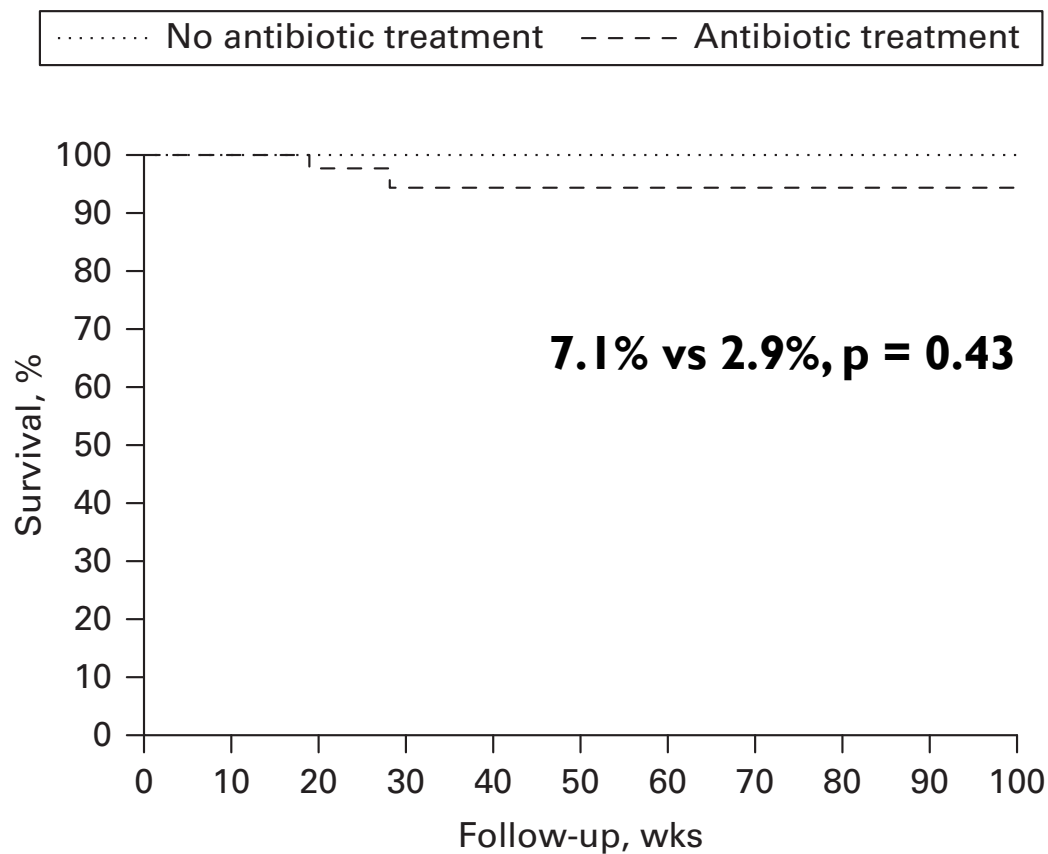
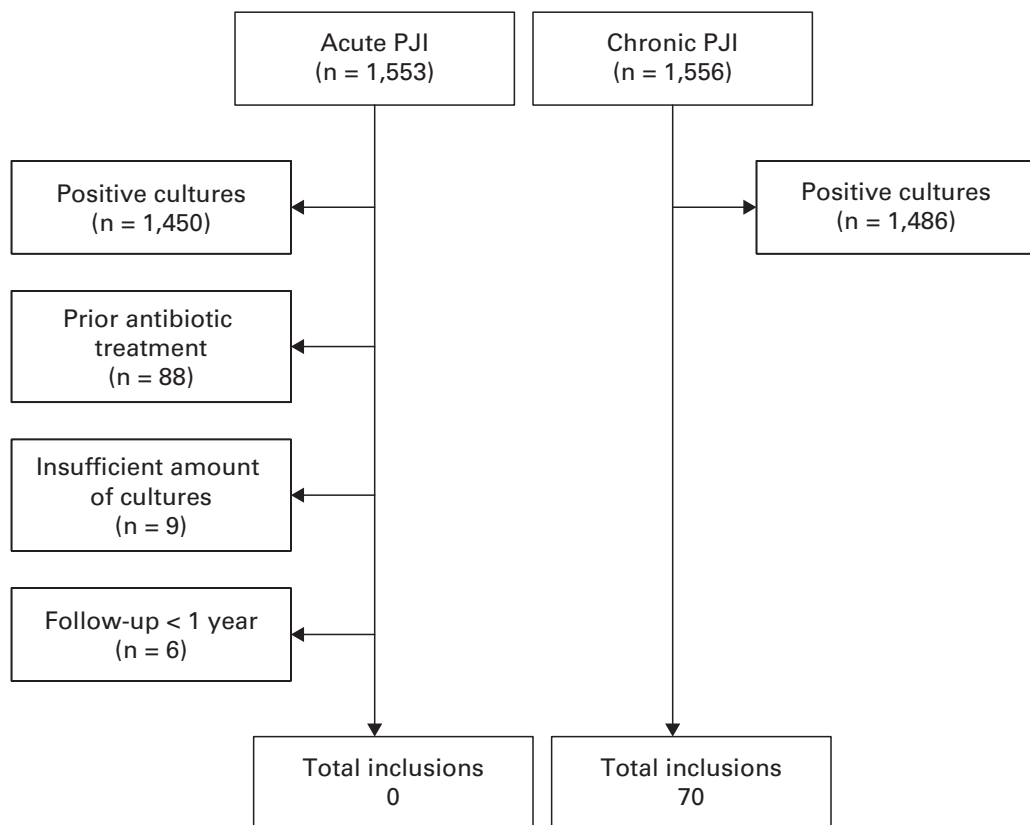
- PJI avec culture négative : 22.0%
- Taux d'échec 30,8% à 1 an
- 53,1% (26/49) secondairement une identification microbiologique



■ GENERAL ORTHOPAEDICS

# Should all patients with a culture-negative periprosthetic joint infection be treated with antibiotics?

A MULTICENTRE OBSERVATIONAL STUDY



**MICROBIOLOGY IS KEY !**

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MERCI

# PERFORMANCES DE LA CULTURE DE LA PONCTION

