

# Antibiothérapie locale Phagothérapie

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Centre de Référence des IOA complexes de Lyon (CRIOAc Lyon)



# Les antibiotiques en systémique

- Rôle **important** dans la prévention de l' infection de prothèse (réduction du risque de plus de 10% à <2%)
  - Antibioprophylaxie recommandée (SFAR)
  - Efficacité moindre en cas de reprise
  - Taux incompressible ?
- Rôle **important** dans le traitement de l' infection de prothèse :
  - Rôle majeur de la chirurgie
  - Rôle complémentaire de l' antibiothérapie pour traiter le(s) germe(s) retrouvé(s)
  - Notion d' antibiothérapie optimale (doses, voie d' administration, combinaisons)
  - Durée prolongée (> 6 semaines)

# Les antibiotiques locaux

- Rôle **potentiellement** intéressant dans la prévention de l' infection de prothèse
  - Prothèse de 1<sup>ère</sup> intention ?
  - Prothèse de révision ?
- Rôle **potentiellement** intéressant dans le traitement de l' infection de prothèse :
  - Utilisation de spacer aux antibiotiques dans le changement en 2 temps
  - Prothèse cimentée avec du ciment aux antibiotiques lors d'un changement en 1 temps

# Antibiotiques locaux

**IOA = infection locale**

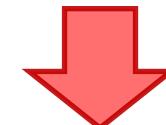
Légitime de vouloir agir localement



- Billes de gentamicine
- Chirurgie non optimal
- Faible relargage local
- Sans antibiothérapie systémique

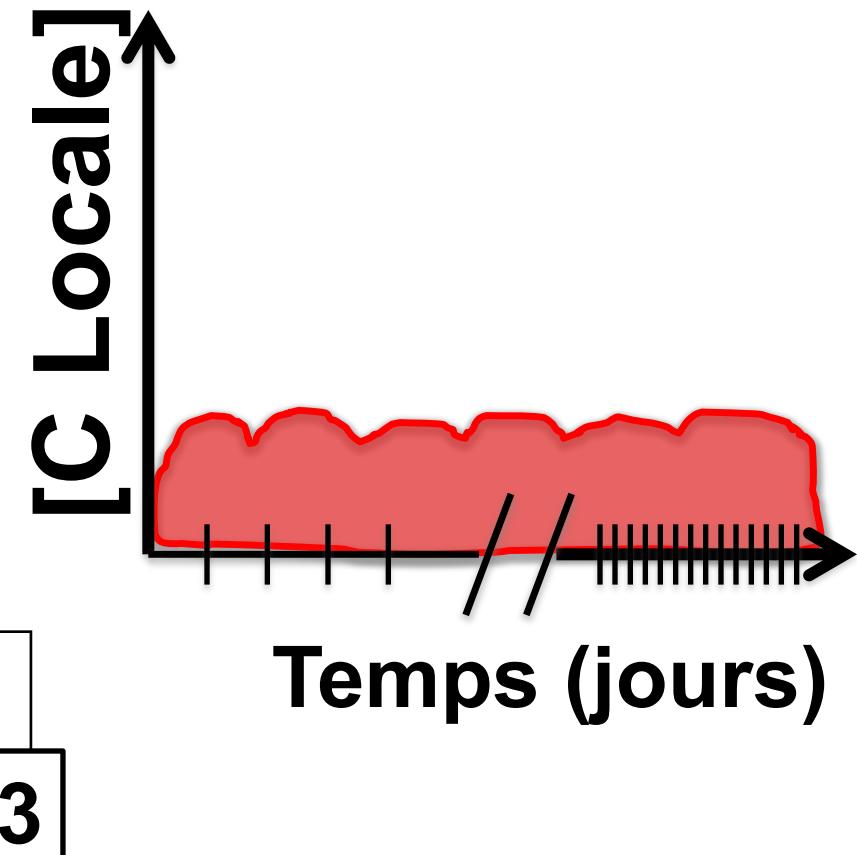
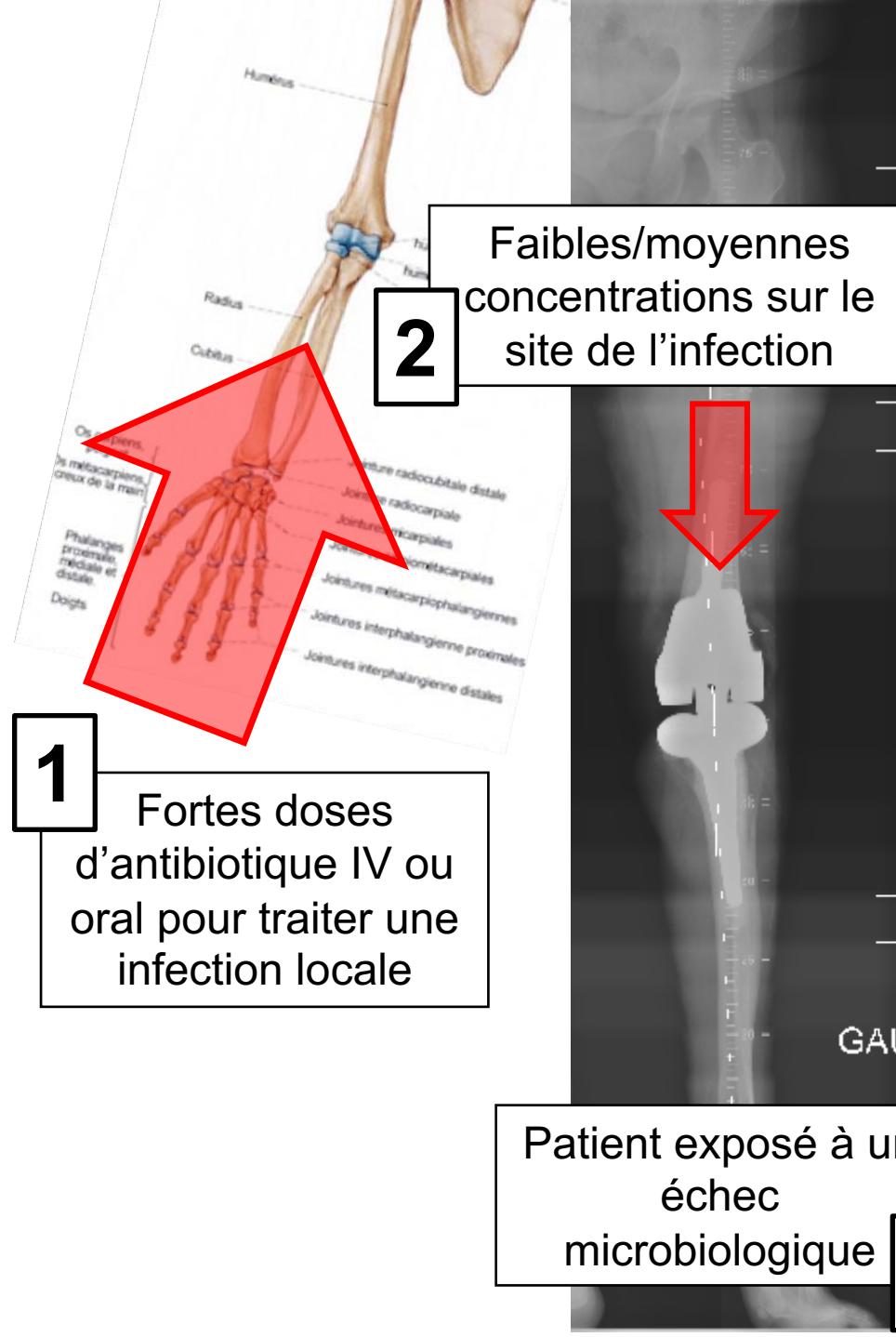


**Echec**

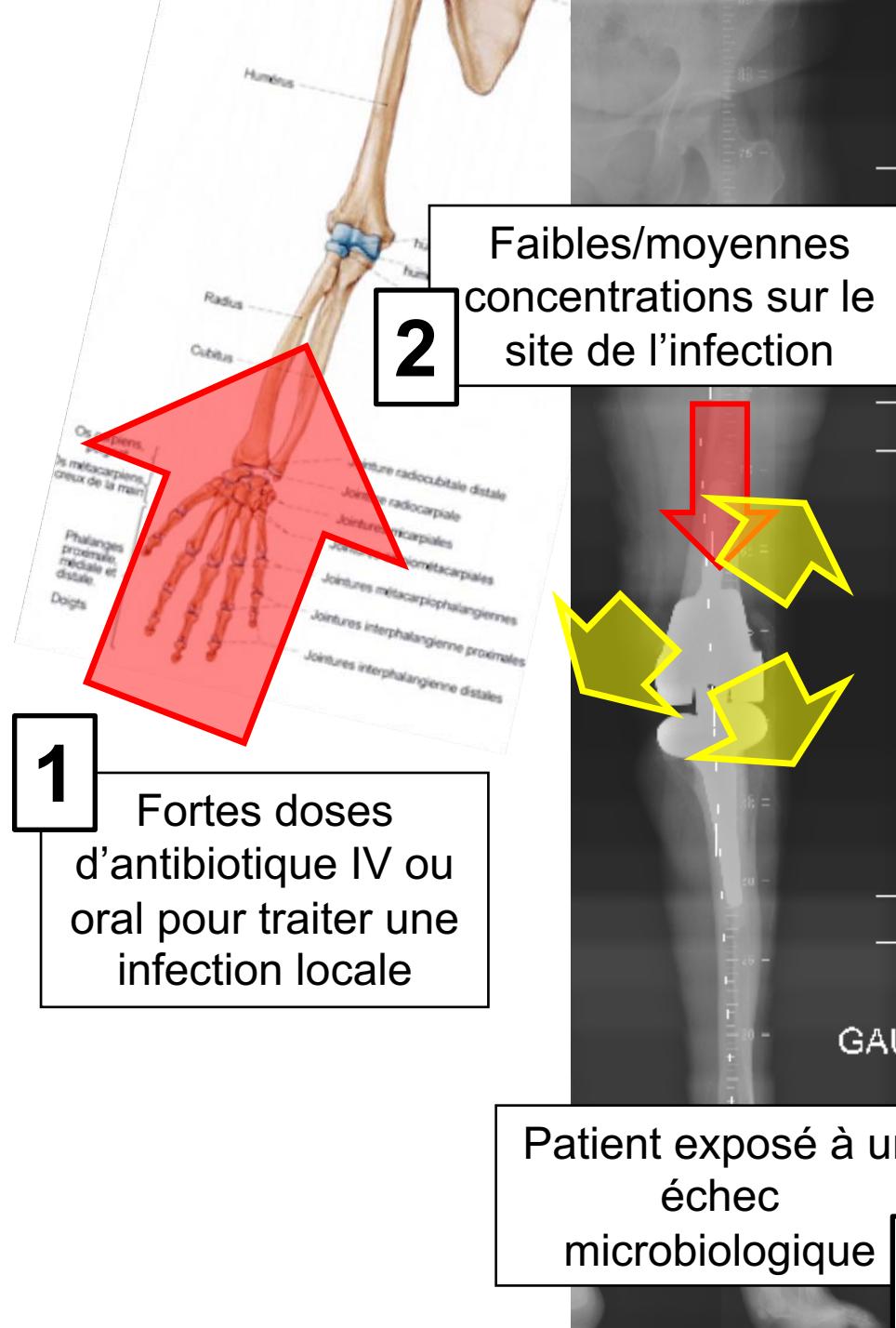


**Acquisition  
de résistance**

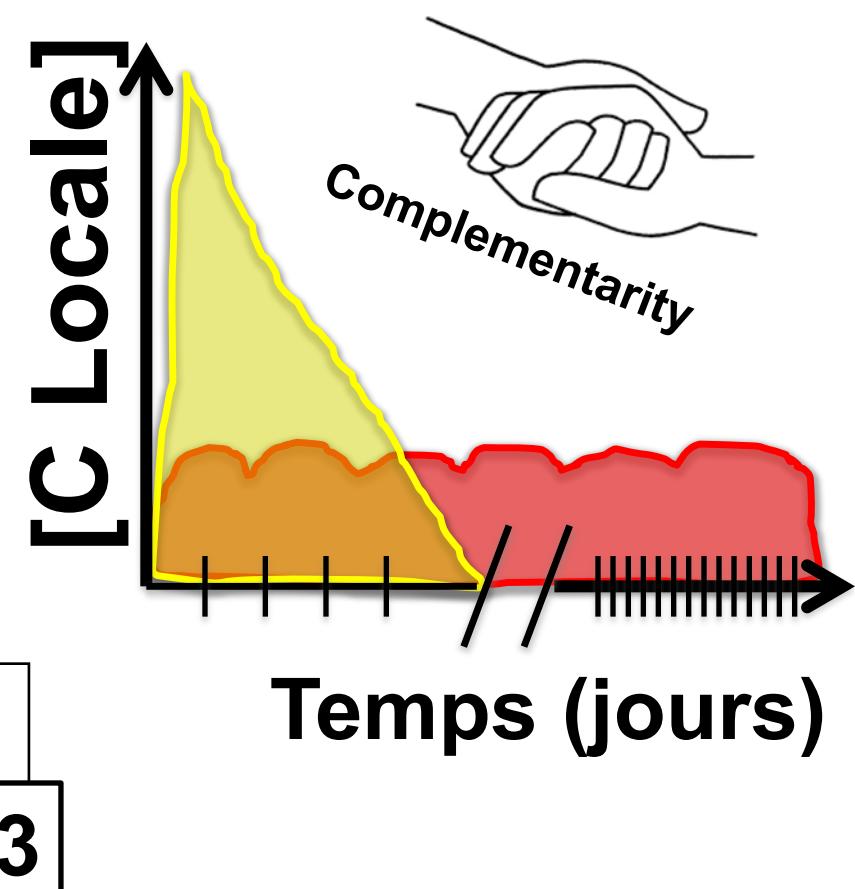
# Rationnel pour l'utilisation d'antibiotique(s) locaux



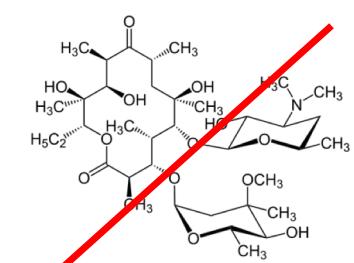
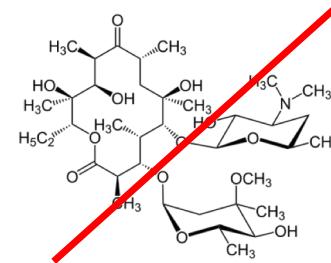
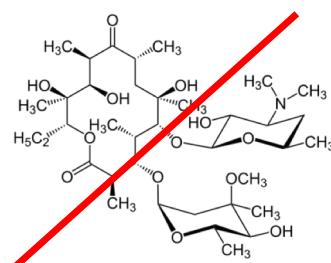
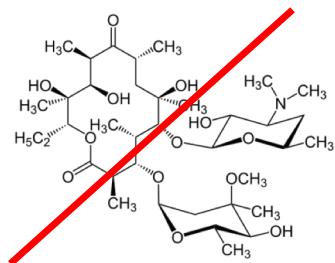
# Rationnel pour l'utilisation d'antibiotique(s) locaux



**En plus des antibiotiques systémiques  
Pour obtenir de fortes [C] locales**

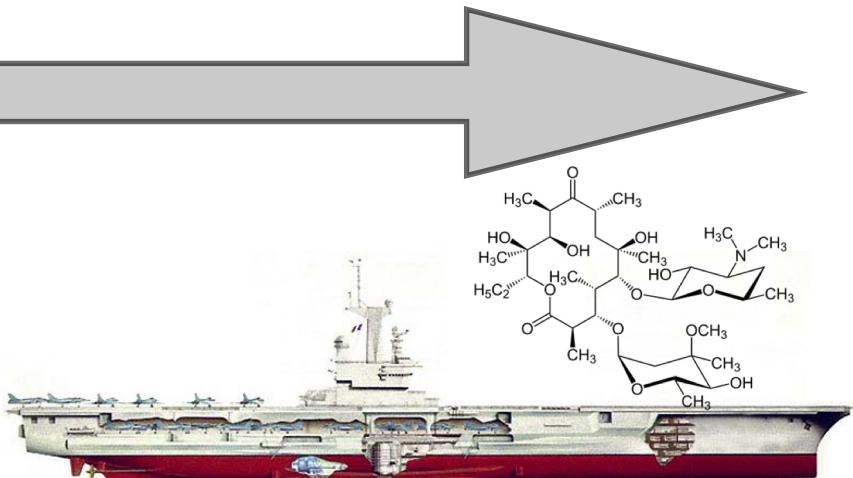


# Durée de vie des antibiotiques



Temps

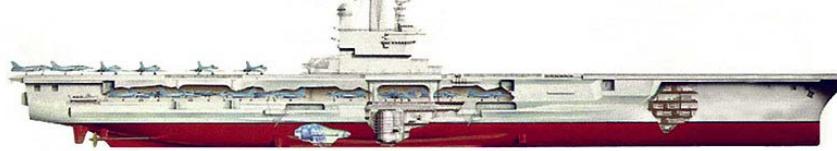
A large grey arrow pointing to the right, indicating the progression of time. The word "Temps" (Time) is written above the arrow.



# Transporteur

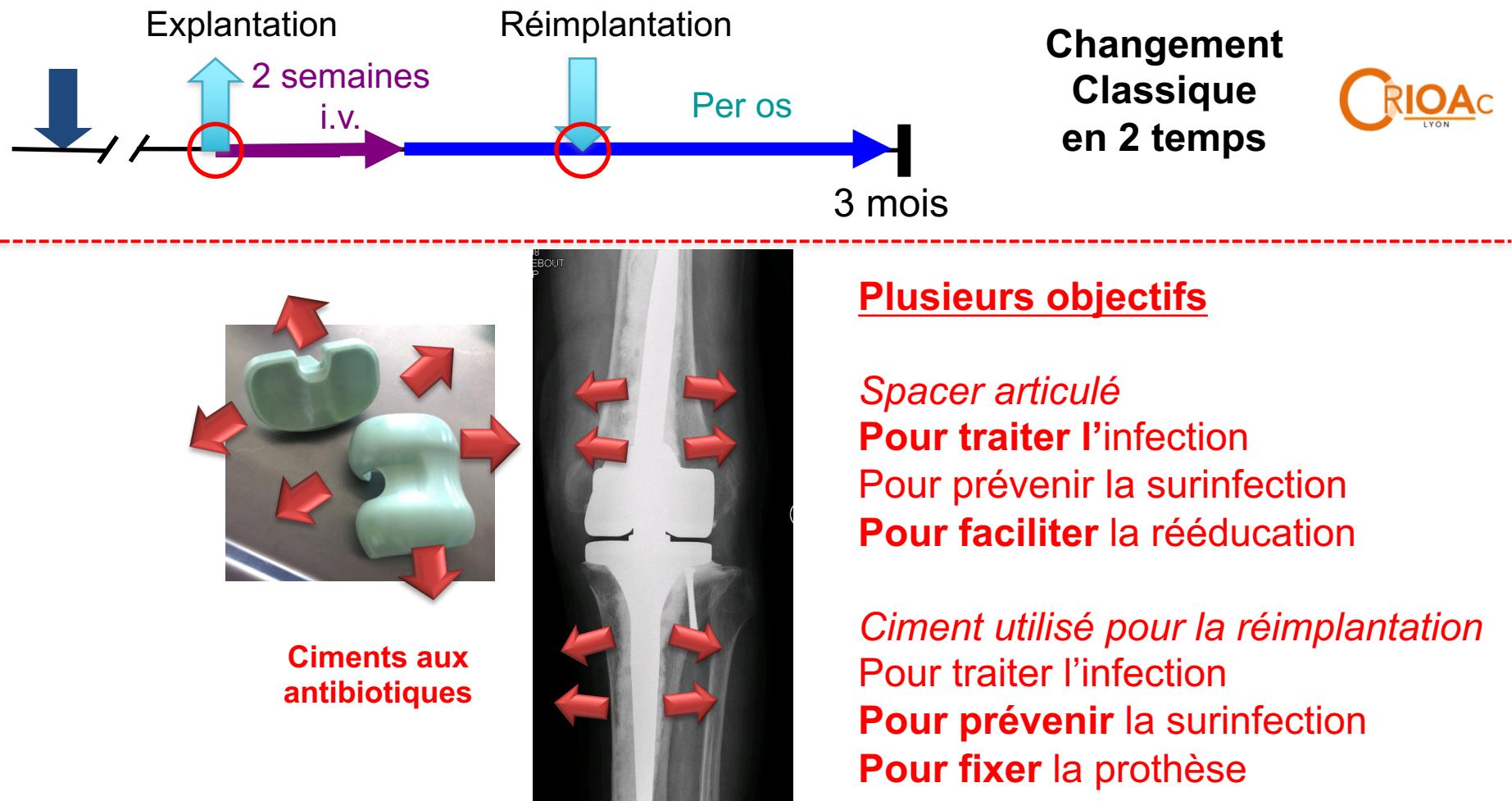


# Transporteur



Ciment  
PMMA

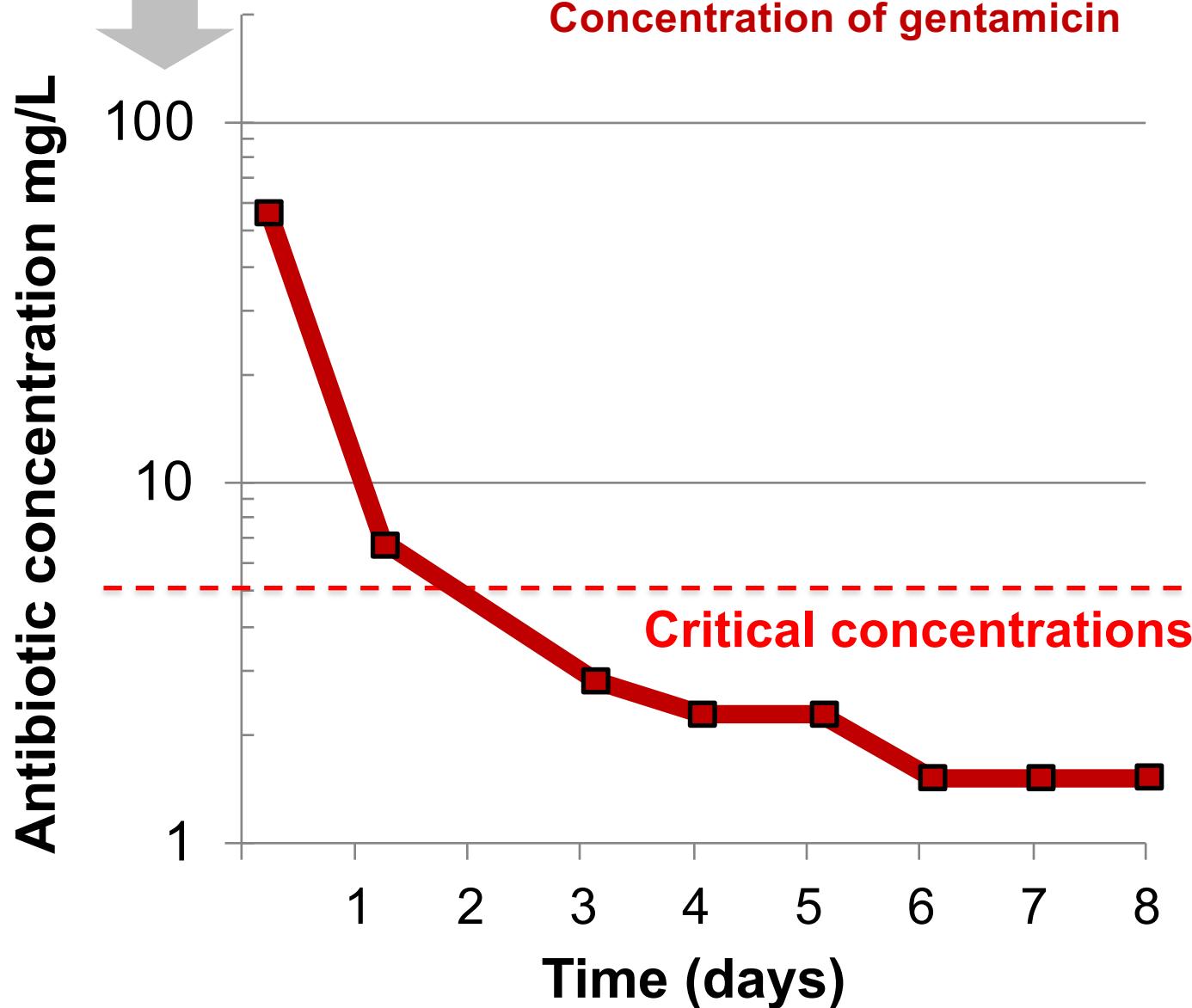
# **Stratégie médico-chirurgicale au cours des infections de PTG**



# logarithmic scale!

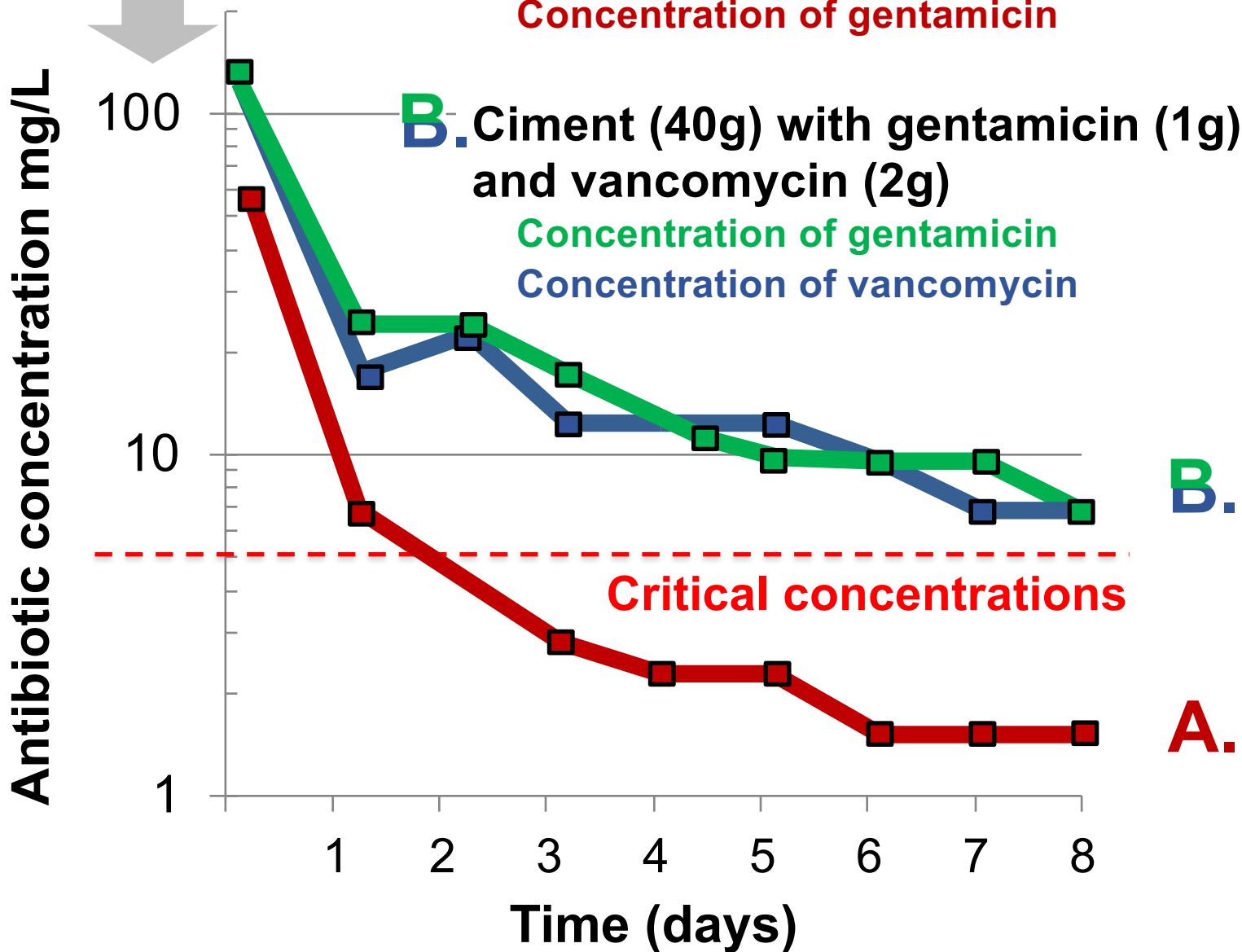
## **A. Ciment (40 g) with Gentamicine (0.5g)**

## Concentration of gentamicin



logarithmic scale! **A.**Ciment (40 g) with Gentamicine (0.5g)

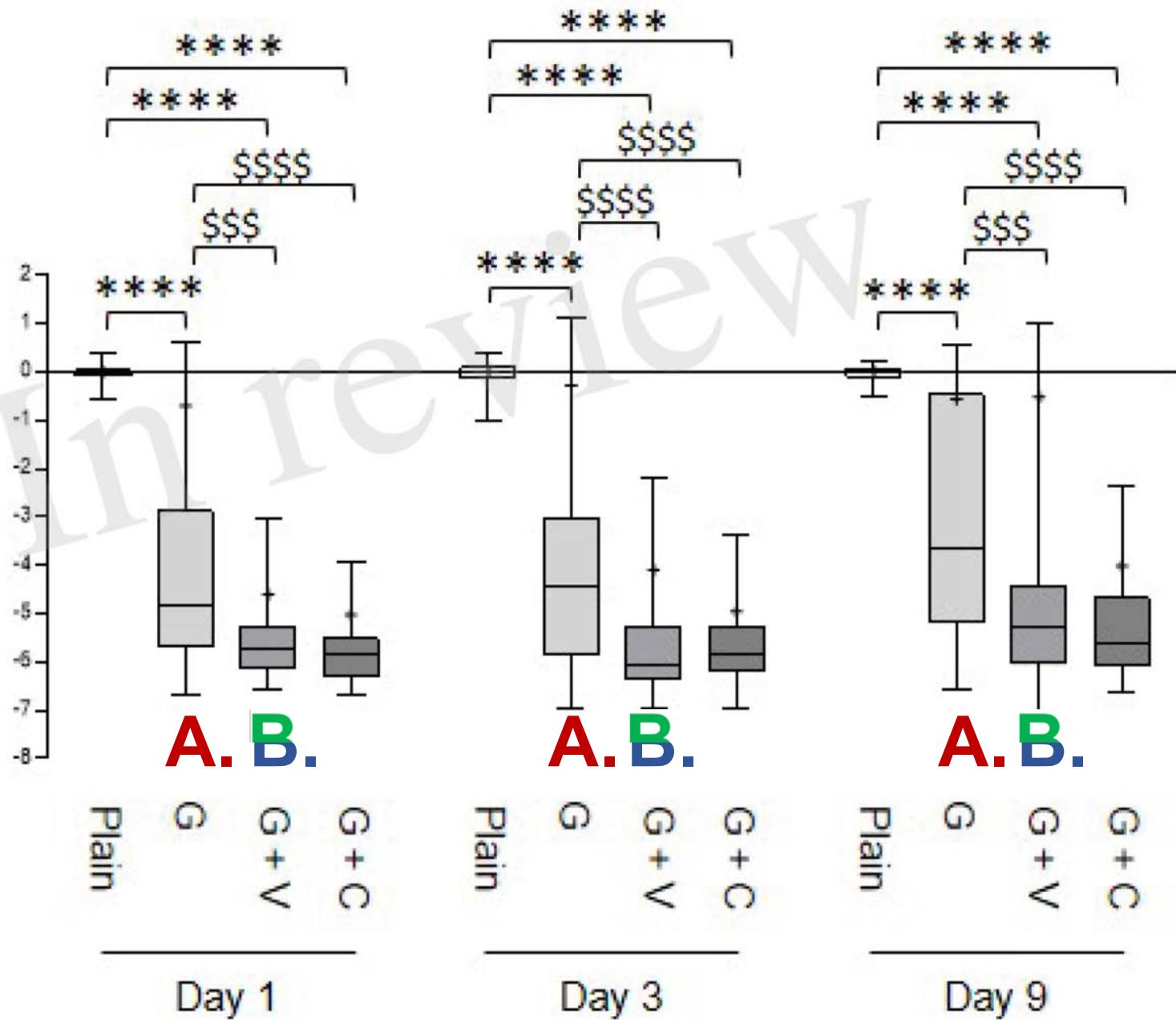
Concentration of gentamicin

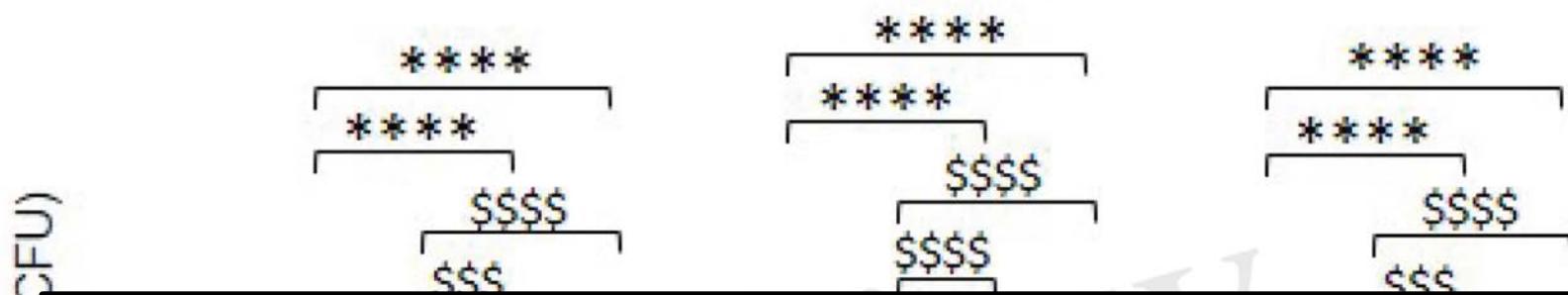


**B.**

**A.**

Inhibition of biofilm formation ( $\Delta \text{Log CFU}$ ) / plain cement

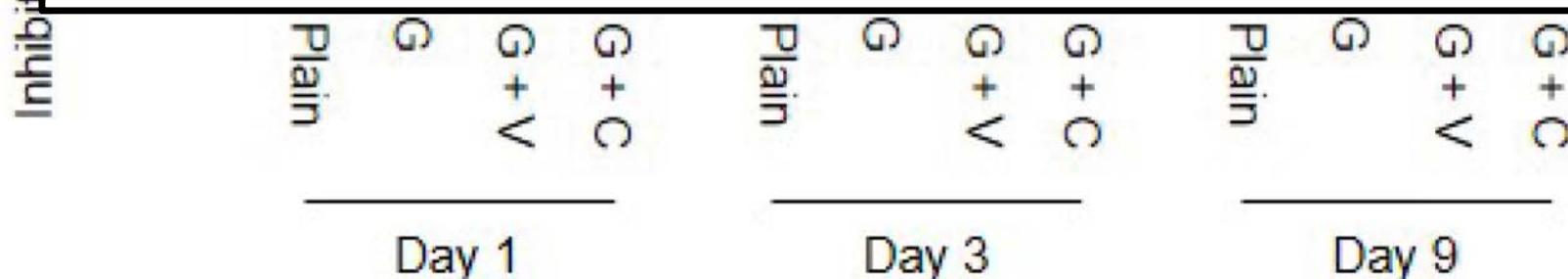




# Antibiotics in Bone Cements Used for Prosthesis Fixation: An Efficient Way to Prevent *Staphylococcus aureus* and *Staphylococcus epidermidis* Prosthetic Joint Infection

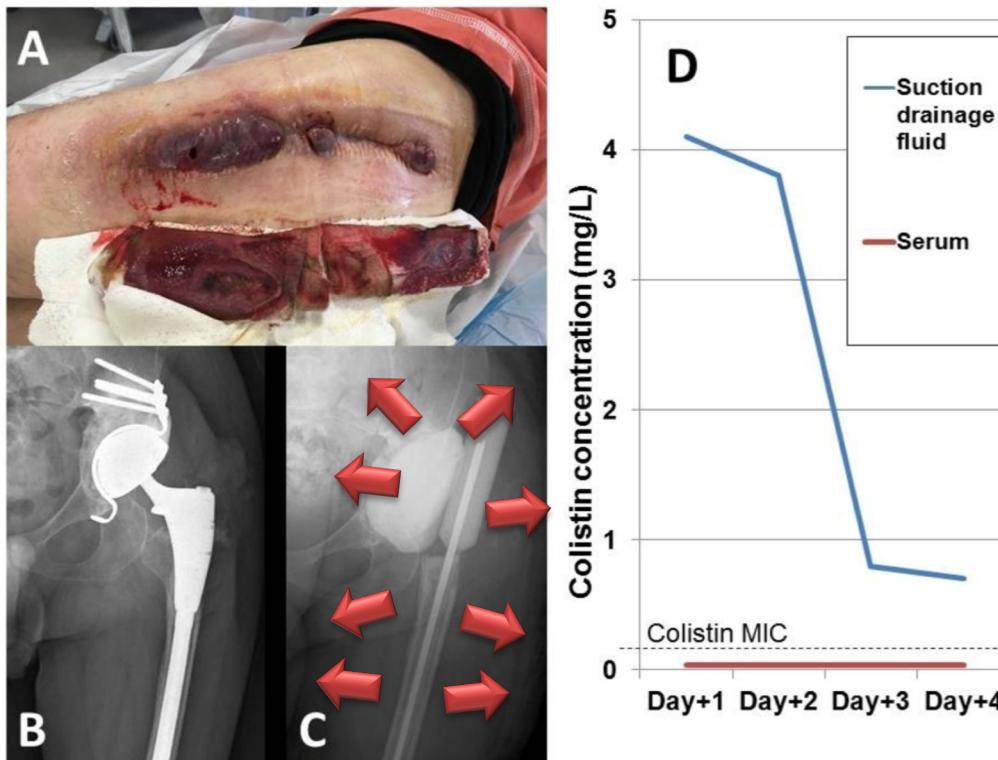


Andréa Cara<sup>1</sup>, Mathilde Ballet<sup>1,2</sup>, Claire Hemery<sup>1</sup>, Tristan Ferry<sup>1,3,4,5</sup>, Frédéric Laurent<sup>1,2,3,5</sup> and Jérôme Josse<sup>1,3,5\*</sup>

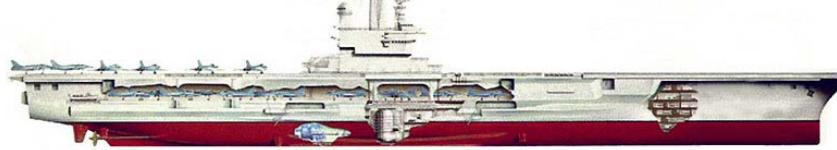


# Gentamicin–vancomycin–colistin local antibiotic therapy in a cement spacer in a 54-year-old haemophilic patient with relapsing plurimicrobial severe prosthetic joint infection

Tristan Ferry,<sup>1,2,3,4</sup> Romain Desmarchelier,<sup>5</sup> Sophie Magréault,<sup>6,7</sup> Florent Valour,<sup>1,2,3,4</sup> on behalf of the Lyon BJI Study group



# Transporteur



Ciment  
PMMA

# Transporteur

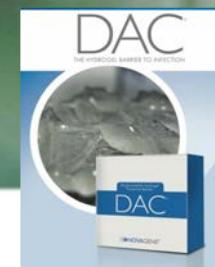
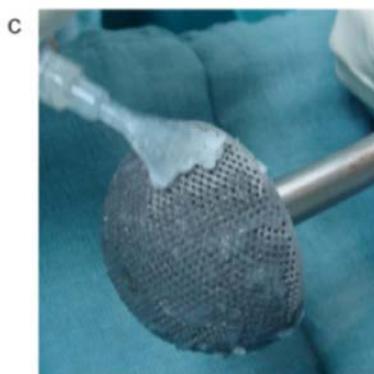
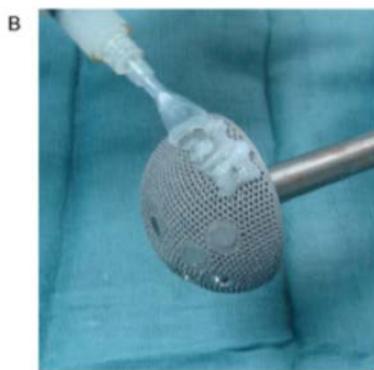
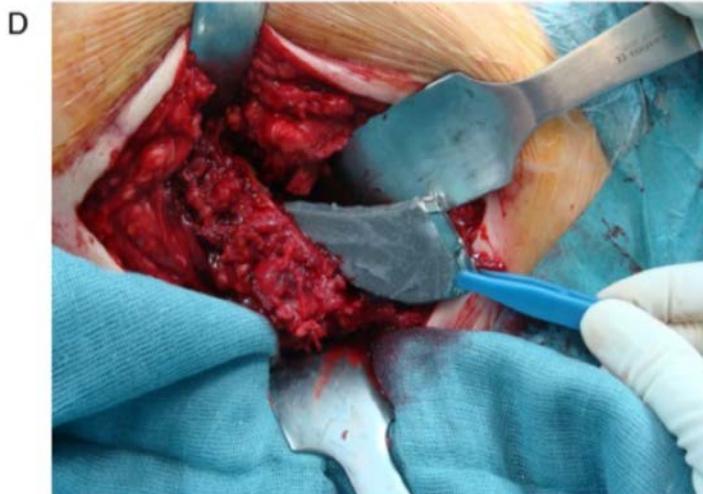


Ciment  
PMMA

Hydrogel

# Does an Antibiotic-Loaded Hydrogel Coating Reduce Early Post-Surgical Infection After Joint Arthroplasty?

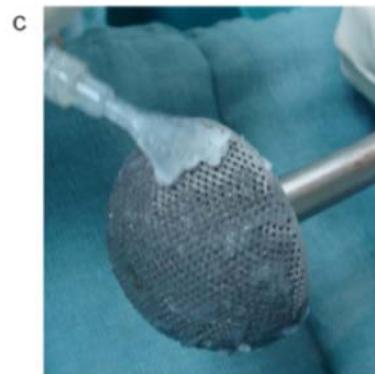
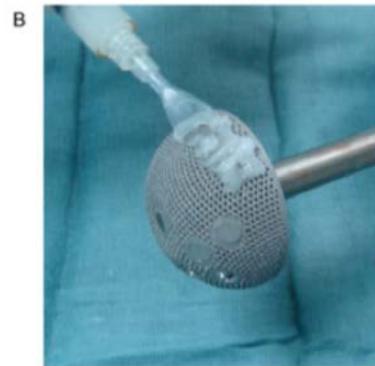
Carlo Luca Romanò<sup>1</sup>✉, Kostantinos Malizos<sup>2</sup>, Nicola Capuano<sup>3</sup>, Riccardo Mezzoprete<sup>4</sup>, Michele D'Arienzo<sup>5</sup>, Catherine Van Der Straeten<sup>6,7</sup>, Sara Scarponi<sup>1</sup> and Lorenzo Drago<sup>8,9</sup>



*J. Bone Joint Infect.* 2016

# Does an Antibiotic-Loaded Hydrogel Coating Reduce Early Post-Surgical Infection in Total Arthroplasty?

Carlo Luca Romanò<sup>1</sup>✉, Koen D'Arienzo<sup>5</sup>, Catherine Van

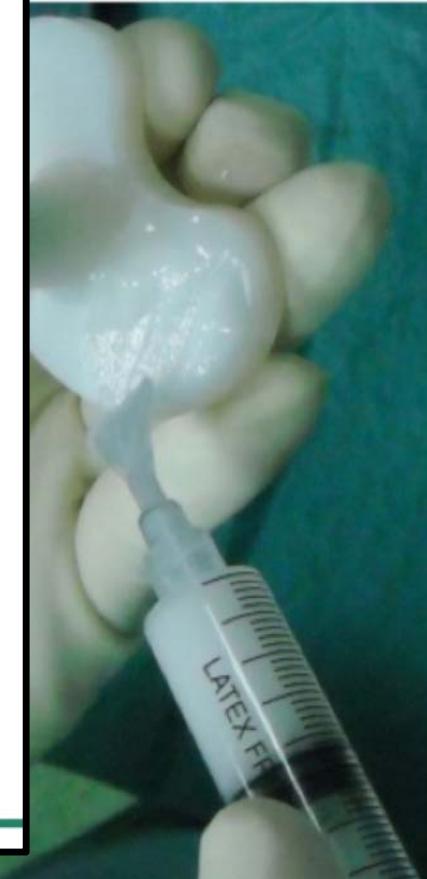


E

		Treated	%
Joint	Hip	153	80.9
	Knee	36	19.0
Type of surgery	Primary	135	71.8
	Revision	54	28.2
Systemic prophylaxis	Cefazolin	69	48.2
	Cefazolin + Glycopeptides	29	20.3
	Cefazolin + Vancomycin	46	38.3
	Vancomycin + Meropenem	45	31.5
DAC volume (mL)	Mean ± SD	8.3 ± 2.7	
	Min - Max	5 - 10	
DAC + vancomycin 5%		100	52.9
DAC + gentamicin 3.2%		70	37.0
DAC + vancomycin 2% + meropenem 2%		15	7.9
Other associations		4	2.1

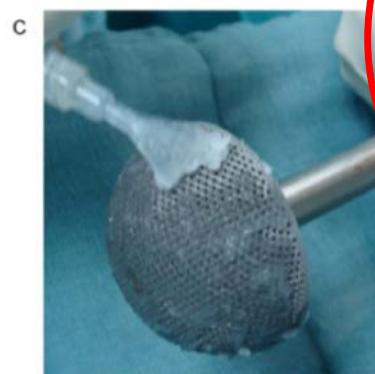
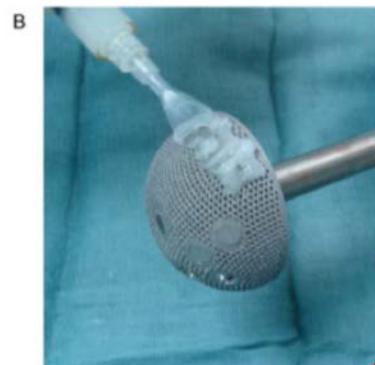


J. Bone Joint Infect. 2016



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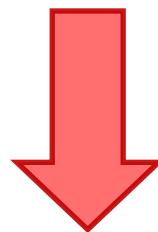
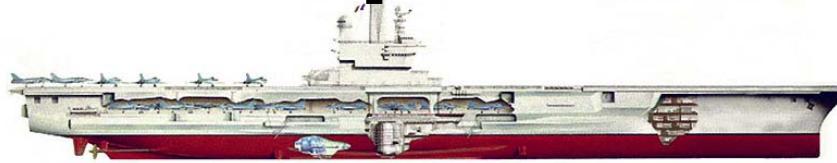
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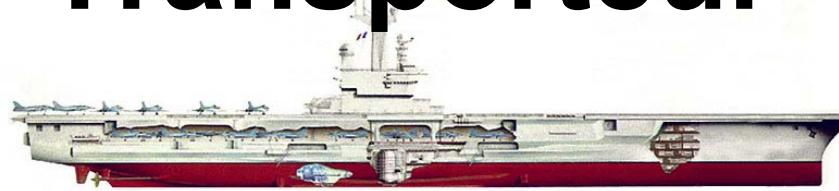
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Ciment  
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Hydrogel

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PMMA



Hydrogel

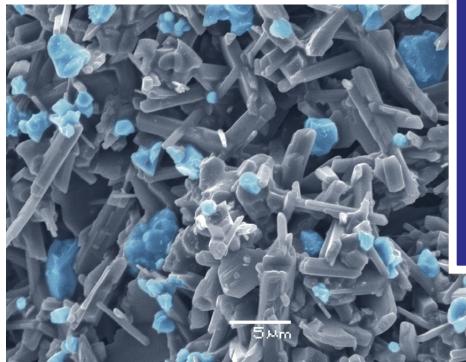


Pâte

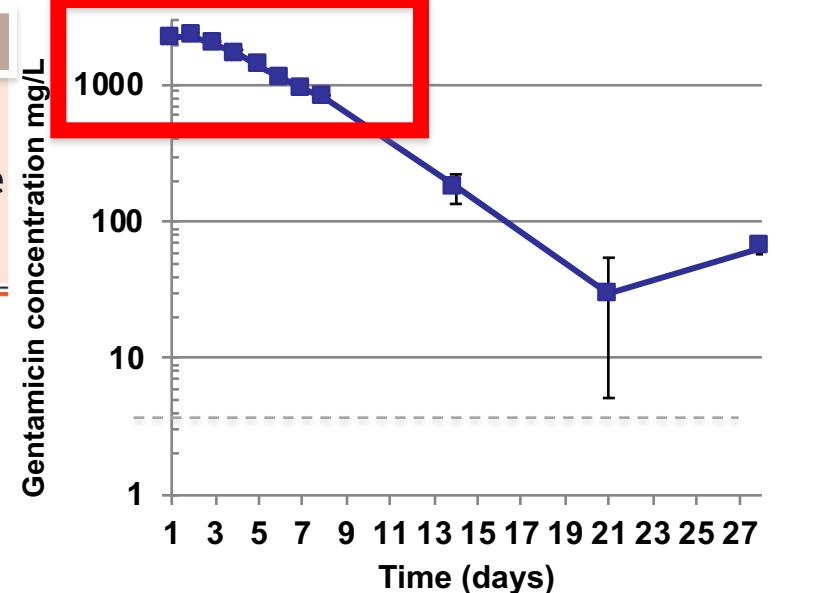


## Pharmacokinetics of gentamicin eluted from a regenerating bone graft substitute

IN VITRO AND CLINICAL RELEASE STUDIES



**CERAMENT G™**  
Hydroxyapatite  
Sulfate de calcium  
Gentamicine



Régénération osseuse, Résorbable, sous forme de pâte

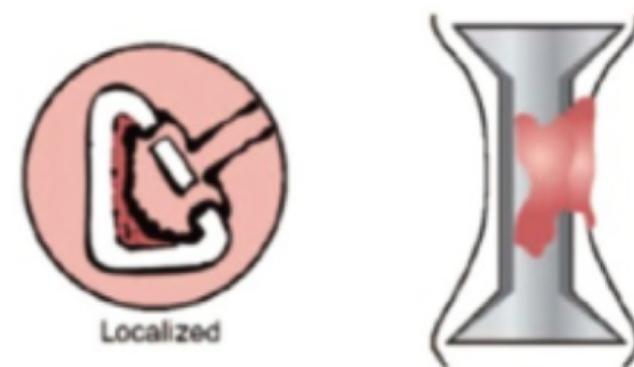
### ■ GENERAL ORTHOPAEDICS

**Single-stage treatment of chronic osteomyelitis with a new absorbable, gentamicin-loaded, calcium sulphate/hydroxyapatite biocomposite**

A PROSPECTIVE SERIES OF 100 CASES

Mac Nally M. et al.

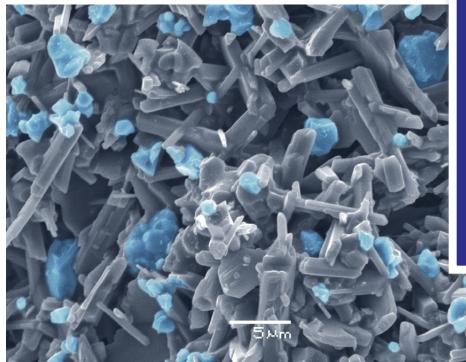
**Oxford Bone infection unit**



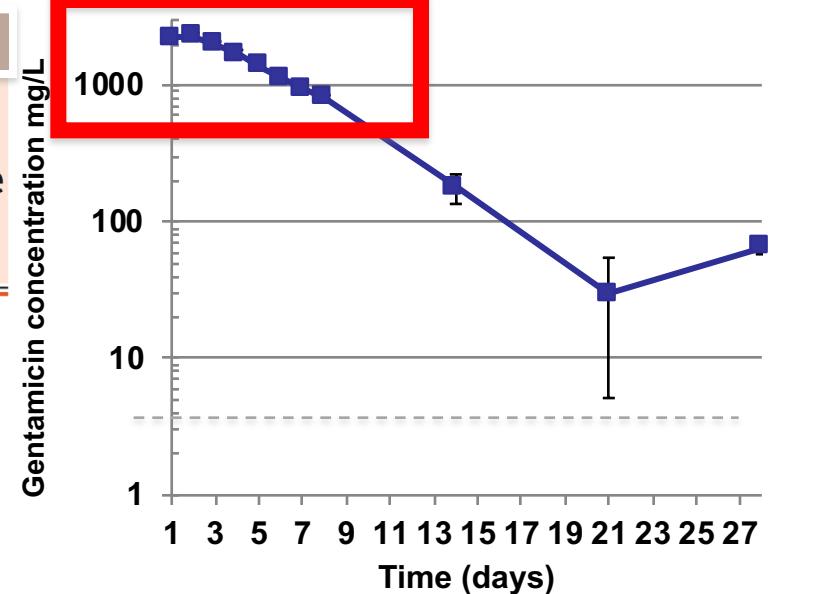


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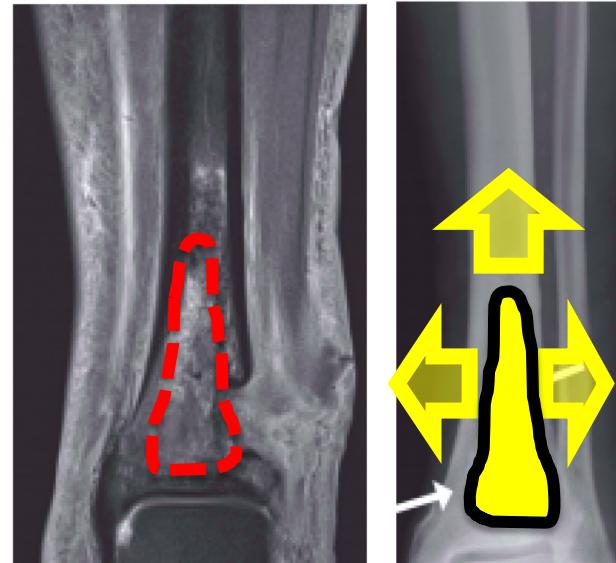
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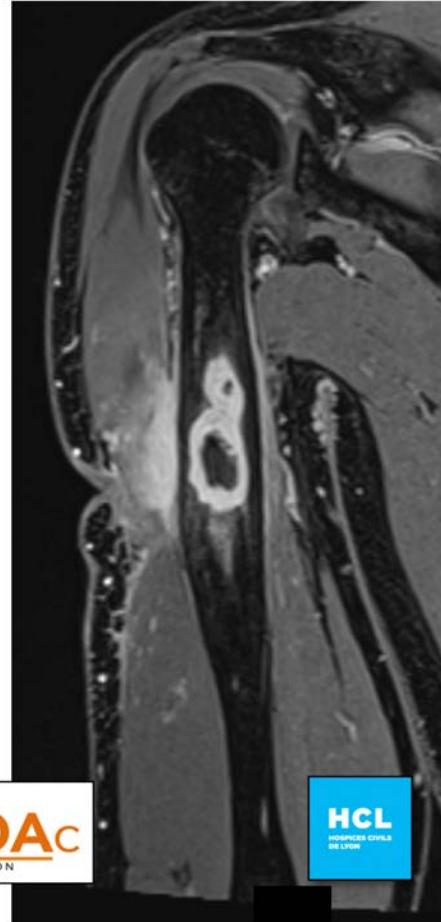
**Oxford Bone infection unit**

### Chirurgie en 1 temps



96% guérison

# CONVICTION clinical trial

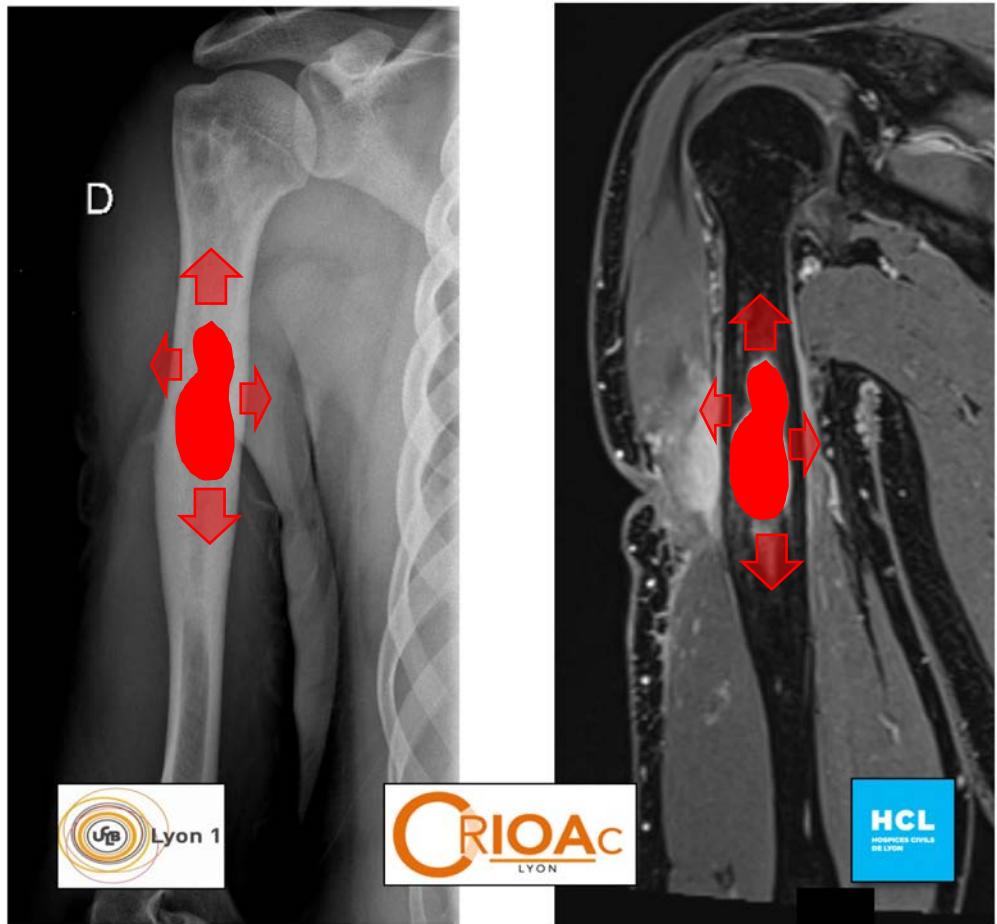


Evaluation of the efficiency  
of the bone substitute  
**Cerament-G®** locally  
delivering gentamicin in the  
treatment of chronic  
osteomyelitis of long  
bones: **randomized**  
**multicentre study in the**  
**CRIODAC network**

T. Ferry PRME 2019

First inclusion  
Q2 2021?

# CONVICTION clinical trial



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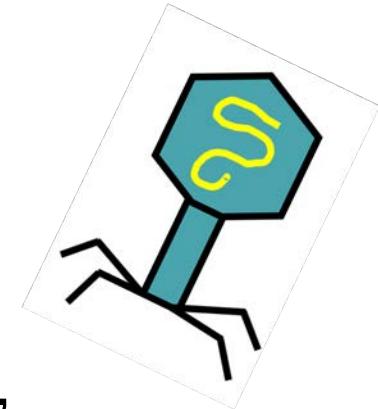
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UMR5308, ENS de Lyon, UCBL1, Lyon, France

Centre de Référence des IOA complexes de Lyon (CRIODAc Lyon)



# What is a « bacteriophage » ?



- Suffix –phage, *phagos* φαγεῖν (*phagein*), "to eat", "to devour"
- **Viruses that infect **ONLY** bacteria**
- Classification (*myoviridae*, *podoviridae*, etc...)
- **A phage is specific to A type of bacteria**
- **Largely abundant in the biosphere:  
**10<sup>31</sup> bacteriophages on the planet, more than every other organism****
- Especially in marine environment, sea, lake, backwater, soil, animal and human stools, etc.



10 à 100 fois plus petit qu'une bactérie

Eau du robinet translucide

HCL  
HOSPICES CIVILS  
DE LYON



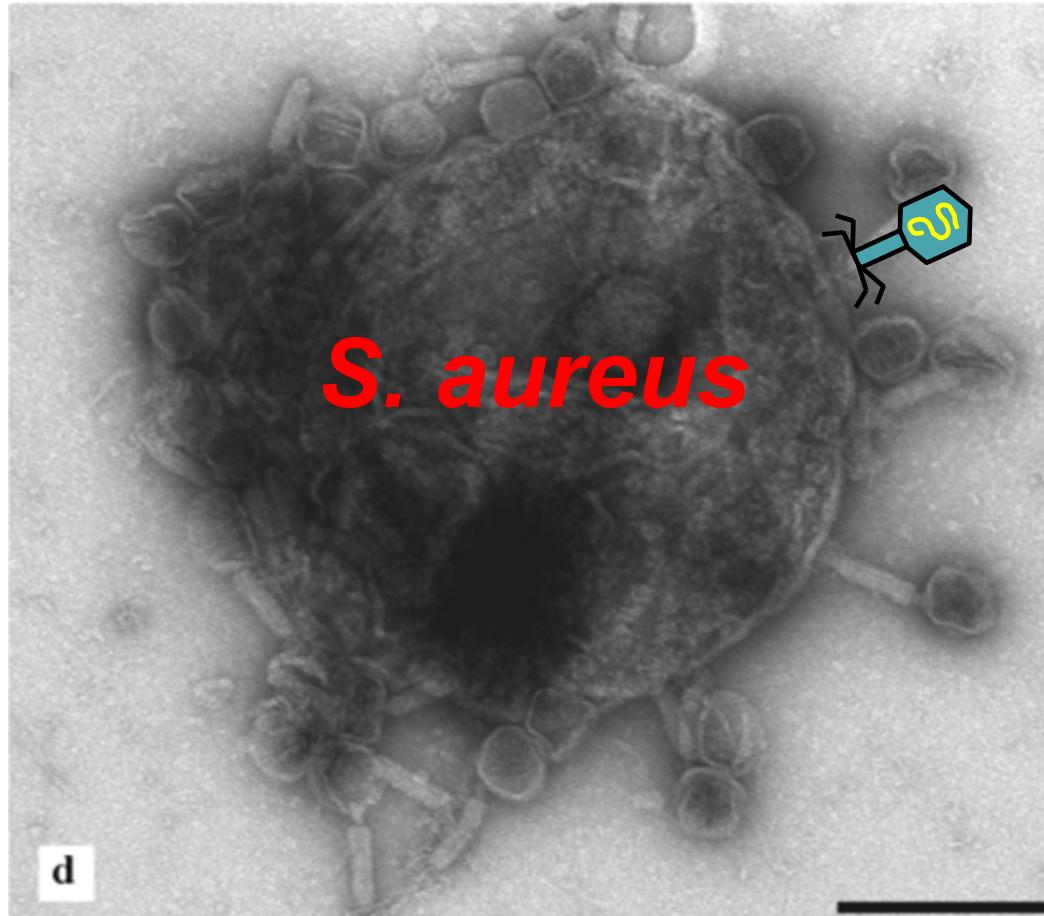
X millions of ≠  
**BactériophageS !!!**  
(ciblant des bactéries  
de l'environnement)



10<sup>8</sup> de TROIS  
bactériophages/mL  
(ciblant *S. aureus*)

10 à 100 fois plus petit qu'une bactérie

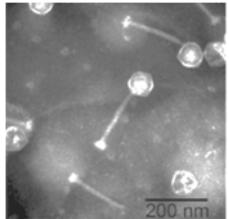
Bacteriophage ISP (*Myoviridae*)



Merabishvili et al. *PLoS ONE* 2009

# Un claire activité anti-bactérienne !!!

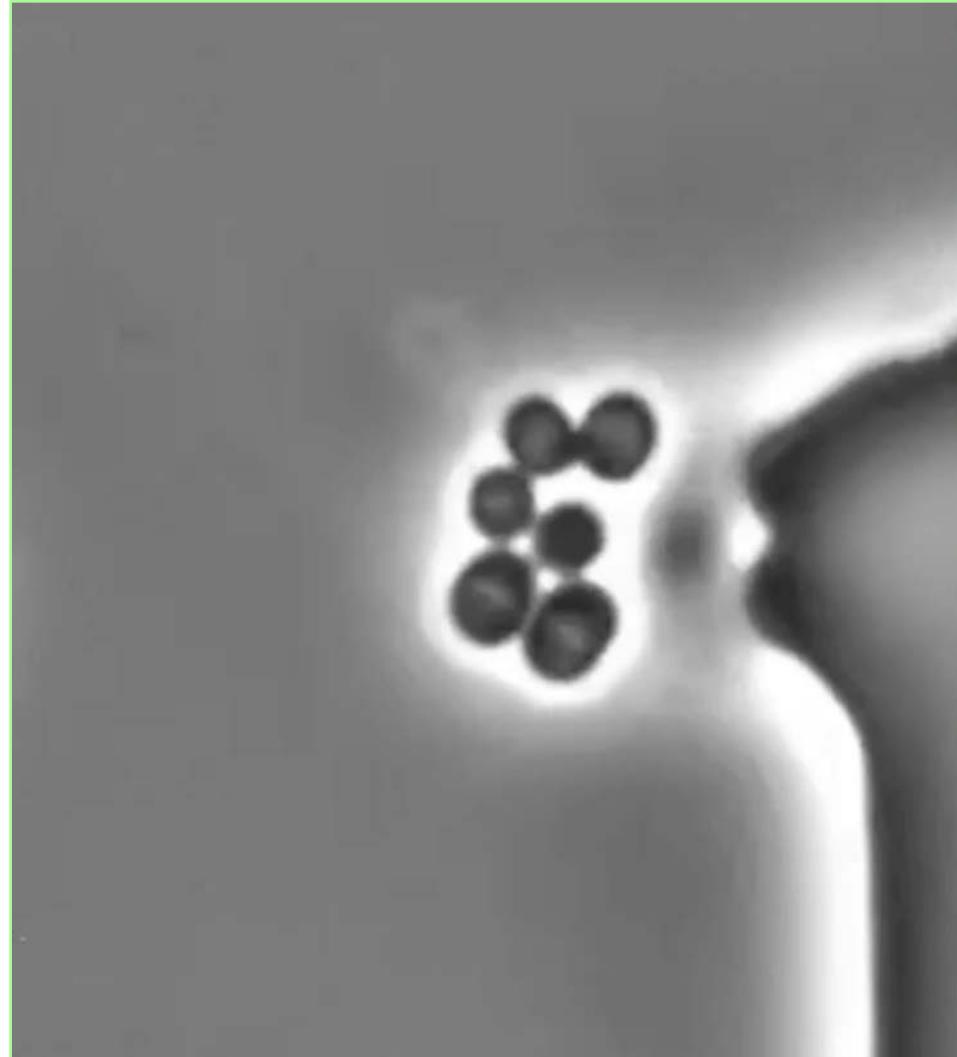
*S. aureus* being lysed by the Sa2 phage



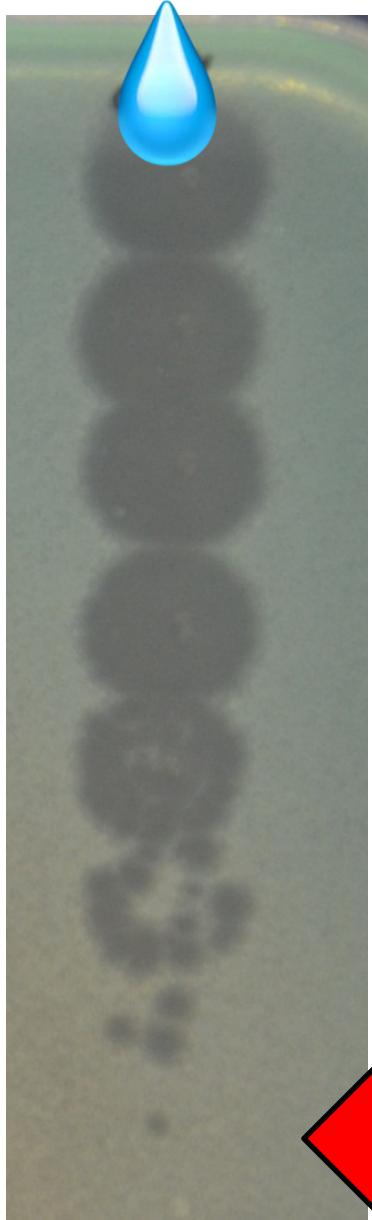
Bacterial DNA appeared in green

Courtesy Pascal Maguin  
Luciano Marraffini Lab

THE ROCKEFELLER UNIVERSITY



# Un claire activité anti-bactérienne !!!



Phage

$10^{10}$

$10^9$

$10^8$

$10^7$

$10^6$

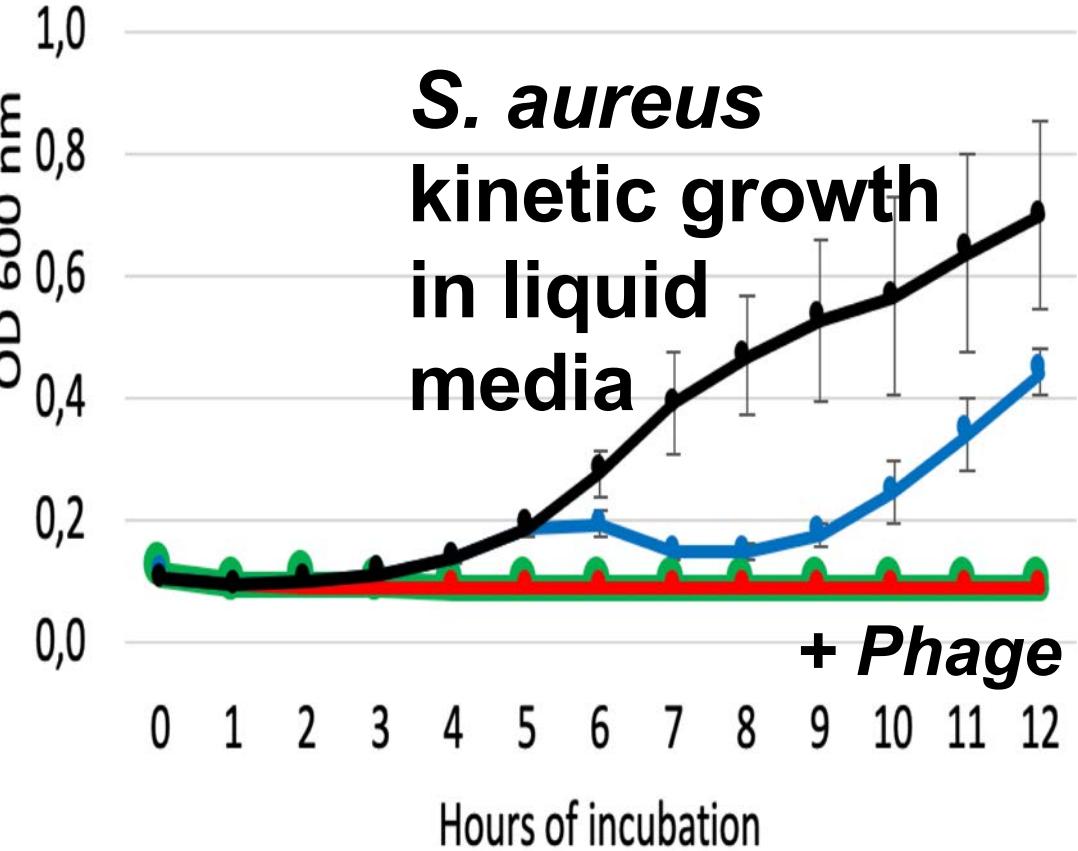
$10^5$

PFU/mL

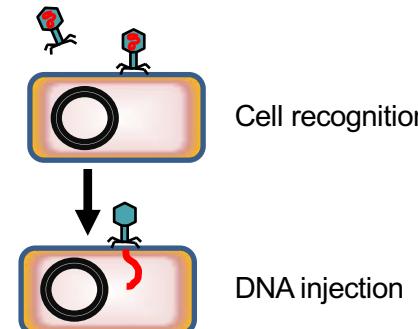
## Phagogramme

***S. aureus*  
kinetic growth  
in liquid  
media**

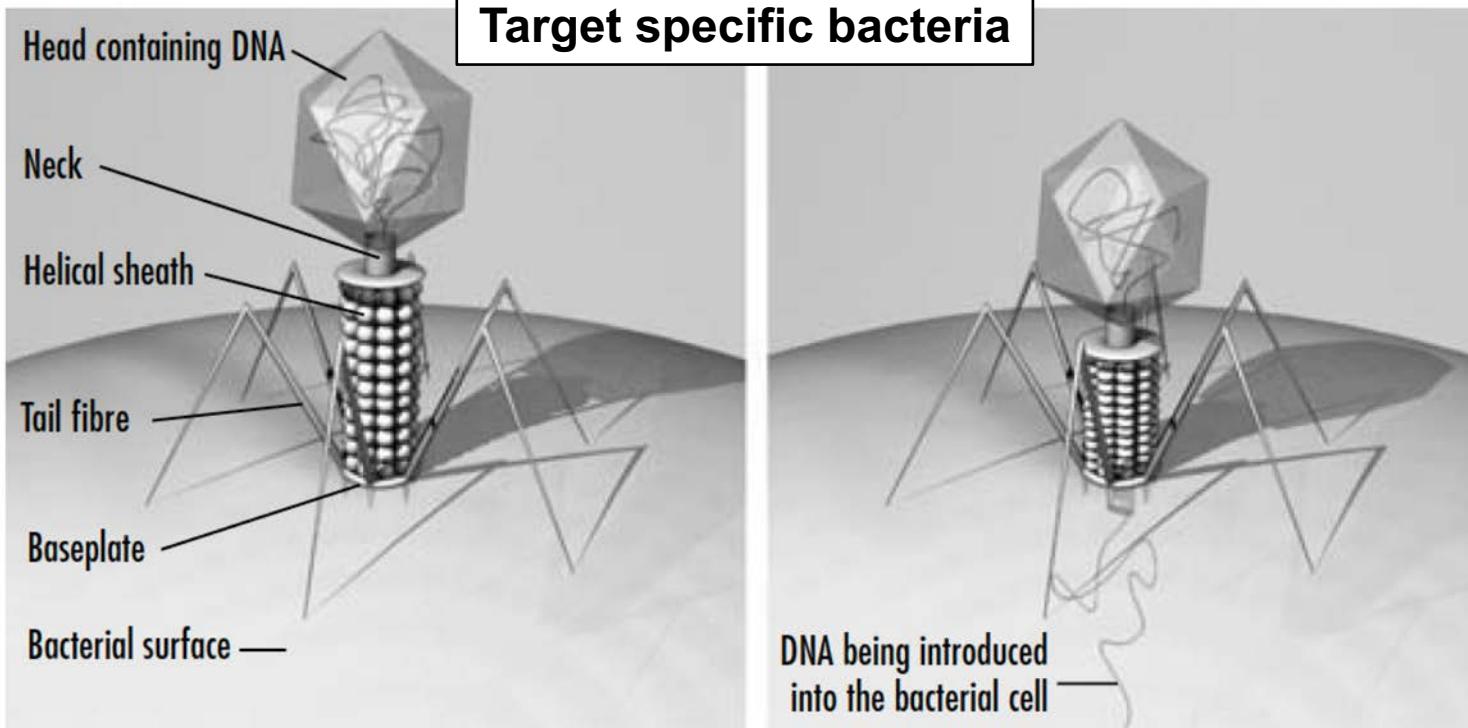
+ Phage

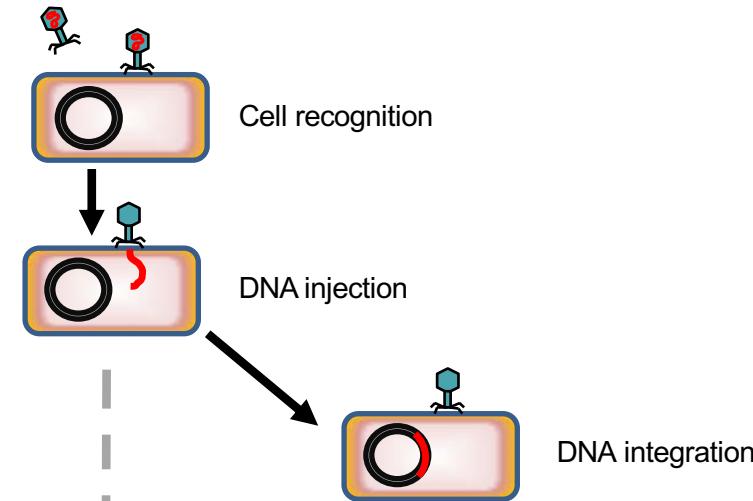


***S. aureus* culture on a gelosis**



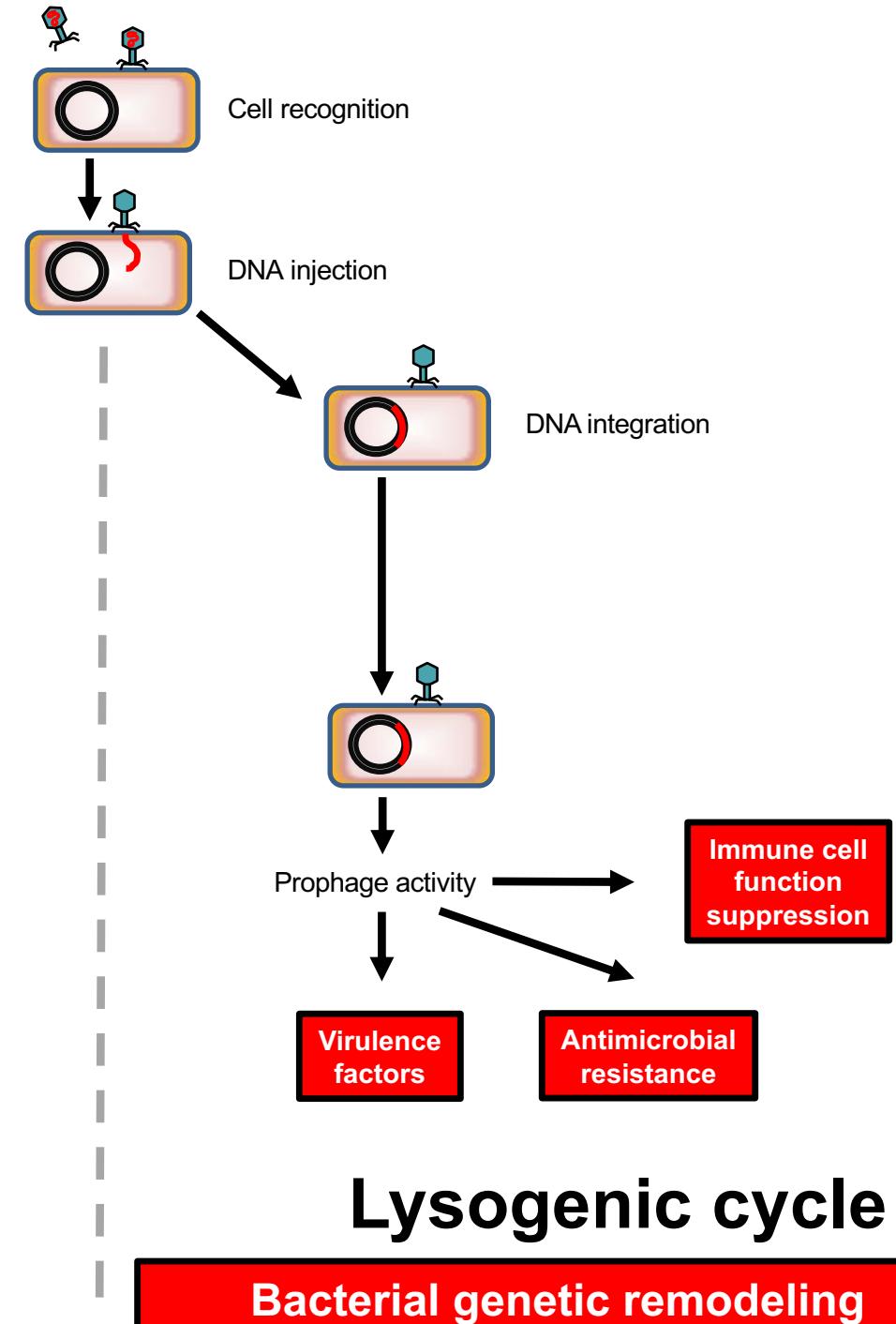
**Environmental viruses  
Target specific bacteria**

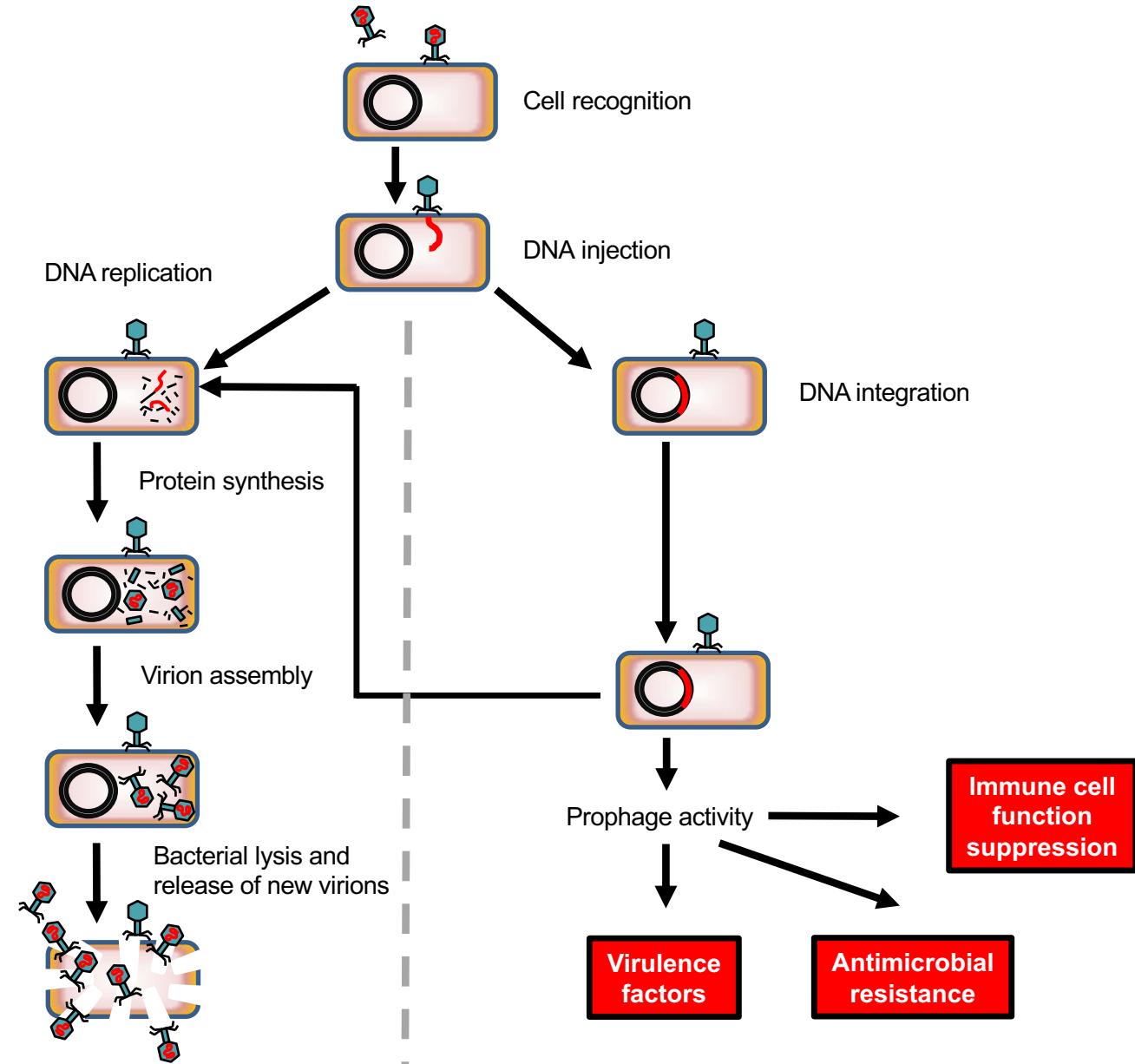




**Lysogenic cycle**

Bacterial genetic remodeling



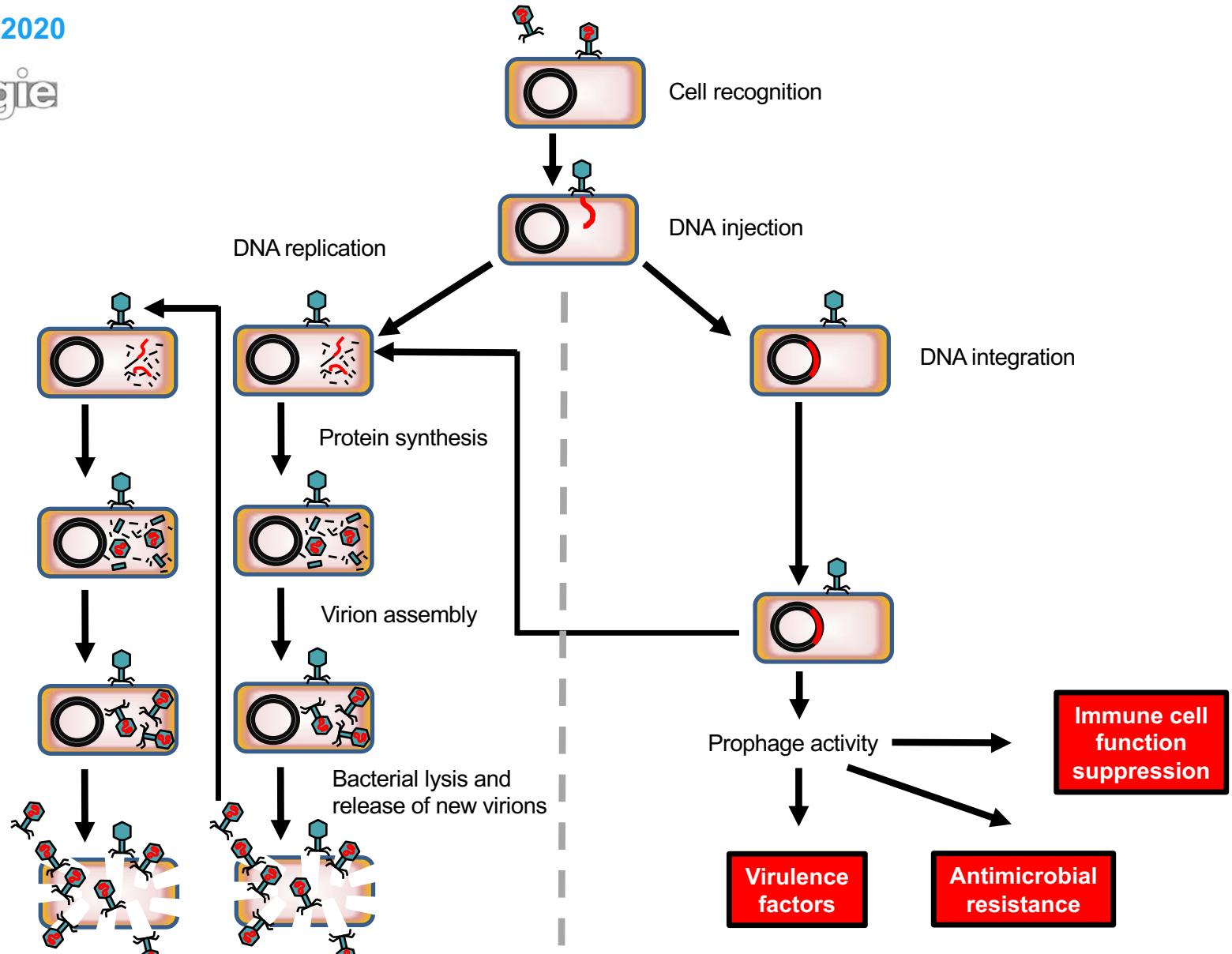


## Lytic cycle

Self-maintained bacterial lysis

## Lysogenic cycle

Bacterial genetic remodeling

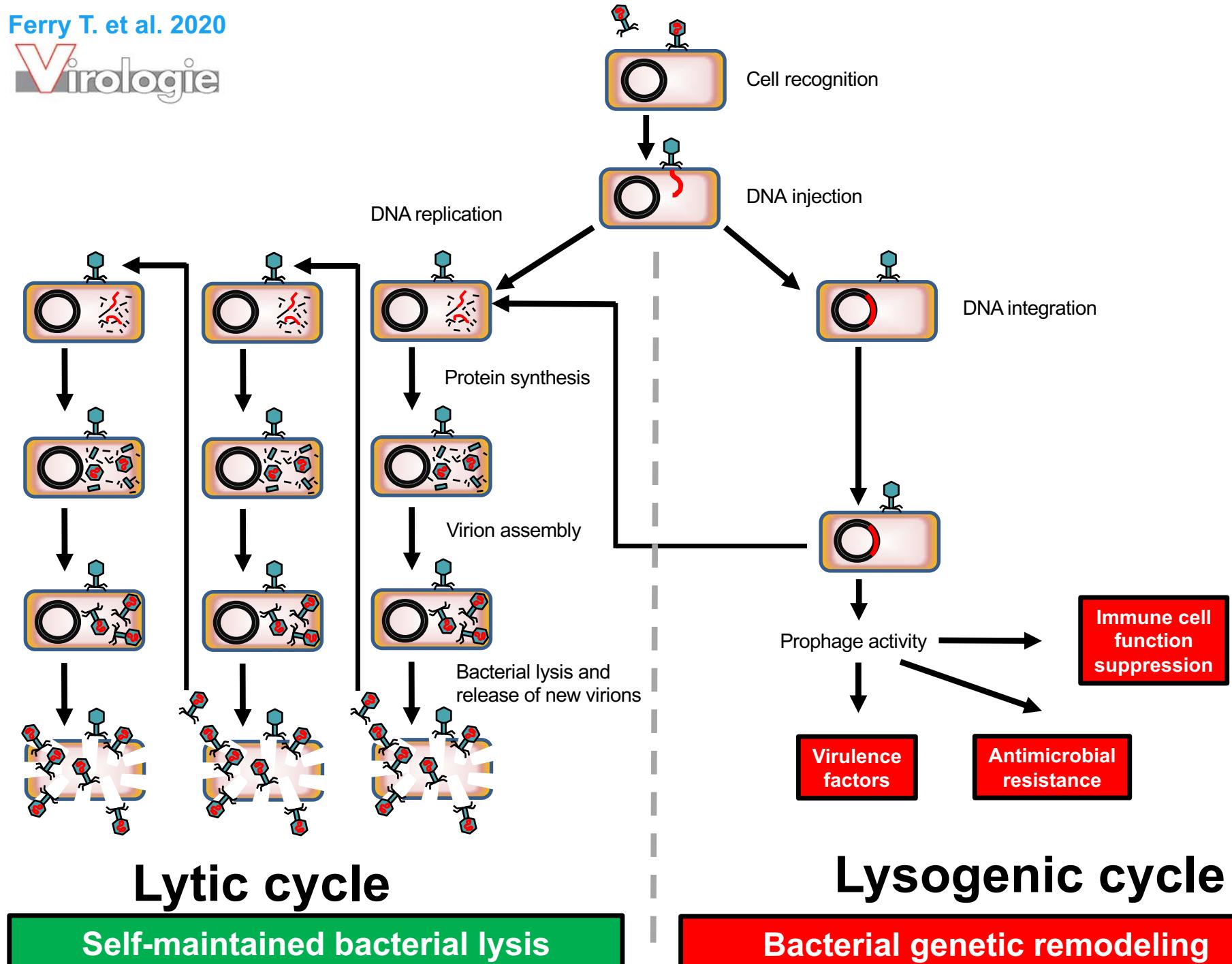


## Lytic cycle

Self-maintained bacterial lysis

## Lysogenic cycle

Bacterial genetic remodeling





# History of phage therapy

- **Felix d'Herelle**
- Institut Pasteur, Paris





# History of phage therapy



- **Felix d'Herelle**
- Institut Pasteur, Paris
- He treated shigellosis (diarrhea) in children with oral intake of specific “filtered” bacteriophages that he found in stools of patients who spontaneously healed from... shigellosis



# History of phage therapy



- **Felix d'Herelle**
- Institut Pasteur, Paris
- He treated shigellosis (diarrhea) in children with oral intake of specific “filtered” bacteriophages that he found in stools of patients who spontaneously healed from... shigellosis
- He founded Eliava institute in Georgia and the “Laboratoire Français des Bactériophages” in Paris



# History of phage therapy

- Founding of the first phage therapy laboratory in Paris by Georges Hérelle
- Introduction of phage therapy into medical practice
- History of phage therapy in France and abroad
- History of phage therapy in Georgia

**LE LABORATOIRE DU BACTÉIOPHAGE**  
Laboratoire de recherches dont les bénéfices sont destinés à des fins scientifiques  
sous le contrôle du  
**PROF. d'HÉRELLE**

**Bacté-coliphage**  
Colibacilluries . Pyélonephrites . Cystites

**Bacté-rhino-phage**  
Grippe . Coryza . Rhino-pharyngites

**Bacté-intesti-phage**  
Entérites . Colites . Diarrées infantiles

**Bacté-pyo-phage**  
Panaris . Phlegmons . Plaies Infectées

**Bacté-staphy-phage**  
Furonculose - Anthrax

AGENTS GÉNÉRAUX  
LABORATOIRES ROBERT & CARRIÈRE ... 37, rue de Bourgogne ... Paris

and the **“Laboratoire Français des Bactériophages”** in Paris



Docteur André RAIGA

Ancien Interne lauréat des Hôpitaux  
Ex-Chef de Clinique chirurgicale à la Faculté

• • •

*At the stage of bone necrosis, it will only succeed in stopping the progression of the infection, but it will be able to do nothing against the dead bone deprived of circulation; this bone will become sequestered and the lesion is no longer a matter of surgery. To do otherwise is to commit, in my opinion, an error of therapeutic indication.*

Au stade de nécrose osseuse, il ne réussira plus qu'à enrayer la progression de l'infection, mais il ne pourra plus rien contre l'os que la mort a privé de circulation ; cet os va se séquestrer et la lésion ne relève plus maintenant que de la chirurgie. Agir autrement c'est commettre, à mon sens, une erreur d'indication thérapeutique.

1961



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Ancien Interne lauréat des Hôpitaux  
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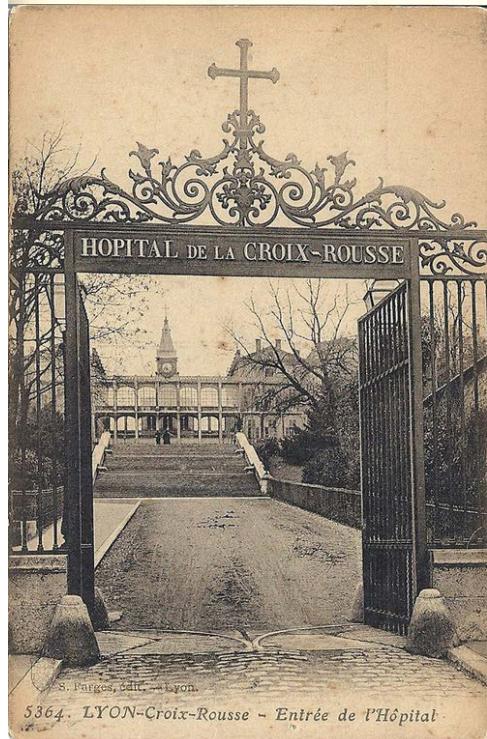
• • •

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# Traitemen<sup>t</sup> des infections à bacilles pyocyaniques par des bactériophages adaptés par sélection.

Par MM. André BERTOYE et A.-L. COURTI<sup>E</sup>.



S. Pargas, éditeur, Lyon.  
5364. LYON-Croix-Rousse - Entrée de l'Hôpital.

Les bacilles pyocyaniques sont fréquemment résistants aux antibiotiques usuels. Cependant, leur caractère rebelle est une de leurs caractéristiques. La sélection des bactériophages adaptés par stock-bactériophagie permet une action nutritive et thérapeutique contre, l'adaptation au malade sur bouillon dilué pour arachidiennes rapportées dans cette publication.

**Antimicrobial resistance**

**Phage banking**  
**Phage training**

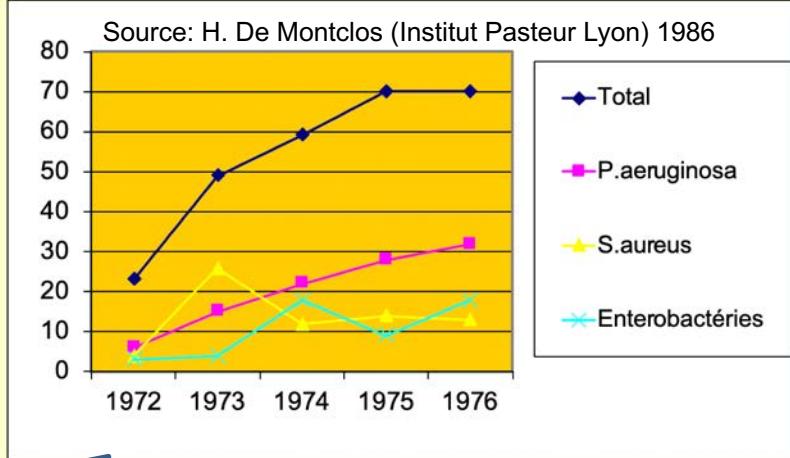
**Meningitis**  
**Skin and soft tissue**  
**Bone and joint**



**Clinique des Maladies Infectieuses, Hôpital de la Croix-Rousse  
Hospices Civils de Lyon**

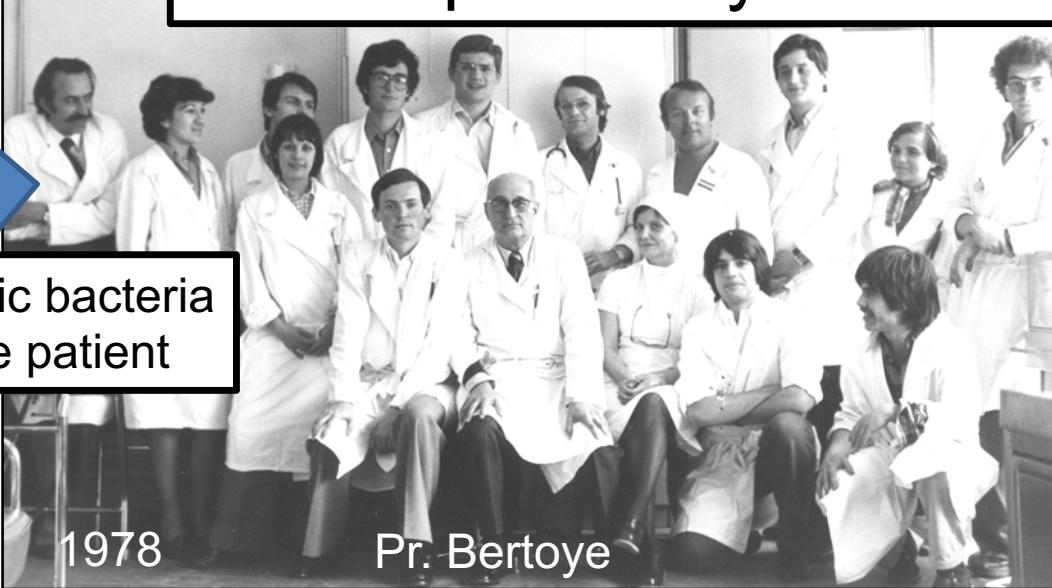
1958-1960

# Institut Pasteur Lyon



Bactériophages thérapeutiques  
préparés à l'Institut Pasteur de Lyon  
dans les années 1970

Academic collaboration  
70 patients/year!



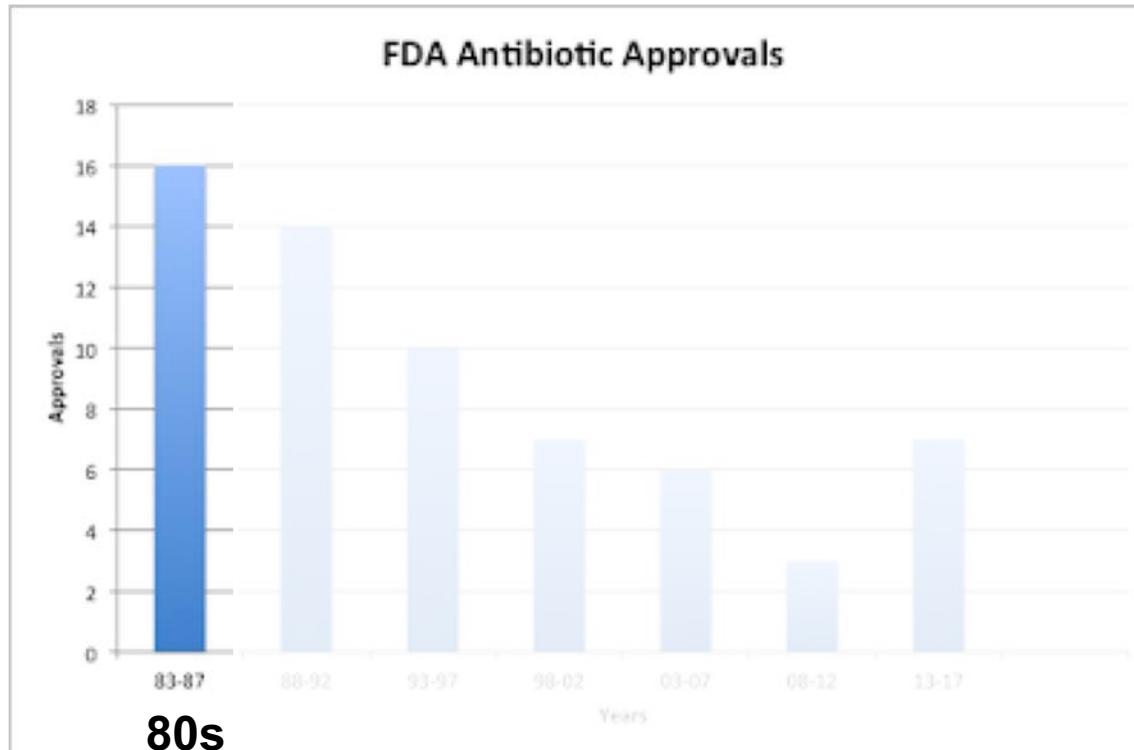
Pathogenic bacteria  
from the patient



Infectious  
Disease  
clinic

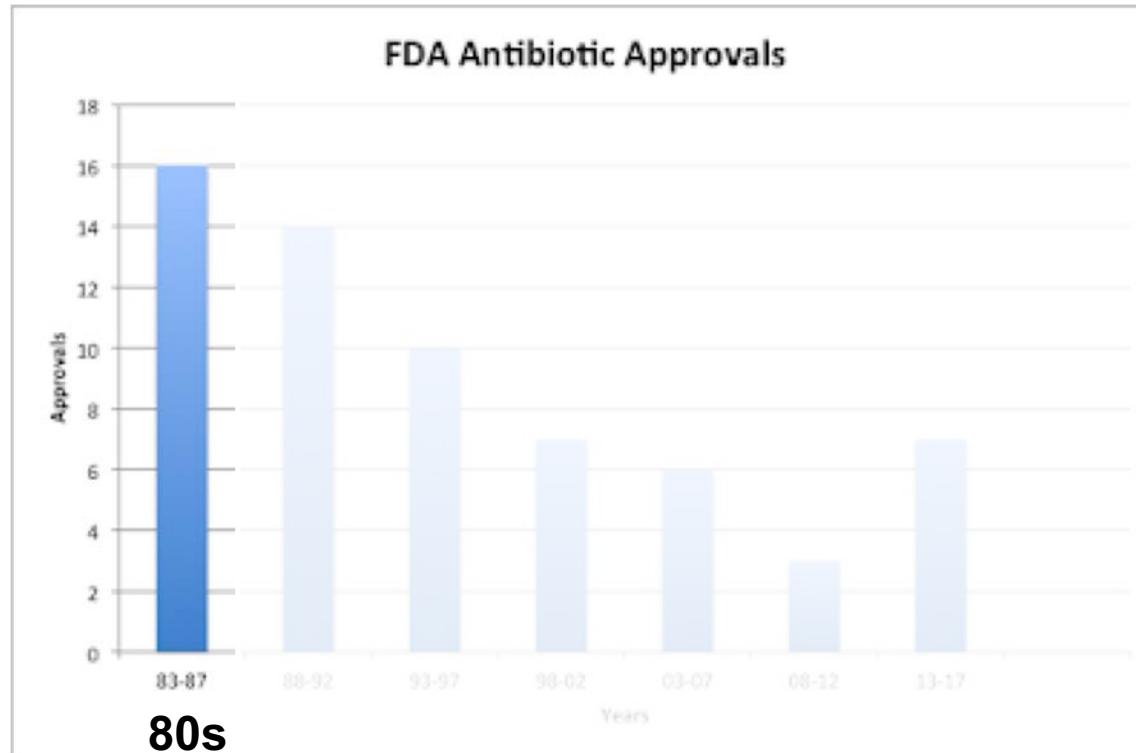
# Large production of antibiotics in 1970-1980 killed the phage therapy

- Industrial production
- Large spectrum
- Bactericidal activity
- Oral and IV
- Systemic diffusion  
to the infected site
- Numerous different kinds of families,  
with different mechanism of action



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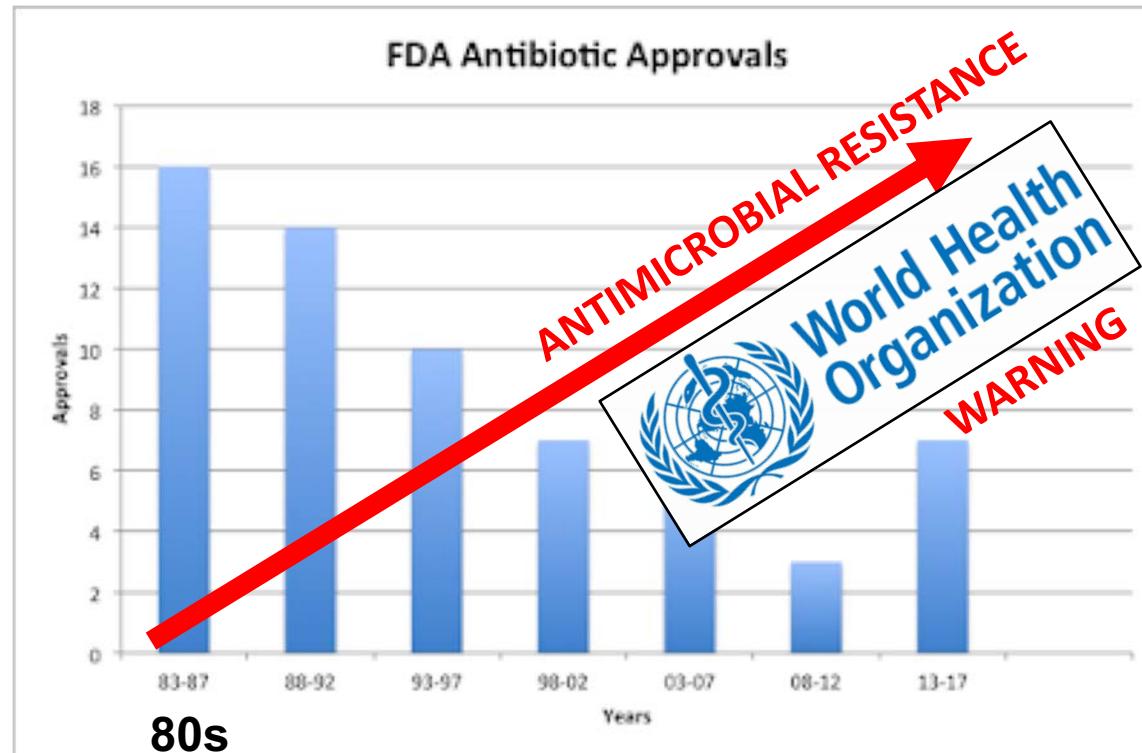
VS.



Complex virus-based personalized treatment without clear industrial process, not considered as a drug

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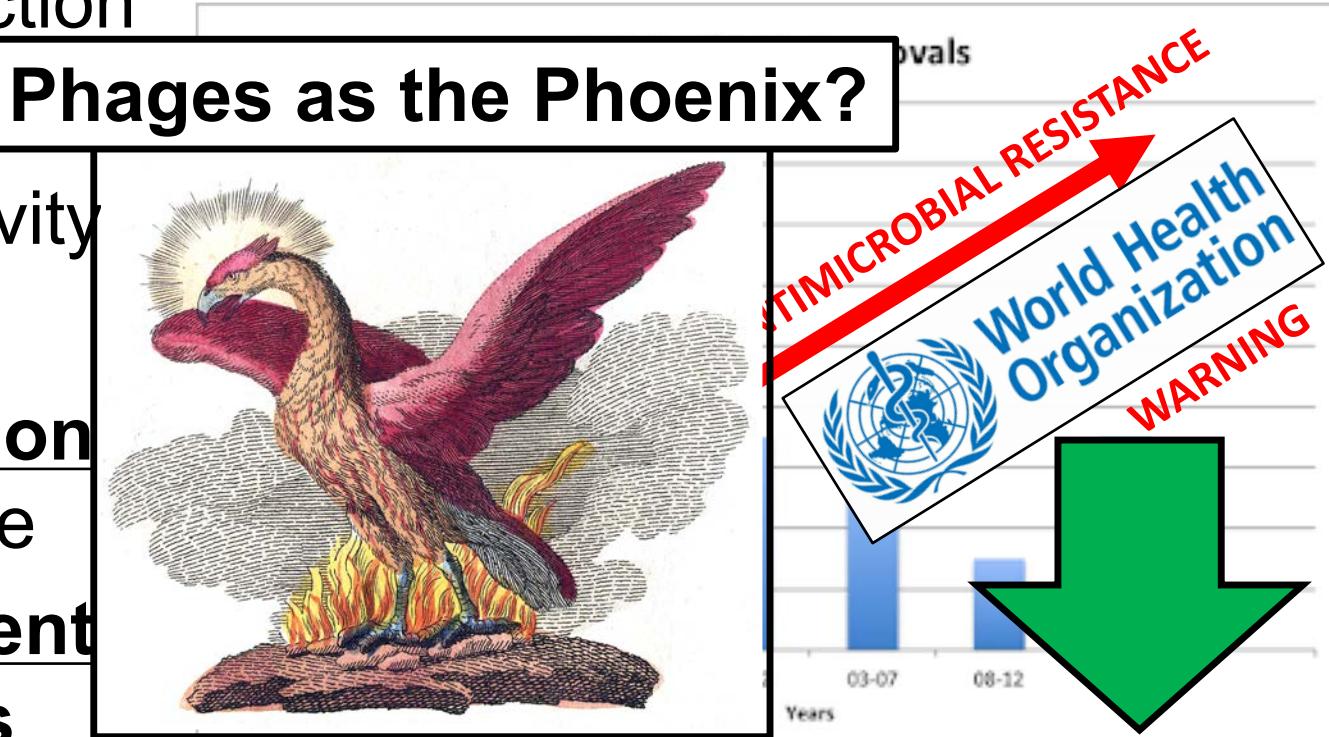
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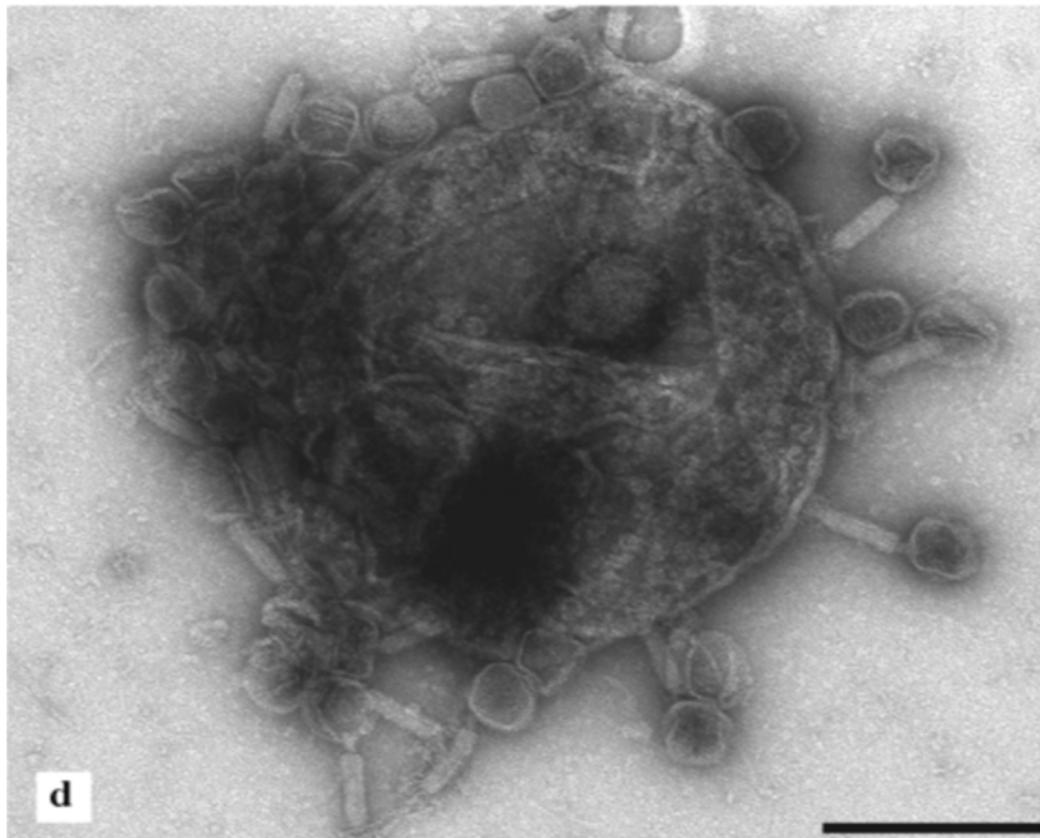
# Cocktails produced in 2020 by the Eliava Institute

- PYO Bacteriophage
- FERSIS Bacteriophage
- STAPHYLOCOCCAL Bacteriophage
- SES Bacteriophage
- INTESTI Bacteriophage
- ENKO Bacteriophage



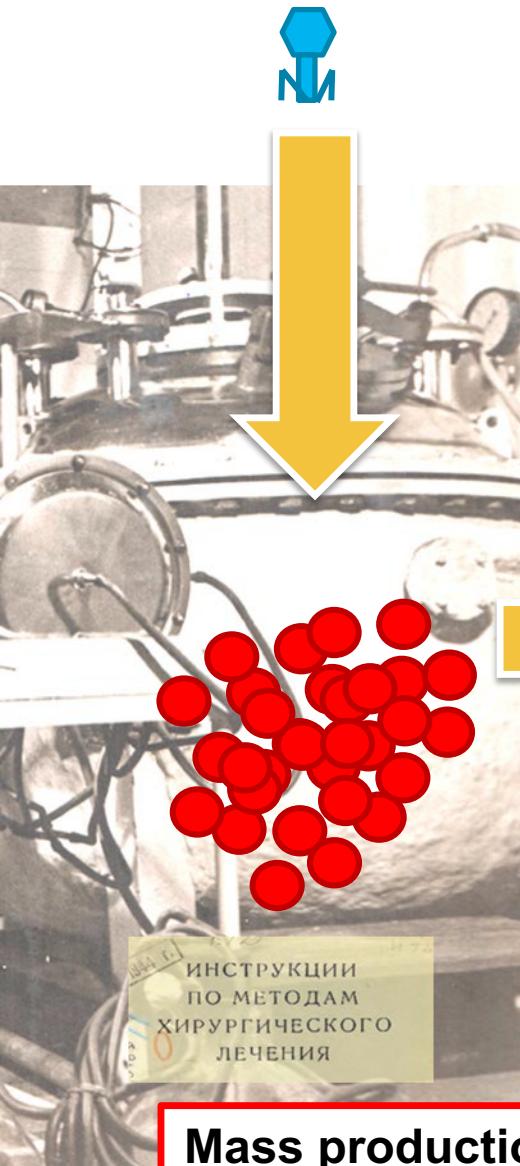
T. Ferry

Bacteriophage ISP (*Myoviridae*)

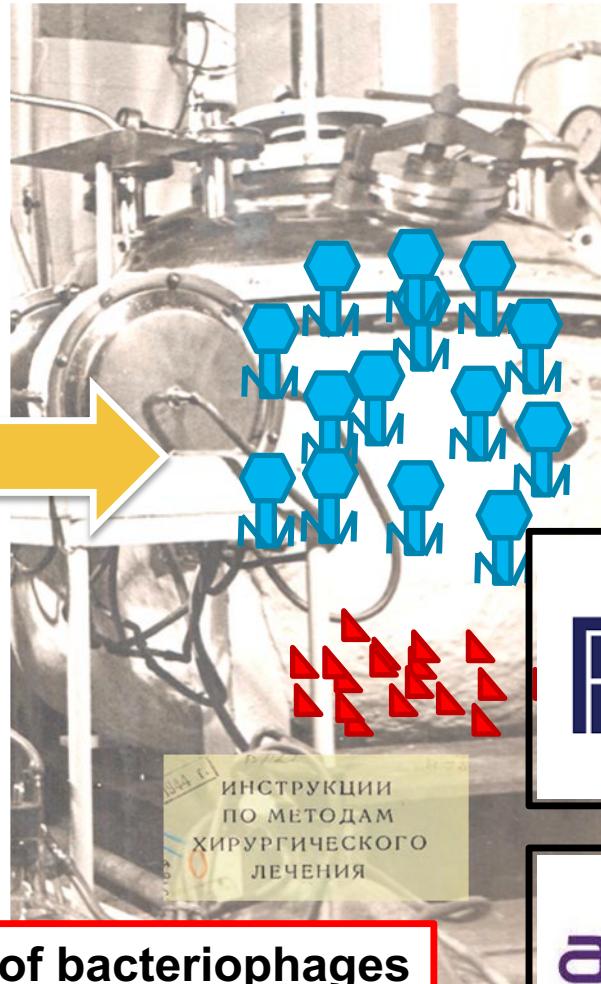


Merabishvili et al. PLoS ONE 2009

# Not meeting Good Manufacturing Practices (GMP)



Mass production of bacteriophages  
in Soviet Union during WWII



Pyrogenic  
Bacterial  
remnant?



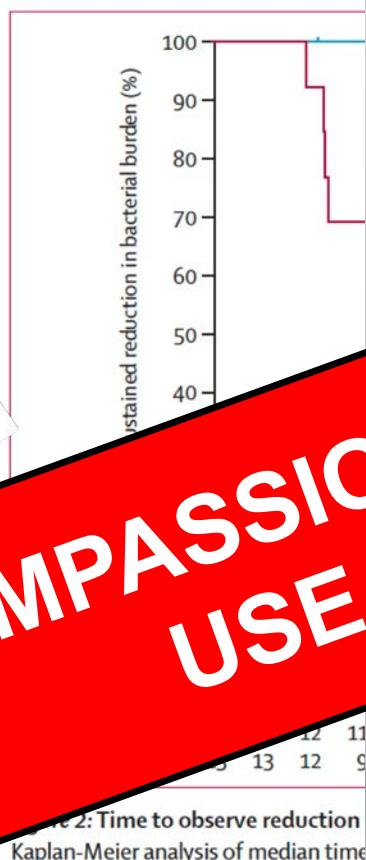
$10^6$  phages/mL



GMP

# Efficacy and tolerability of a cocktail of bacteriophages to treat burn wounds infected by *Pseudomonas aeruginosa* (PhagoBurn): a randomised, controlled, double-blind phase 1/2 trial

Patrick Jault, Thomas Leclerc, Serge J...  
Ronan Le Floch, Jean Vivien Schaal, C...



COMPASSIONATE  
USE



*Pseudomonas*

RECYDES  
RMA



# PHOSA



PHOSA & Phagothérapie

Consortium PHOSA

Communication

Contact



PHERECYDES  
PHARMA



LES PÔLES DE COMPÉTITIVITÉ  
MOTEURS DE CROISSANCE ET D'EMPLOI



bpifrance



PHERECYDES  
PHARMA

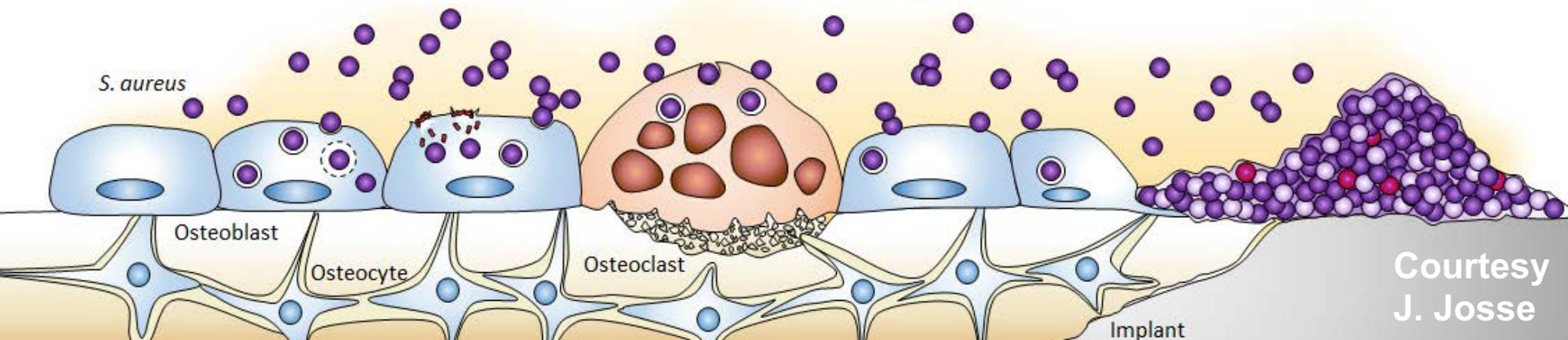
**Phage discovery**  
**to find active**  
**bacteriophages**  
**against Staphylococci**



**Phages anti-*S. aureus***

# Persisters in chronic BJI

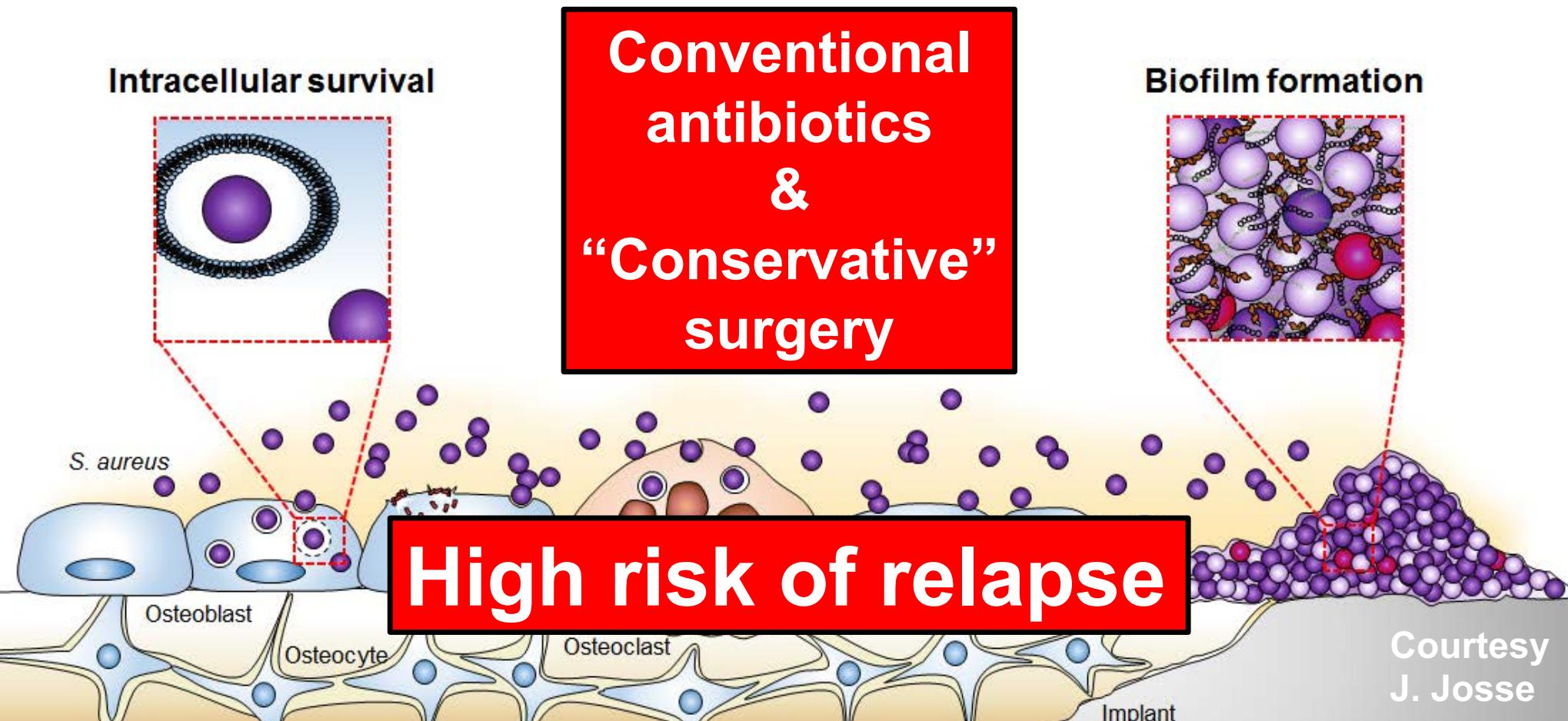
**“Bacterial cells that escape the effects of antibiotics without undergoing genetic change”**



Courtesy  
J. Josse

# Persisters in chronic BJI

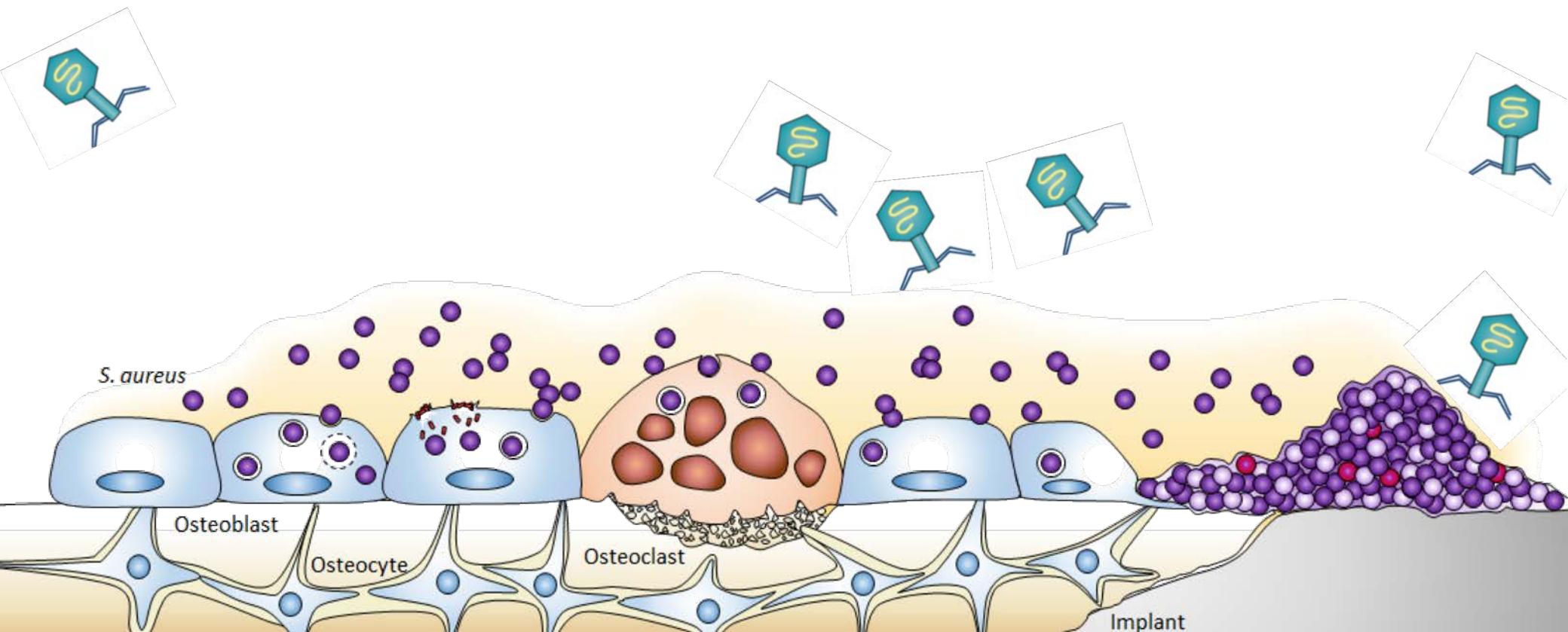
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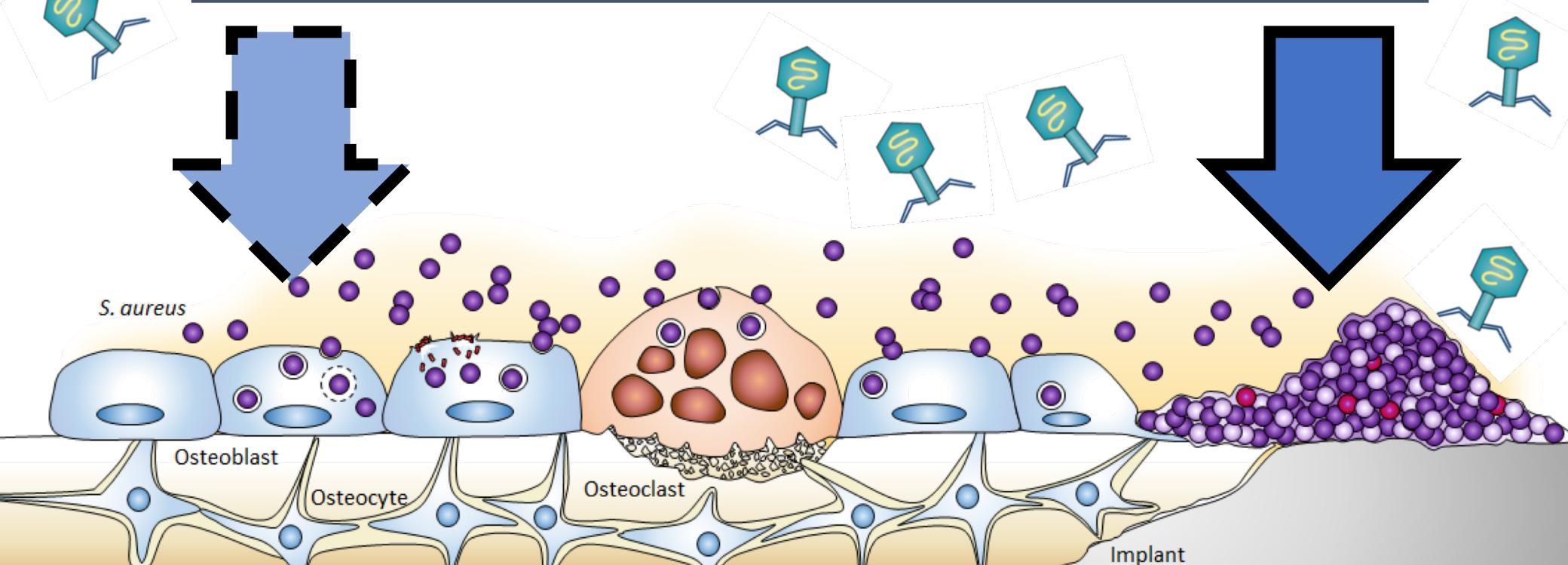
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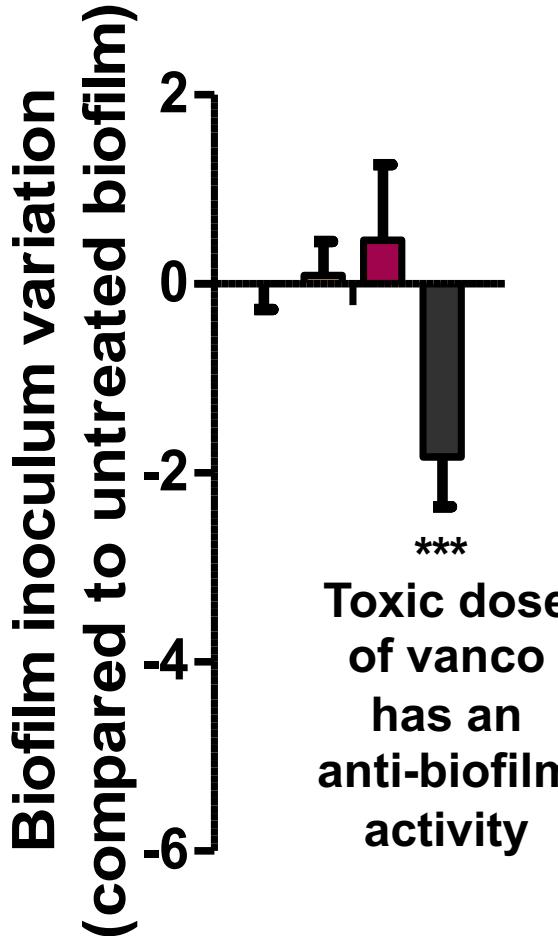


# Persisters in chronic BJI

**“Bacterial cells that escape the effects of antibiotics without undergoing genetic change”**

Bacteriophages  
have anti-persister activity

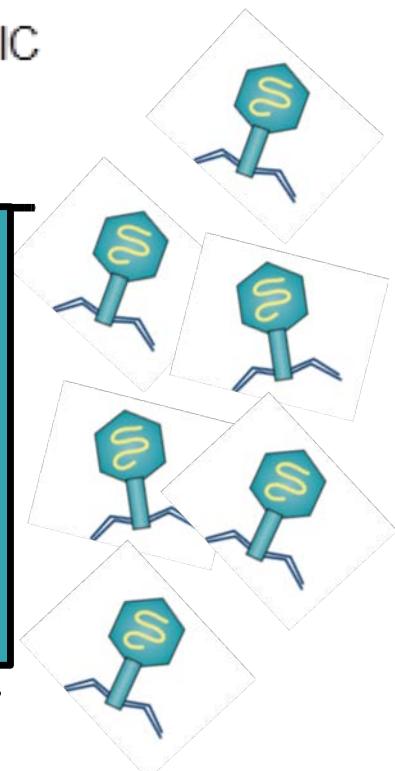
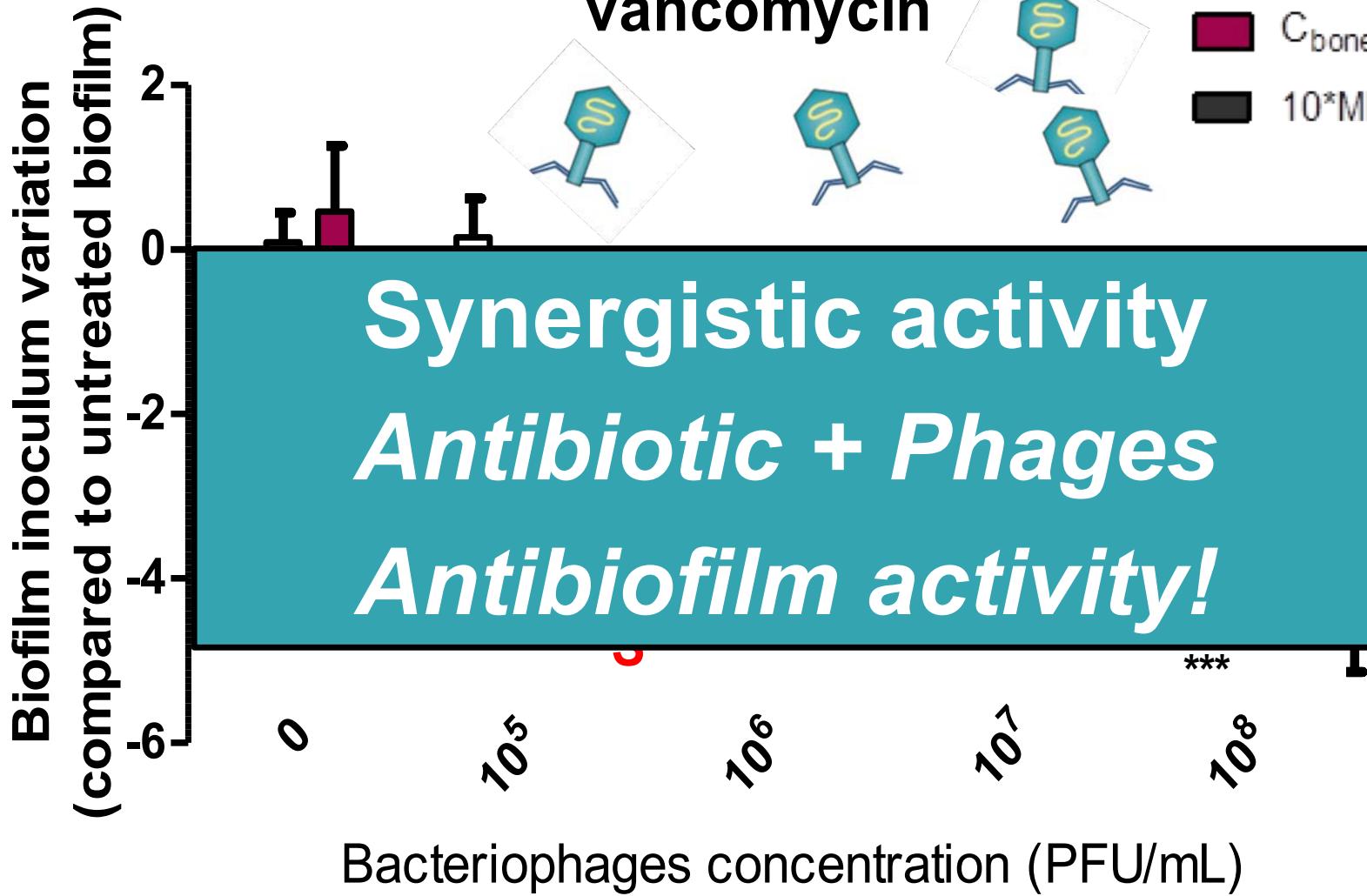




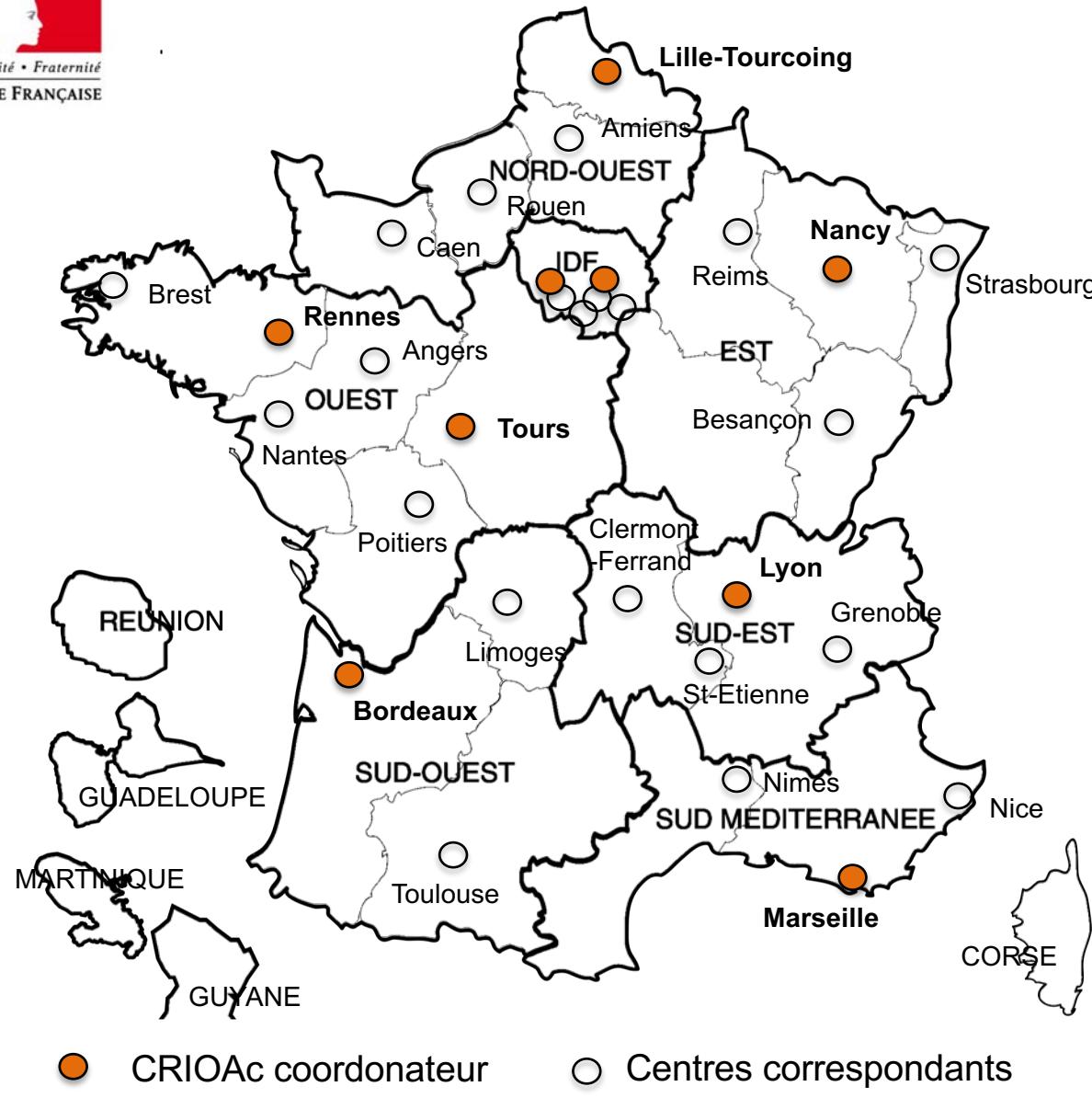
- No Antibiotic
- MIC
- $C_{bone} (4^*MIC)$
- $10^*MIC$



- No Antibiotic
- MIC
- $C_{\text{bone}} (4^*\text{MIC})$
- $10^*\text{MIC}$



# REFERENCE CENTERS FOR THE MANAGEMENT OF BONE AND JOINT INFECTION



**“CrioAc”  
Network**

G4 HOPITAUX  
UNIVERSITAIRES  
AMIENS CAEN  
LILLE ROUEN

CrioAc  
Grand Est

CENTRES DE RÉFÉRENCE  
DES INFECTIONS  
OSTÉO-ARTICULAIRES COMPLEXES  
CrioAc  
ÎLE DE FRANCE

CENTRES DE RÉFÉRENCE  
POUR LES INFECTIONS OSTÉO-ARTICULAIRES COMPLEXES  
CrioAc  
GSO

CrioAc  
LYON

CrioAc  
GSO

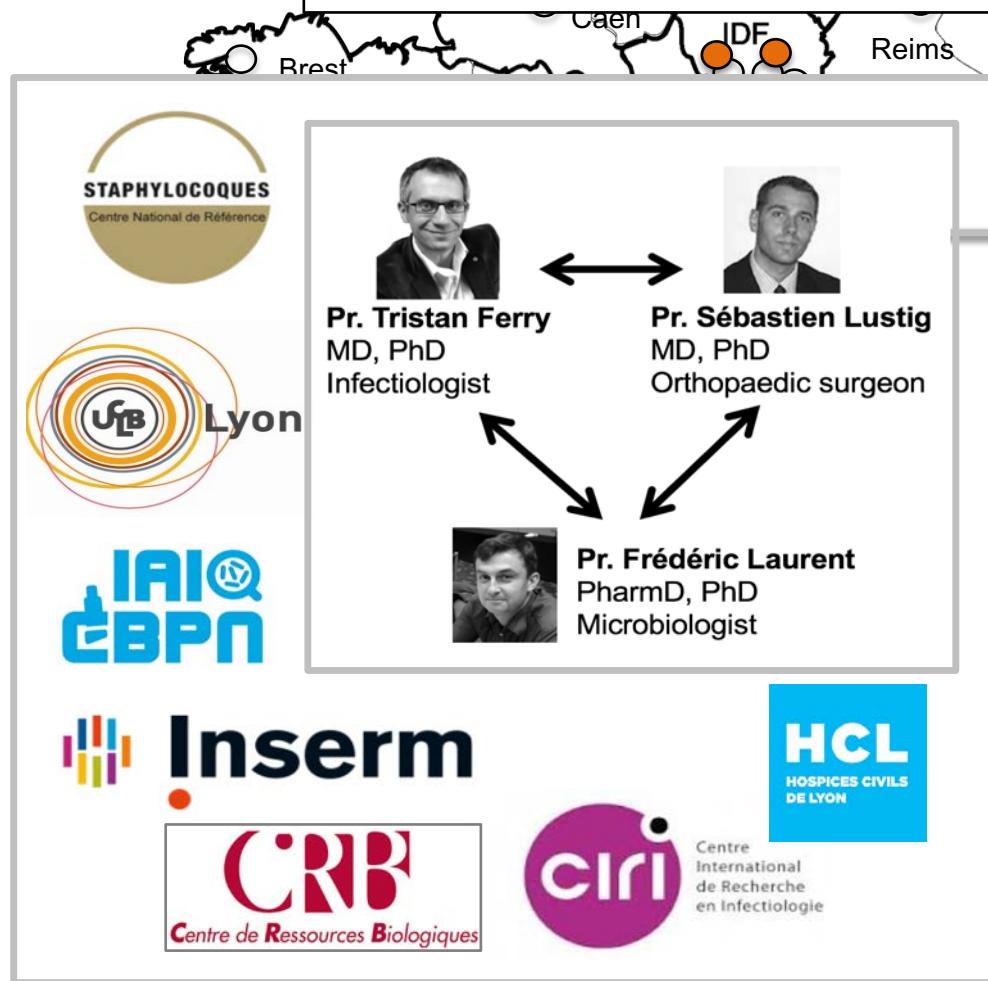


<http://www.crioac-lyon.fr>



@CrioacLyon

# CRIOAc Lyon



Multidisciplinarian management of the patient

Better understanding of the pathophysiology of BJI

Promotion of innovative treatments

# Declaration of Helsinki

Medical Research Involving Human Subjects



WMA

WORLD  
MEDICAL  
ASSOCIATION

Special Communication

World Medical Association Declaration of Helsinki  
Ethical Principles for Medical Research  
Involving Human Subjects

World Medical Association

## • Unproven Interventions in Clinical Practice

- 37. In the treatment of an **individual patient, where proven interventions do not exist or other known interventions have been ineffective, the physician**, after seeking expert advice, **with informed consent from the patient or a legally authorised representative, may use an unproven intervention if in the physician's judgement it offers hope of saving life, re-establishing health or alleviating suffering.**

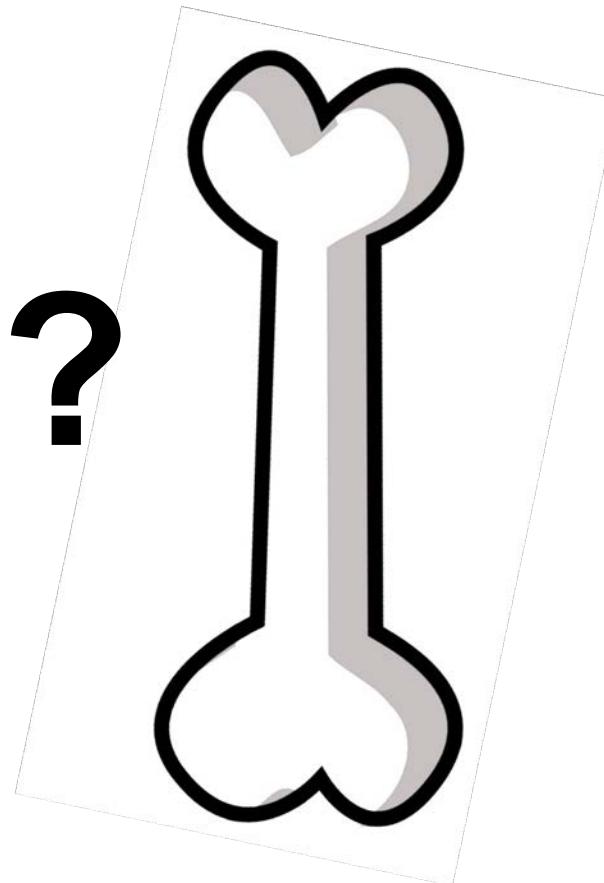
JAMA 2013  
The Journal of the American Medical Association

In France: **compassionate use,  
magistral preparation** by the hospital pharmacist

# Phagotherapy and bone and joint infection

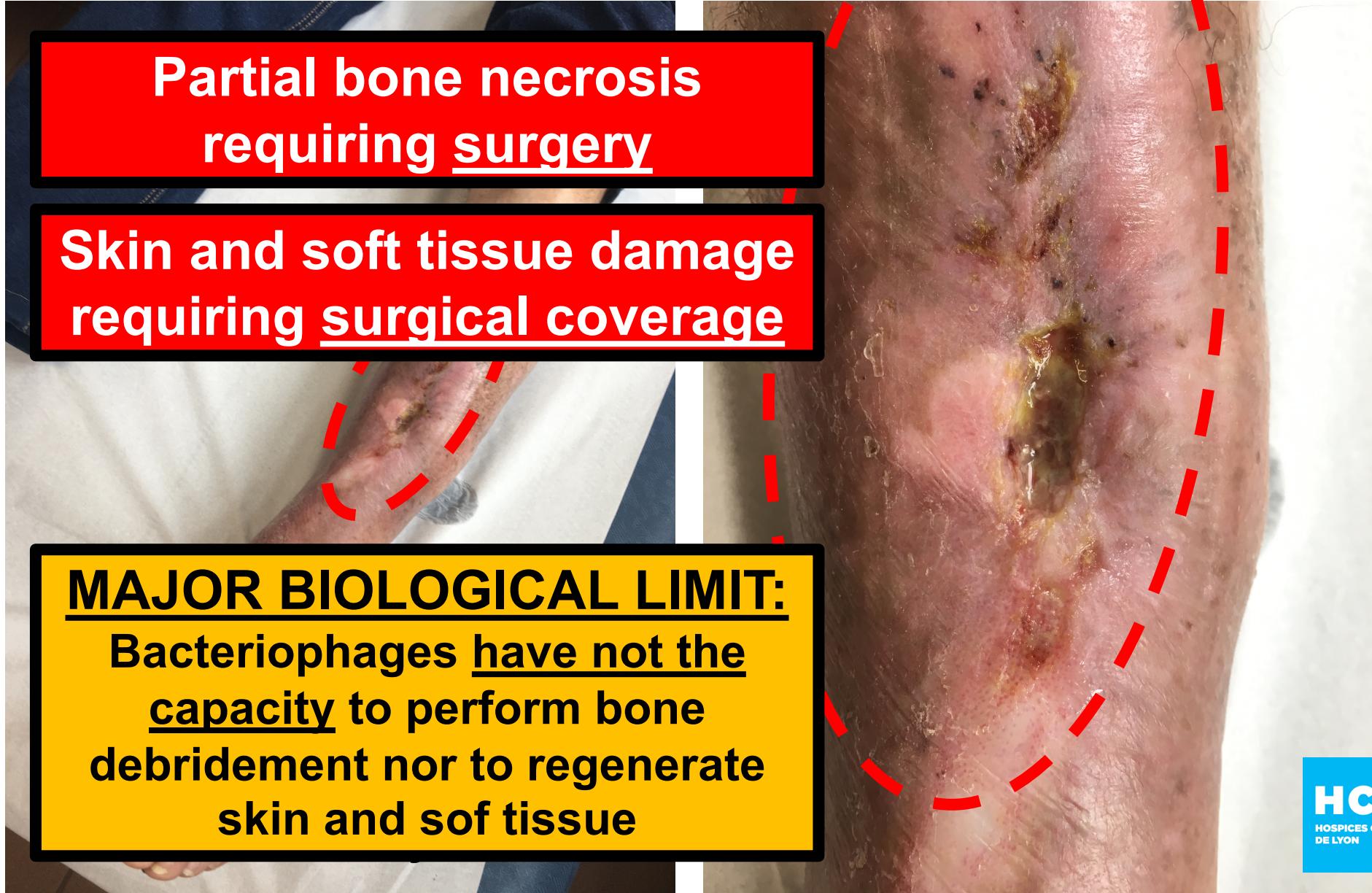


Non GMP  
bacteriophages  
in liquid form



No « injections »  
Iterative oral and local administrations  
No action on mechanical problems  
No action on soft tissue coverage





**Partial bone necrosis  
requiring surgery**

**Skin and soft tissue damage  
requiring surgical coverage**

**MAJOR BIOLOGICAL LIMIT:**

Bacteriophages have not the  
capacity to perform bone  
debridement nor to regenerate  
skin and soft tissue

# Clinical case #4

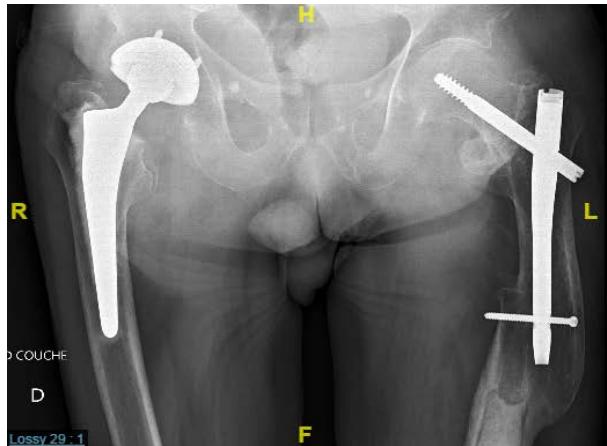
80-year-old man

**Relapsing MSSA** prosthetic left knee infection (past revision)

**Failure under suppressive oral antimicrobial therapy**

Complex orthopaedic situation with past femoral fracture

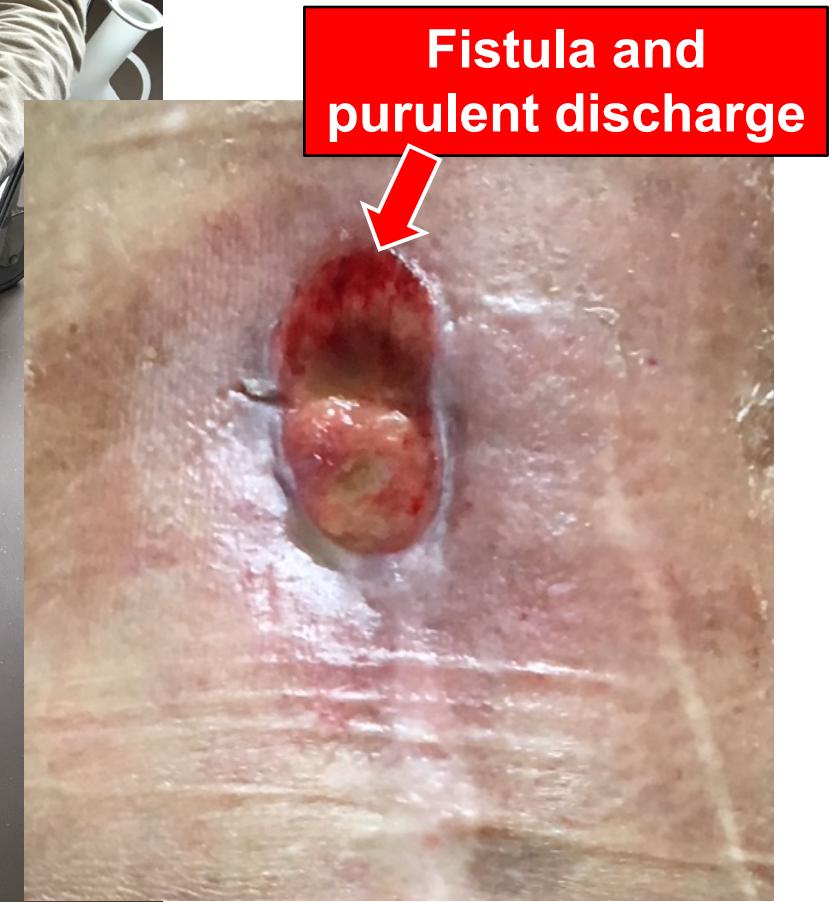
Impossible to walk (painful knee)



Ferry T. et al. 2020

 **frontiers**  
in Medicine





Fistula and  
purulent discharge

# Clinical case #4

Amputation  
(but not feasible !) ?



Doing nothing, but poor clinical situation with risk of complication and death

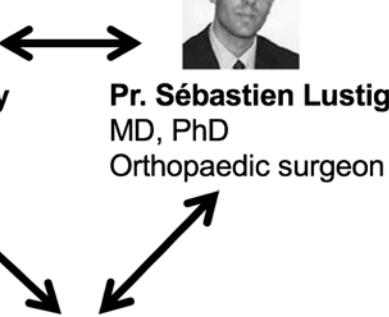
Conservative surgery  
“Debridement And Implant Retention” (DAIR) +  
innovative approach to disrupt biofilm +  
suppressive antimicrobial therapy ?



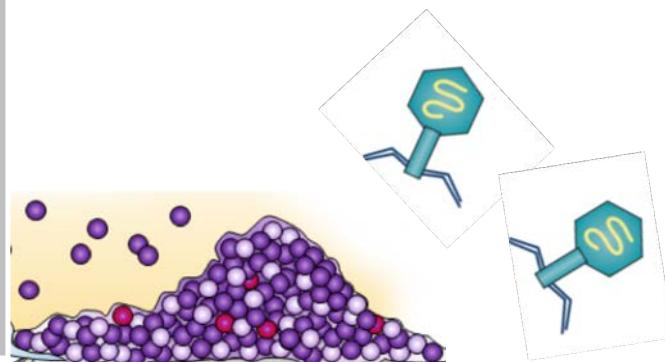
# Lyon Phage team

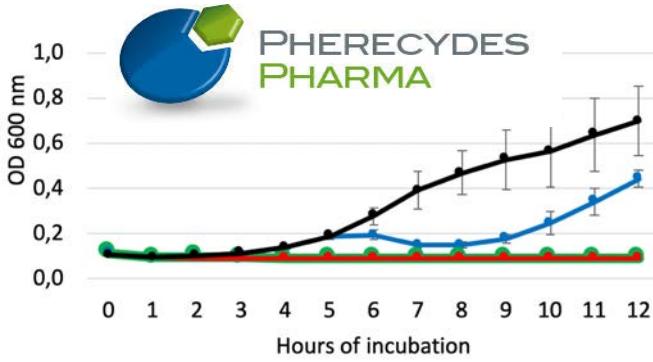


Centre  
International  
de Recherche  
en Infectiologie

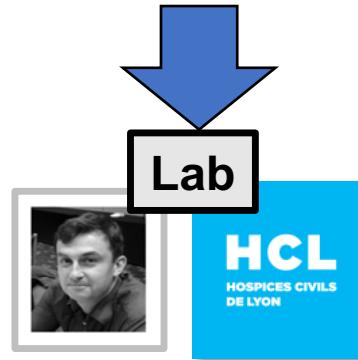


**Dr. Gilles Leboucher**  
PharmD  
Pharmacist





## Phagogram Selection of active bacteriophages

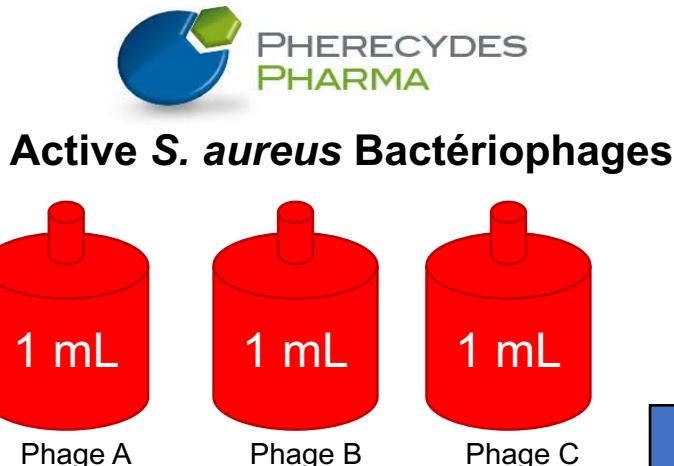


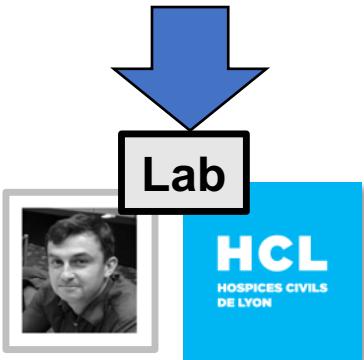
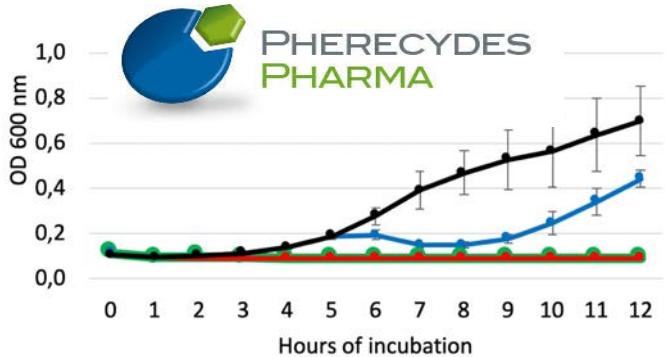
Under the supervision of

**ansm**

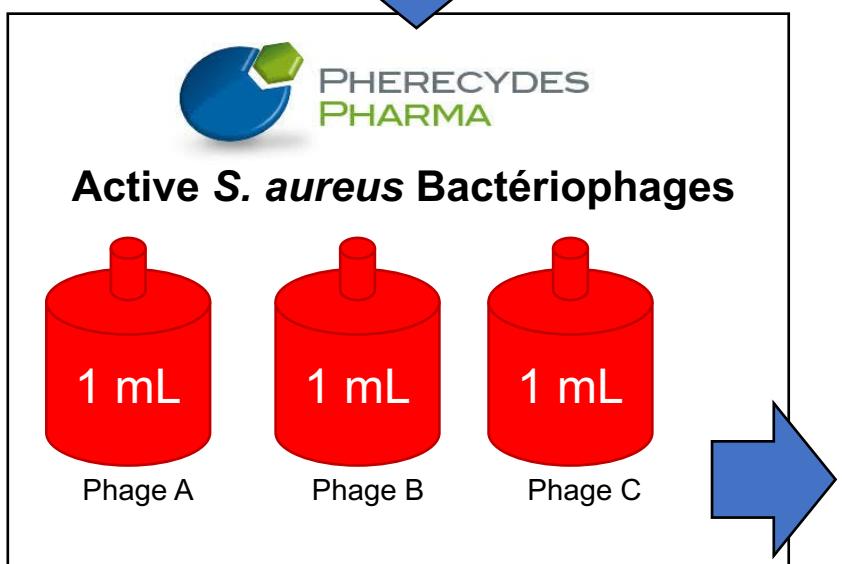
Agence nationale de sécurité du médicament  
et des produits de santé

French Health Authority





Under the supervision of  
**anSM**  
Agence nationale de sécurité du médicament  
et des produits de santé  
French Health Authority







**“Debridement And Implant  
Retention” (DAIR)**





# “PhagoDAIR”



**One shot peroperative phage  
application after “DAIR”**



# Clinical case #4

Post-operative antibiotics:

Daptomycin + Rifampin

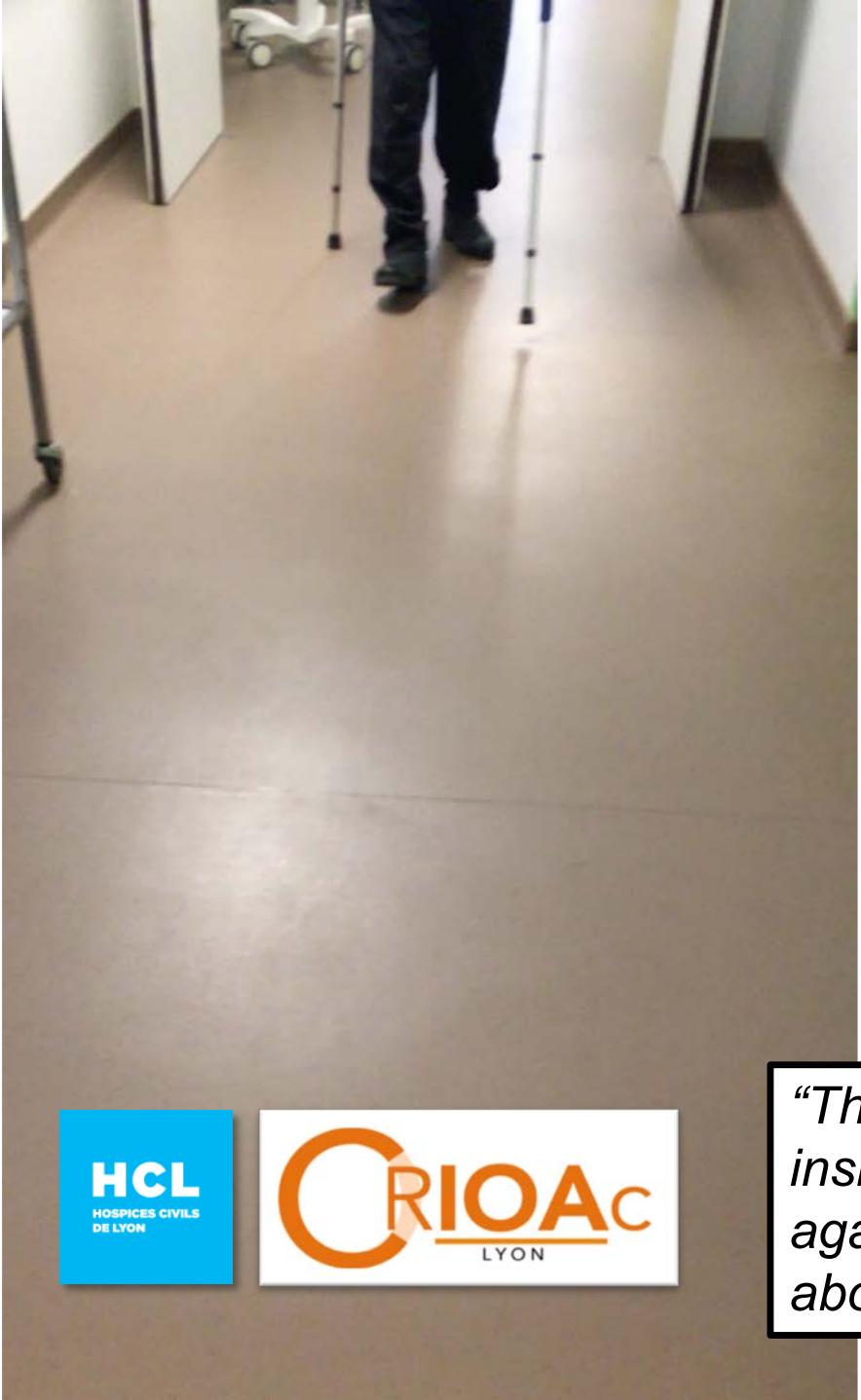
At day 4 (only MSSA in all intraoperative samples):

Levofloxacin + Rifampin

Then:

Cefalexin as suppressive antimicrobial therapy





*"The bacteriophages saved my life, he insists. I never thought one day to walk again. And to say that doctors were talking about cutting my leg off!"*

R.N.

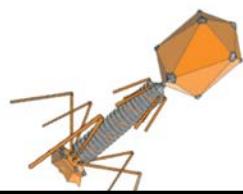
# Innovations for the treatment of a complex bone and joint infection due to XDR *Pseudomonas aeruginosa* including local application of a selected cocktail

Tristan Ferry , Fabien Boucher, Cindy Fevre, Théophile Jérôme Josse, Christian Chidiac, Guillaume L'hostis

*Journal of Antimicrobial Chemotherapy*, Volume 75

Open Forum Infectious Diseases

BRIEF REPORT



# The Potential Innovative Use of Bacteriophages Within the DAC® Hydrogel to Treat Patients With Knee Megaprostheses Infection Requiring “Debridement Antibiotics and Implant Retention” and Soft Tissue Coverage as Salvage Therapy

**Tristan Ferry**<sup>1,2,3,4</sup>, **Cécile Batailler**<sup>2,3,5</sup>, **Charlotte Petitjean**<sup>6</sup>, **Joseph Chateau**<sup>7</sup>,  
**Cindy Fevre**<sup>6</sup>, **Emmanuel Forestier**<sup>8</sup>, **Sophie Brosset**<sup>7</sup>, **Gilles Leboucher**<sup>9</sup>,  
**Camille Kolenda**<sup>2,3,4,10</sup>, **Frédéric Laurent** and  
**Sébastien Lustig**<sup>2,3,5</sup> on behalf of the Lyon BJI Study Group

# Salvage Debridement, Implant Retention ("Local Injection of a Solution of Bacteriophages: Is It an Elderly Patient With *Staphylococcus aureus* Infection?

Ferry T. 2018

# Phage therapy as adjuvant to conservative surgery and antibiotics to salvage patients with relapsing *S. aureus* prosthetic knee infection

Tristan Ferry<sup>1\*</sup>, Camille Kolenda<sup>1</sup>, Cécile Batailler<sup>1</sup>, Claude-Alexandre Gustave<sup>1</sup>, Sébastien Lustig<sup>1</sup>, Matthieu Malatray<sup>1</sup>, Cindy Fevre<sup>2</sup>, Jérôme JOSSE<sup>1</sup>, Charlotte Petitjean<sup>1</sup>, Christian Chidiac<sup>1</sup>, Gilles Leboucher<sup>1</sup>, Frédéric Laurent<sup>1</sup>



# Conclusion



Lyon 1



Centre  
International  
de Recherche  
en Infectiologie



## • Ciment aux antibiotiques

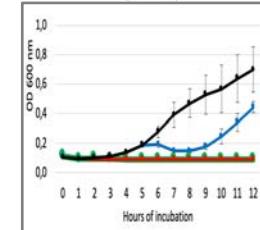
- Pharmacocinétique de libération des antibiotiques
- Synergie des combinaisons
- Ciments commerciaux ≠ Rajout manuel

## • Substituts osseux aux antibiotiques

- Pharmacocinétique
- Haut potentiel dans l'ostéomyélite chronique
- Essai thérapeutique CONVICTION

## • Bactériophages - Phagothérapie

- Expertise CRIoAc Lyon
- **Phages 2.0 ► 19 patients traités en 3 ans**
- Indications pertinentes ?
- Besoin d'un centre expert national
- Développer des essais thérapeutique (réseau CRIoAc)



# *Lyon BJI Study group*

## **Coordinator: Tristan Ferry**

**Infectious Diseases Specialists** – Tristan Ferry, Florent Valour, Thomas Perpoint, Florence Ader, Sandrine Roux, Claire Triffault-Filit, Agathe Becker, Anne Conrad, Marielle Perry, Cécile Pouderoux, Nicolas Benech, Pierre Chauvelot, Johanna Lippman, Evelyne Braun, Christian Chidiac

**Surgeons – Sébastien Lustig**, Elvire Servien, Cécile Batailler, Stanislas Gunst, Axel Schimdt, Matthieu Malatray, Elliott Sappey-Marinier, Michel-Henry Fessy, Anthony Viste, Jean-Luc Besse, Philippe Chaudier, Lucie Louboutin, Quentin Ode, Adrien Van Haecke, Marcelle Mercier, Vincent Belgaid, Arnaud Walch, Sébastien Martres, Franck Trouillet, Cédric Barrey, Ali Mojallal, Sophie Brosset, Camille Hanriat, Hélène Person

**Microbiologists – Frederic Laurent**, Céline Dupieux, Laetitia Berraud, Camille Kolenda, Jérôme Josse, Tiphaine Roussel-Gaillard

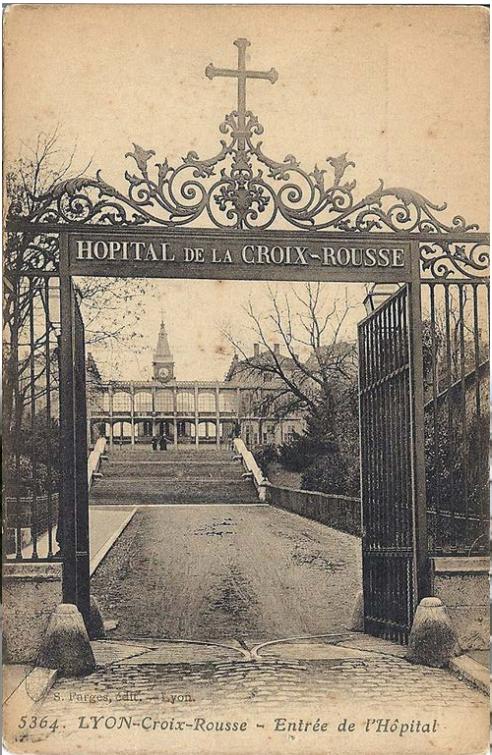
**Nuclear Medicine** – Isabelle Morelec, Marc Janier, Francesco Giammarile

**PK/PD specialists** – Michel Tod, Marie-Claude Gagnieu, Sylvain Goutelle

**Clinical Research Assistant** – Eugénie Mabrut



# Croix-Rousse Hospital



# SAVE THE DATE!!!

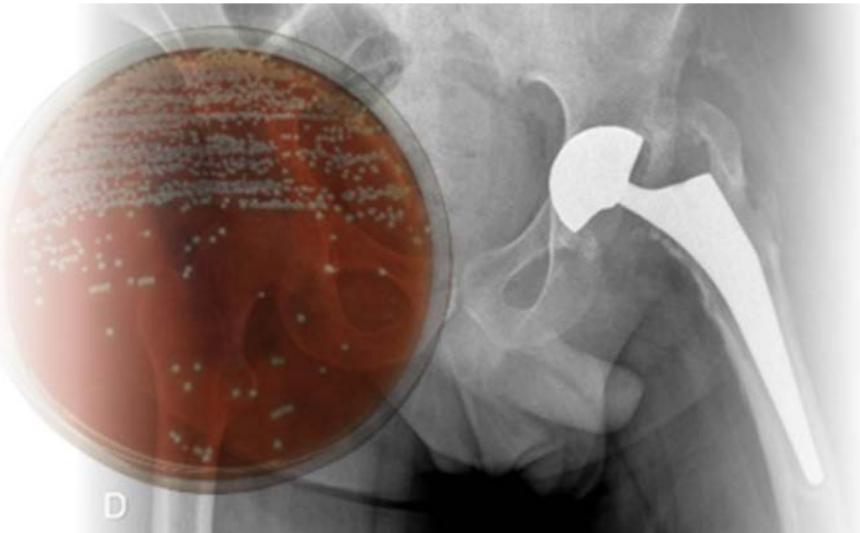


DIRECTION  
GÉNÉRALE  
DE L'OFFRE  
DE SOINS



5ème Congrès  
national des CRIoAC  
À Lyon  
Les 20-21-22 octobre 2021 !

<http://www.crioac-lyon.fr>



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