



DÉCLARATION DE LIENS D'INTÉRÊTS

Conférencier: Estelle, JUMAS-BILAK, Montpellier

Je n'ai pas de lien d'intérêt potentiel à déclarer



Du contrôle microbiologique à l'écologie microbienne

Complexité des populations bactériennes dans l'environnement hospitalier

Estelle Jumas-Bilak



HydroSciences
Montpellier
Pathogènes



MUSE
MONTPELLIER UNIVERSITÉ D'EXCELLENCE

Environnements



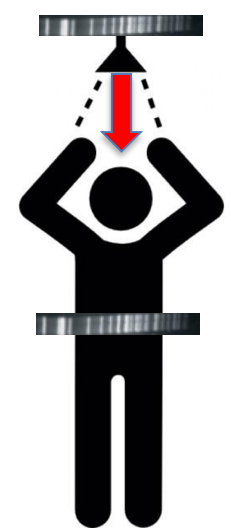
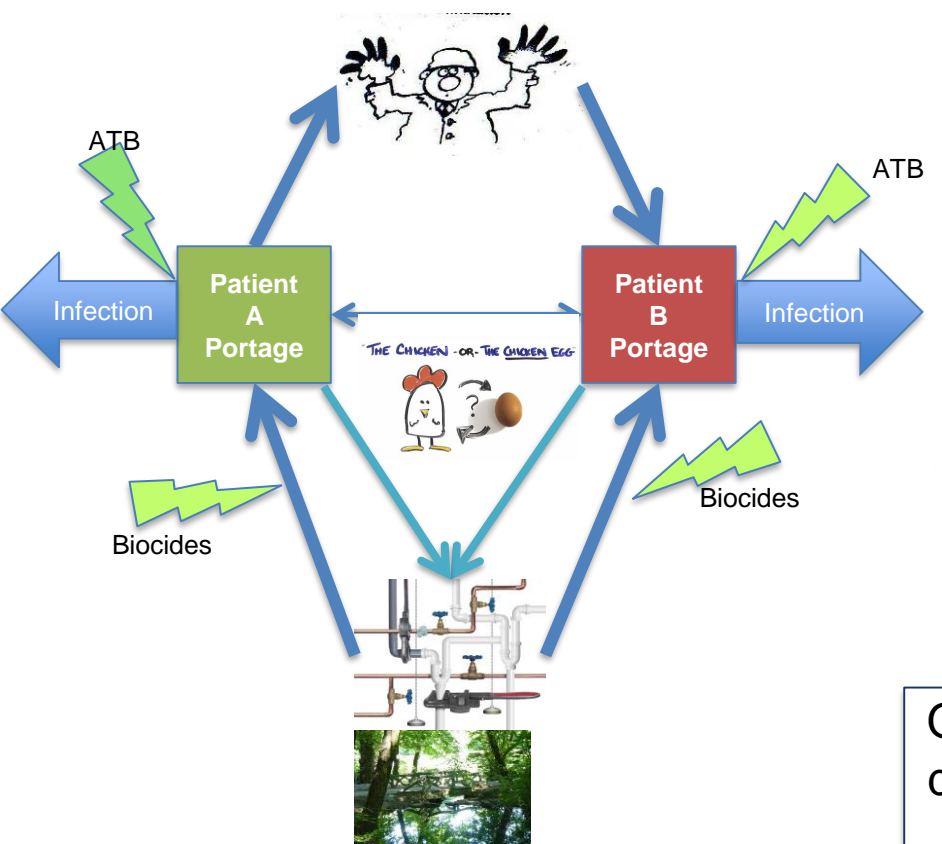
Santé

Hydriques

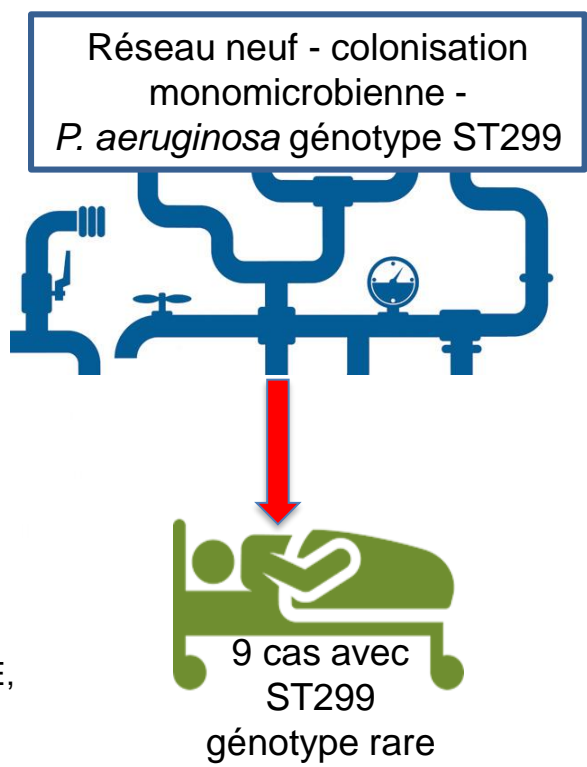


Département
D'Hygiène Hospitalière

Le casse-tête de l'origine environnementale des IAS...



Romano S, et al. ICHE, 2013



Quelques rares situations où la transmission de *P. aeruginosa* de l'environnement vers le patient est démontrée.

RESEARCH

Open Access



The sink as a potential source of transmission of carbapenemase-producing *Enterobacteriaceae* in the intensive care unit

 Deborah De Geyter^{1*}, Lieve Blommaert¹, Nicole Verbracken¹, Mark Sevenois², Luc Huyghens², Helena Martini¹, Lieve Covens¹, Denis Piérard¹ and Ingrid Wybo¹

Abstract

Background: Carbapenemase-producing *Enterobacteriaceae* (CPE) are emerging pathogens that represent a major public health threat. In the University Hospital of Brussels, the incidence of new patients with CPE rose from 1 case in 2010 to 35 cases in 2015. Between January and August 2015, five patients became infected/colonized with CPE during their stay in the same room in the intensive care unit (ICU). Since the time period between those patients was relatively short and the strains belonged to different species with different antibiograms and mechanisms of resistance, the hypothesis was that the environment could be a possible source of transmission.

Methods and results: Environmental samples suggested that a contaminated sink was the source of the outbreak. Besides other strains, *Citrobacter freundii* type OXA-48 was frequently isolated from patients and sinks. To investigate the phylogenetic relationship between those strains, pulsed-field gel electrophoresis was performed. The strains isolated from patients and the sink in the implicated room were highly related and pointed to sink-to-patient transmission. In total, 7 of 8 sinks in the isolation rooms of the ICU were found to be CPE contaminated. To control the outbreak, the sinks and their plumbings were replaced by new ones with another structure, they were flushed every morning with a glucoprotamin solution and routines regarding sink practices were improved leading to discontinuation of the outbreak.

Conclusions: This outbreak highlights that hospital sink drains can accumulate strains with resistance genes and become a potential source of CPE.

Keywords: Carbapenemase-producing *Enterobacteriaceae*, Hospital sinks, Outbreak, Intensive care unit, *Citrobacter freundii* OXA-48, Transmission

SURVEILLANCE AND OUTBREAK REPORT

Persisting transmission of carbapenemase-producing *Klebsiella pneumoniae* due to an environmental reservoir in a university hospital, France, 2012 to 2014

 B Clarivet¹, D Grau¹, E Jumas-Bilak^{1,2}, H Jean-Pierre³, A Pantel^{4,5}, S Parer^{1,2}, A Lotthé^{1,2}

1. Department of Infection Control and Prevention, University Hospital of Montpellier, France

Contaminated Handwashing Sinks as the Source of a Clonal Outbreak of KPC-2-Producing *Klebsiella oxytoca* on a Hematology Ward

 Eva Leitner,^a Gernot Zarfel,^a Josefa Luxner,^a Kathrin Herzog,^b Shiva Pekard-Amenitsch,^c Martin Hoenigl,^d Thomas Valentin,^d Gebhard Feierl,^a Andrea J. Grisold,^a Christoph Högenauer,^b Heinz Sill,^e Robert Krause,^d Ines Zollner-Schwetz^d

Institute of Hygiene Microbiology and Environmental Medicine, Medical University of Graz, Graz, Austria^a; Division of Gastroenterology and Hepatology, Department of Internal Medicine, Medical University of Graz, Graz, Austria^b; Austrian Agency for Health and Food Safety, Institute of Medical Microbiology and Hygiene, Graz, Austria^c; Section of Infectious Diseases and Tropical Medicine, Department of Internal Medicine, Medical University of Graz, Graz, Austria^d; Division of Hematology, Department of Internal Medicine, Medical University of Graz, Graz, Austria^e

We investigated sinks as possible sources of a prolonged *Klebsiella pneumoniae* carbapenemase (KPC)-producing *Klebsiella oxytoca* outbreak. Seven carbapenem-resistant *K. oxytoca* isolates were identified in sink drains in 4 patient rooms and in the medication room. Investigations for resistance genes and genetic relatedness of patient and environmental isolates revealed that all the isolates harbored the *bla*_{KPC-2} and *bla*_{TEM-1} genes and were genetically indistinguishable. We describe here a clonal outbreak caused by KPC-2-producing *K. oxytoca*, and handwashing sinks were a possible reservoir.

J PREV MED HYG 2017; 58: E302-E307

ORIGINAL ARTICLE

VIM-*Klebsiella oxytoca* outbreak in a Neonatal Intensive Care Unit. This time it wasn't the drain

 R. HERRUZO¹, G. RUIZ², S. GALLEGO³, J. DIEZ³, A. SARRIA², F. OMEÑACA⁴

¹ Department of Preventive Medicine and Public Health and Microbiology, School of Medicine, Autonomous University of Madrid, Spain; ² Microbiology Service, University Hospital "La Paz", Madrid, Spain; ³ Preventive Medicine Service, University Hospital "La Paz", Madrid, Spain; ⁴ Neonatology Service, Children Hospital. University Hospital "La Paz", Madrid, Spain

Keywords

 VIM-*Klebsiella oxytoca* • NICU • Sink (drain)

Intervention =
suppression des points d'eau
dans les chambres de réanimation

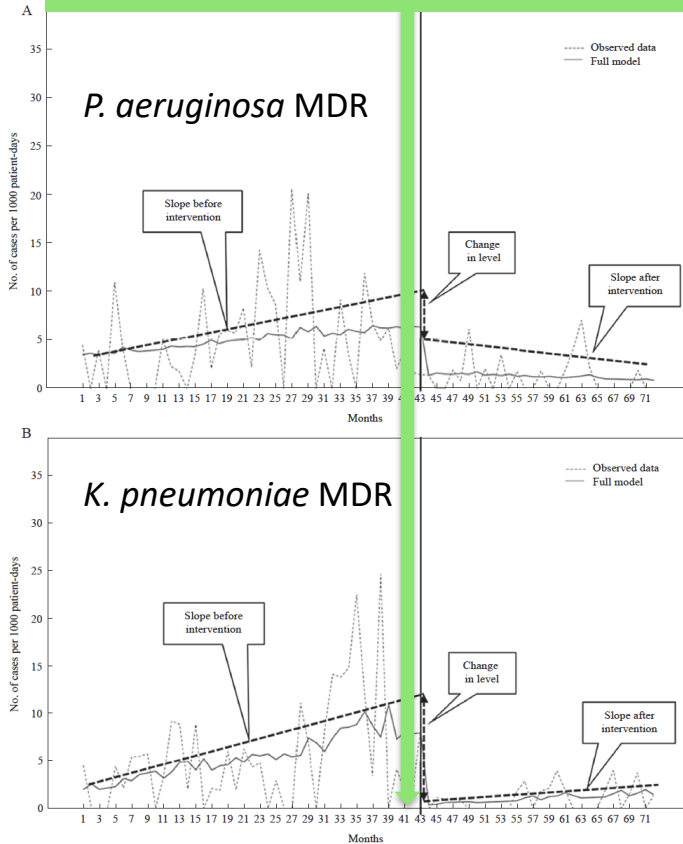


Figure 2. Changes in the incidence rates of multidrug-resistant bacteria in the intensive care units. (A) Multidrug-resistant *Pseudomonas aeruginosa*. (B) Multidrug-resistant *Klebsiella pneumoniae*. (C) Overall multidrug-resistant Gram-negative bacteria.



Control of endemic multidrug-resistant Gram-negative bacteria after removal of sinks and implementing a new water-safe policy in an intensive care unit

E. Shaw^{a,b,*}, L. Gavalda^c, J. Càmarà^d, R. Gasull^e, S. Gallego^e, F. Tubau^{d,f}, R.M. Granada^e, P. Ciercoles^a, M.A. Dominguez^{d,b,g}, R. Mañez^e, J. Carratalà^{a,b,g}, M. Pujol^{a,b}

D'après Shaw et al., 2018

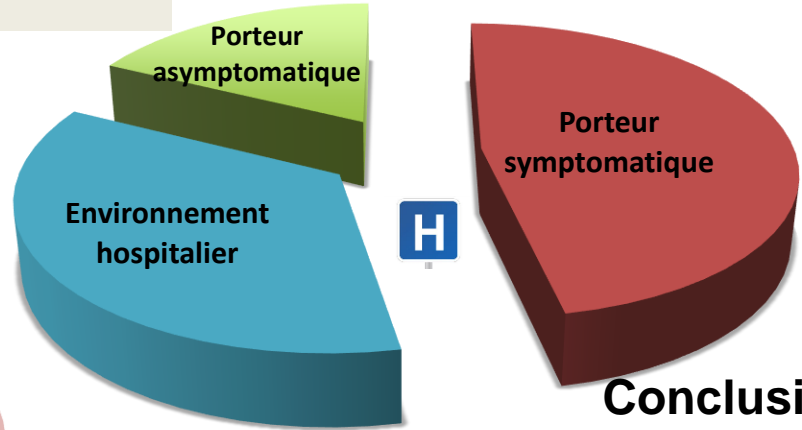
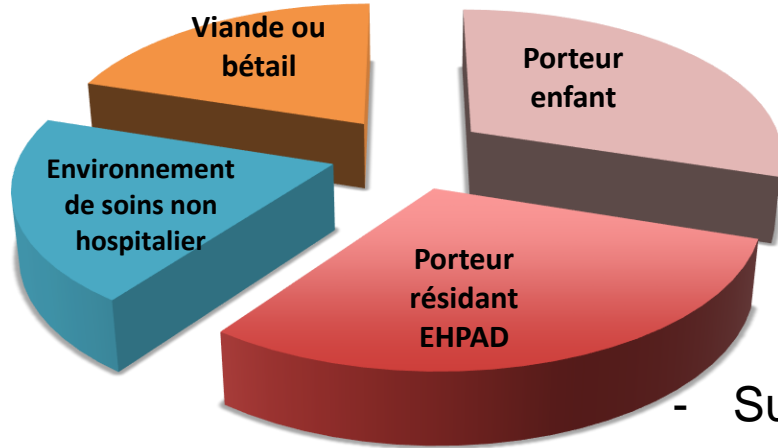
Taux d'incidence des bactéries à Gram négatif MDR:

Avant intervention: 9.15 / 1000 patients-jour

Après intervention: 2.20 / 1000 patients-jour

D'après *Durovic et al., CMI, 2018*
PRISMA guidelines
24 articles originaux

Voies de transmission de *C. difficile*



Conclusions:

- Optimiser et élargir le bio-nettoyage sporicide à distance du patient
- Surveillance/recherche véto/agro-alimentaire
- ***Rien n'est suggéré sur la surveillance microbiologique de l'environnement de soins***

VII. Environmental cleaning and disinfection

Does environmental disinfection of rooms of patients with CDI decrease the transmission of C. difficile compared to routine cleaning?

Recommendation for the outbreak setting

14. Introduce daily environmental sporicidal disinfection and terminal disinfection of rooms of patients with CDI to decrease the transmission of CDI (strong recommendation, very low quality of evidence).

Sarah Tschudin-Sutter¹ MD MSc, Ed J. Kuijper² PhD, Ana Durovic¹, Maria J. G. T. Vehreschild³ MD, Frédéric Barbut⁴ PhD, Catherine Eckert⁴ PhD, Fidelma Fitzpatrick⁵ MD, Markus Hell⁶ MD, Torbjörn Norén⁷ MD, Jean O'Driscoll⁸ MB, John Coia⁹ MD, Petra Gastmeier MD¹⁰, Lutz von Müller¹¹ MD, Mark H. Wilcox¹² MD PhD, Andreas F. Widmer¹ MD MSc, on behalf of the Committee*

Chaînon manquant qui permettrait d'établir des liens de causalités?

Hypothèse: hygiène hospitalière souffre d'un manque de données en microbiologie environnementale pour une meilleure argumentation microbiologique des mécanismes de transmission.

PRATIQUE QUOTIDIENNE

SURVEILLANCE DE L'ENVIRONNEMENT HOSPITALIER : FRANCHIR LES LIMITES

RECHERCHE

**DE L'ESPÈCE BACTÉRIENNE À L'ECOTYPE:
NE PLUS NÉGLIGER LA DIVERSITÉ DES BACTÉRIES HOSPITALIÈRES**

- Peu de laboratoires ont un budget et du personnel dédiés à l'environnement
- Les laboratoires mixtes ne donnent pas la priorité à l'environnement
- Les contraintes réglementaires sont lourdes (légionelles, qualification en endoscopie, suivi des ZEM...)
- Equilibre entre la **réactivité** et la **qualité** difficile à trouver

Réactivité:

- Investigations
- Surveillance des situations à risque, cartographie
- Surveillance des émergences
- Développement d'outils spécifiques et d'indicateurs
- Optimisation et validation de protocoles
- ...

*Laboratoire de microbiologie environnementale
ou d'écologie microbienne hospitalière*
Flexibilité

Connexion directe avec l'EOH et LABM

Lien avec une structure de recherche

Qualité:

Contrôles normalisés et réglementaires
Suivi d'indicateurs
Qualification
...

Laboratoire de contrôle et d'essai
Accréditation, rigueur protocolaire

Il peut s'agir d'un laboratoire extérieur.

Connexion directe avec la direction

Innovation technologique

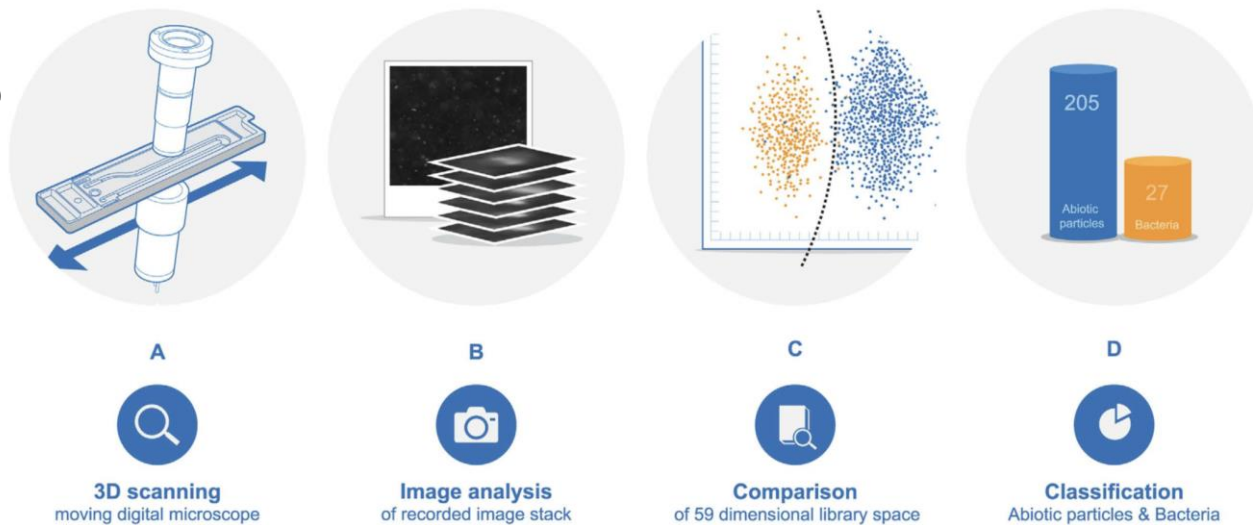


Figure 1. The various steps in determining the concentration of bacteria and abiotic particles. (A) Schematic of flow cell, light source, lens, and camera. (B) Image stack of a particle coming into focus and out again as the tilted image plane moves across it. (C) Extraction of parameters from recorded image stacks and comparison to library data. (D) Classification of particles in “Bacteria” and “Abiotic particles”.

SCIENTIFIC REPORTS

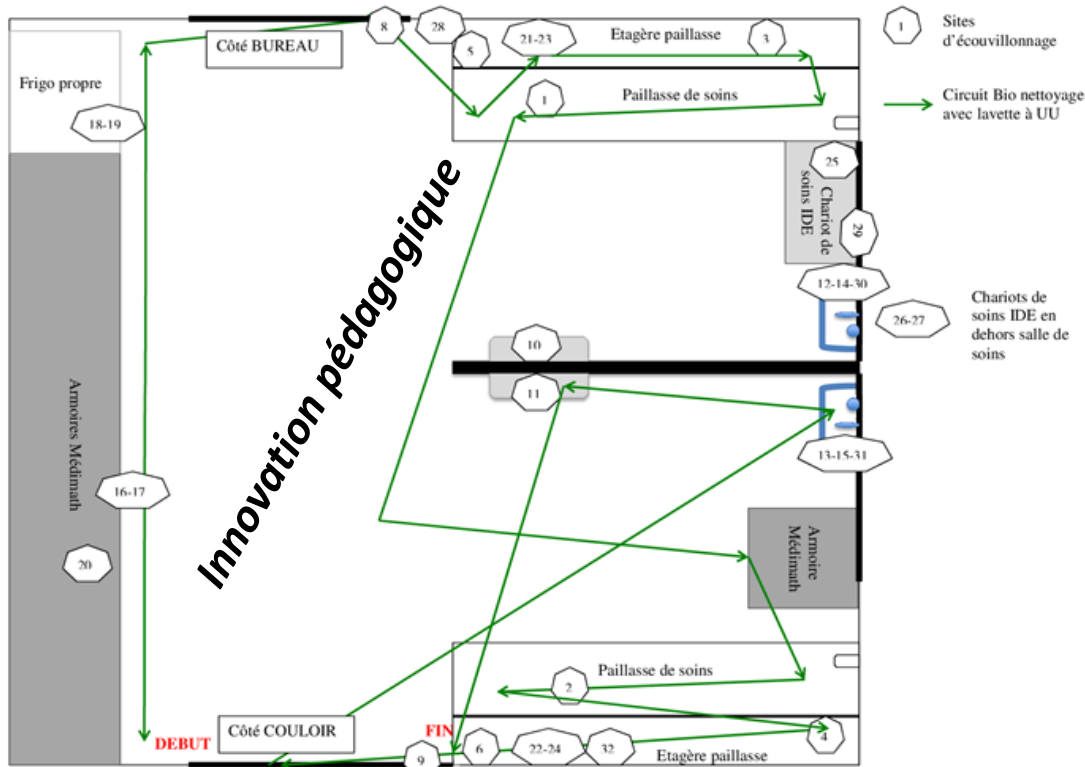
OPEN **A novel, optical, on-line bacteria sensor for monitoring drinking water quality**

Received: 01 October 2015
Accepted: 16 March 2016
Published: 04 April 2016

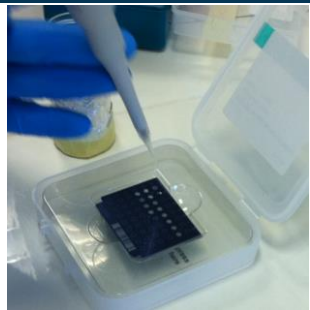
Bo Højris¹, Sarah Christine Boesgaard Christensen², Hans-Jørgen Albrechtsen³, Christian Smith¹ & Mathis Dahlqvist¹

Today, microbial drinking water quality is monitored through either time-consuming laboratory methods or indirect on-line measurements. Results are thus either delayed or insufficient to support proactive action. A novel, optical, on-line bacteria sensor with a 10-minute time resolution has been developed. The sensor is based on 3D image recognition, and the obtained pictures are analyzed with algorithms considering 59 quantified image parameters. The sensor counts individual suspended particles and classifies them as either bacteria or abiotic particles. The technology is capable of distinguishing and quantifying bacteria and particles in pure and mixed suspensions, and the quantification correlates with total bacterial counts. Several field applications have demonstrated that the technology can monitor changes in the concentration of bacteria, and is thus well suited for rapid detection of critical conditions such as pollution events in drinking water.

Restitution d'audit sur l'entretien avec résultats avant/après sur kit colorimétrique (autocontrôle)



D'après
Elodie Bousquet

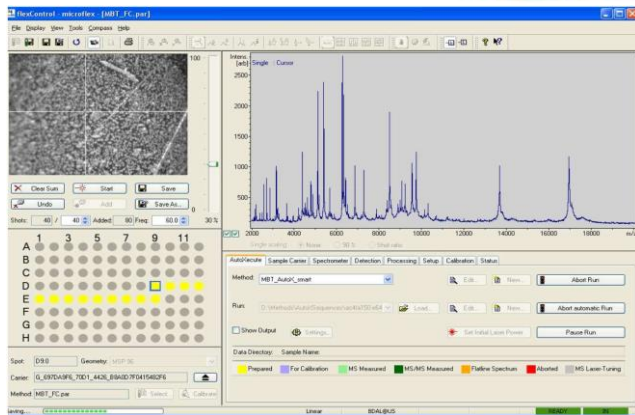


Identification d'espèce : bases de données partagés

- Bactériologie médicale
- Mycologie Médicale
- Microbiologie environnementale

Outils universel pour aller plus loin que l'identification d'espèce?

- Résistotypes
- Définition de cluster épidémiques



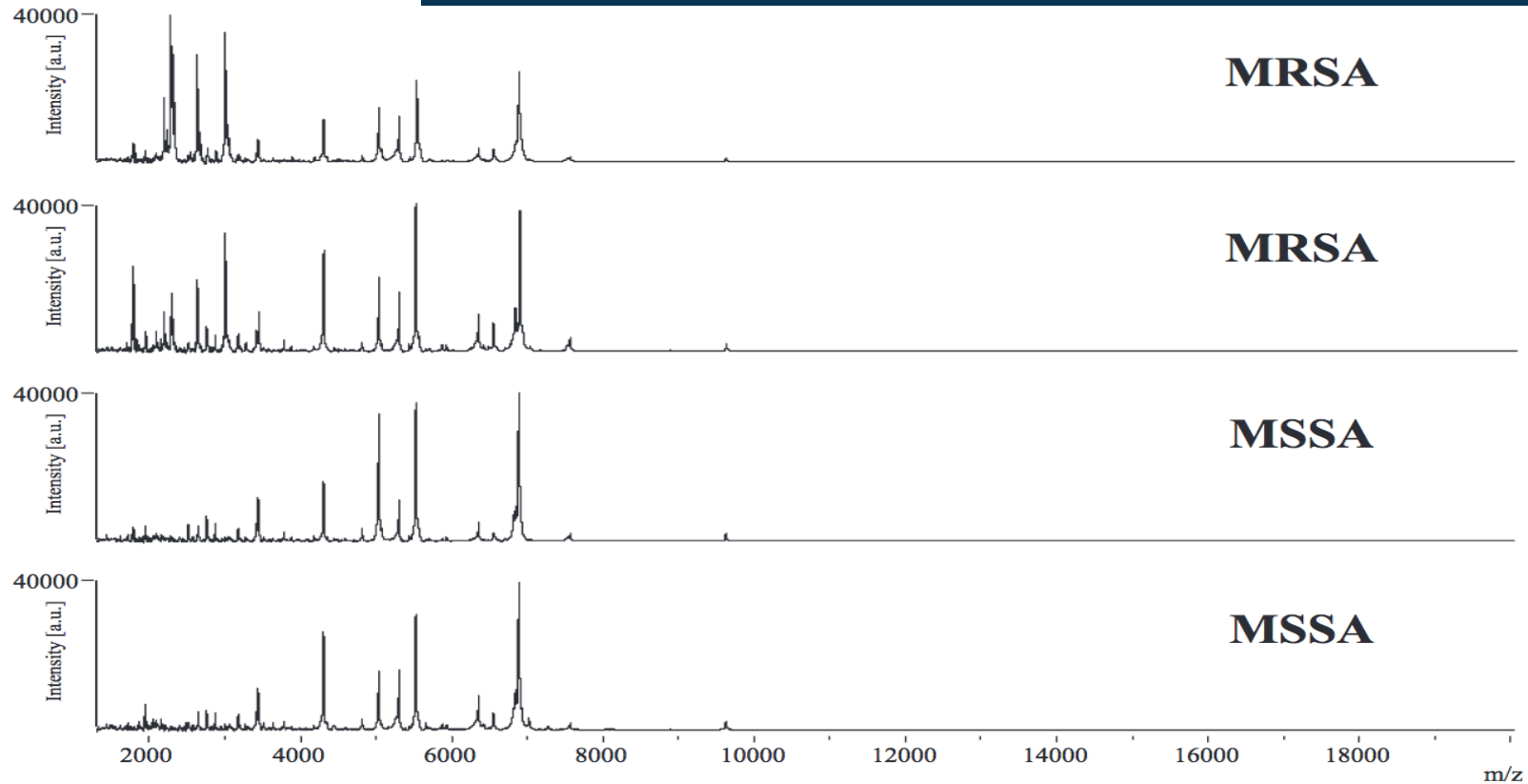


FIG. 1. Representative spectra of *S. aureus* methicillin-susceptible isolates and methicillin-resistant isolates.

Oberlé et al. PLoS ONE, 2016

Validation multicentrique avec différentiation de deux clusters épidémiques d'*E. coli*-BLSE.

Le MALDI-TOF pourrait être une approche couteau-suisse pour l'investigation épidémique.

Une seule analyse – plusieurs niveaux d'interprétations:

- ✧ Identification
- ✧ Résistotype
- ✧ Clusterisation

En temps réel et peu coûteux...

Aide à la décision en hygiène hospitalière

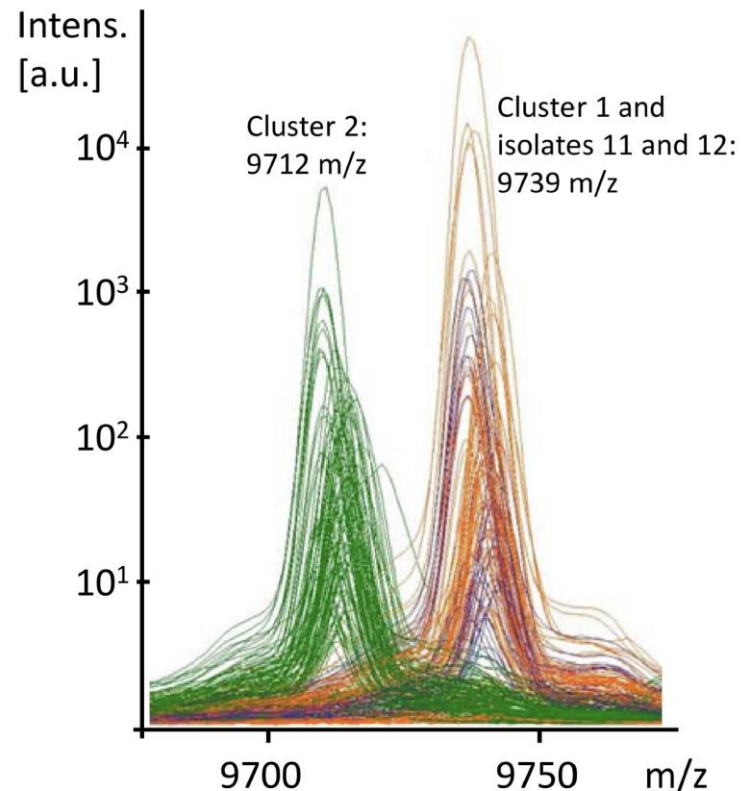


Fig 3. Peak comparison. Identification of cluster-separating peaks. The x-axis indicates the m/z value and the y-axis the peak intensity. Alternative 1: Single line analysis shows an extract of three peak profiles with a 'peak pair' at 9712 and 9739 m/z. The peak on the left part of the graph shows a shift in the top two spectra compared to the bottom spectrum, while the peak on the right is in the same position for all three. Alternative 2: The overlay mode of multiple spectra show 'peak pairs' at 9712 and 9739 m/z. Each line reflects a single measurement. The green lines are spectra of cluster 2-isolates.

VENDREDI 8 JUIN 2018

11:30-13:00

■ **SP14 - Session SFM : Apport pratique des techniques de séquençage de nouvelle génération dans l'investigation des phénomènes épidémiques**

*Modérateurs : Estelle. JUMAS-BILAK, Montpellier ;
Jean-Winoc DECOUSSER, Créteil*

Principes, intérêts et mise en place pratique en routine du séquençage de nouvelle génération au CHU Henri Mondor (Créteil)

Jean-Winoc DECOUSSER, Créteil

Séquençage de Nouvelle Génération et épidémiologie microbienne hospitalière : l'expérience de l'Hôpital NECKER - enfants malades

Anne JAMET, Paris

Interprétation des données du séquençage de nouvelle génération et perspectives

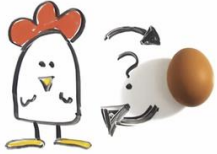
Philippe GLASER, Paris

13:05

Pause déjeuner

- Considérer le patient et son environnement comme une unité de transmission.

"THE CHICKEN - OR - THE CHICKEN EGG"



- Evaluer le risque infectieux à partir de cette unité de transmission.
- La « chambre-contact » ou la « salle de soins-contact » serait suivie et dédouanée comme le « patient-contact ».

Environmental Panels as a Proxy for Nursing Facility Patients With Methicillin-Resistant *Staphylococcus aureus* and Vancomycin-Resistant *Enterococcus* Colonization

Marco Cassone,¹ Julia Mantey,² Mary Beth Perri,² Kristen Gibson,² Bonnie Lansing,² Sara McNamara,^{1,3} Payal K. Patel,^{2,4} Vincent C. C. Cheng,^{5,6} Maroya S. Walters,⁷ Nimalie D. Stone,⁸ Marcus J. Zervos,^{2,9} and Lona Mody¹⁰

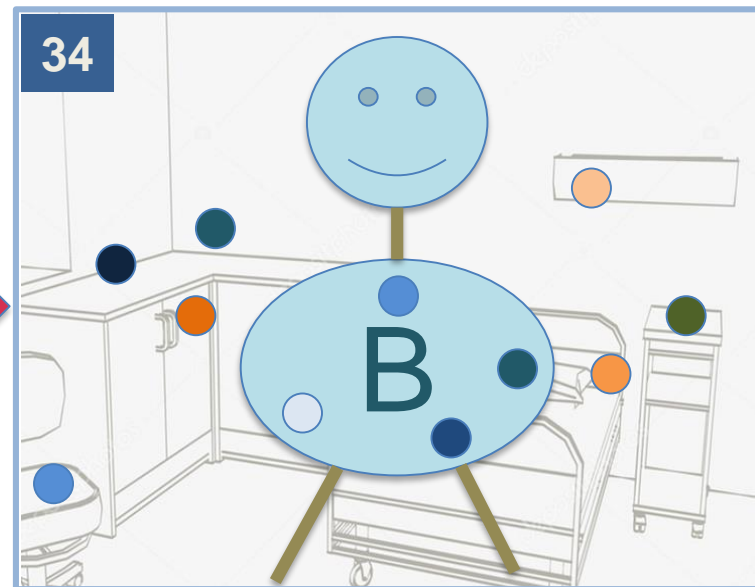
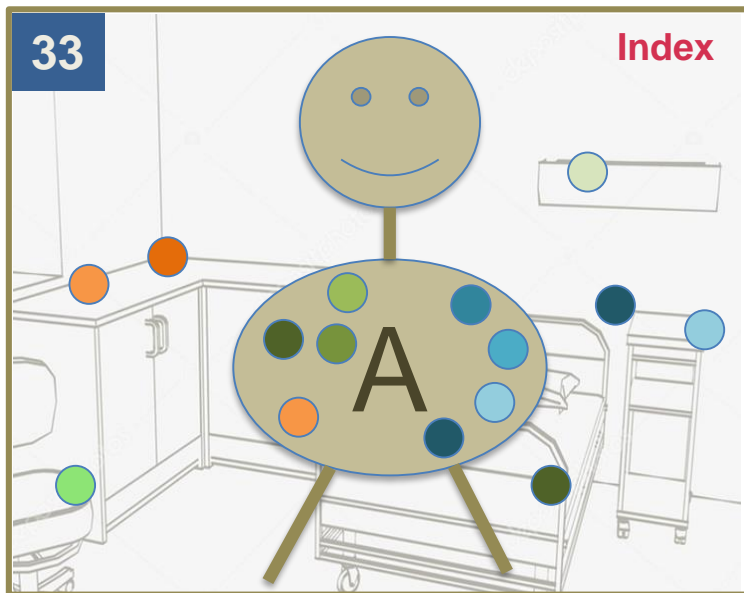
D'après Cassone et al., CID, 2018




Table 1. Concordance of Each Environmental Site With Patient Body Colonization

Site	Receiver Operating Characteristic Curve	(95% Confidence Interval)	Rank	Positive Concordance (%)	Positive Predictive Value (%)	Negative Concordance (%)	Negative Predictive Value (%)
<i>Methicillin-resistant Staphylococcus aureus</i>							
TV remote control	0.71	0.67–0.75	1	46	70	96	89
Bed rail	0.66	0.62–0.70	2	35	75	98	89
Nurse call button	0.64	0.60–0.67	3	29	77	98	87
Bed controls	0.62	0.59–0.65	4	27	74	98	87
Side table (top)	0.60	0.58–0.63	5	23	68	98	86
Toilet seat	0.60	0.56–0.63	5	25	44	94	87
Side table (bottom)	0.59	0.56–0.61	7	19	71	98	85
Wheelchair handles	0.56	0.53–0.58	8	14	55	97	84
Bed curtain	0.55	0.53–0.58	9	13	55	98	85
Door knob	0.55	0.53–0.58	9	13	55	98	84
<i>Vancomycin-resistant Enterococcus</i>							
TV remote control	0.67	0.64–0.70	1	41	72	92	76
Toilet seat	0.65	0.62–0.68	2	46	57	84	77
Bed rail	0.65	0.62–0.67	2	33	82	96	74
Bed controls	0.63	0.61–0.66	4	30	80	96	74
Side table (top)	0.61	0.59–0.63	5	26	74	95	73
Nurse call button	0.60	0.58–0.62	6	24	78	97	73
Side table (bottom)	0.59	0.57–0.62	7	21	80	97	72
Bed curtain	0.59	0.56–0.61	7	27	56	91	74
Wheelchair handles	0.58	0.56–0.60	9	19	75	97	70
Door knob	0.55	0.53–0.57	10	13	68	97	70

Sites included in our environmental panels are highlighted in bold.
Abbreviation: TV, television.

Quelques points de prélèvement dans les chambres seraient de bons indicateurs complémentaires ou alternatifs à la recherche du portage patient.



3 variants d'*E. cloacae* NDM 
 5 variants de *K. pneumoniae* NDM 
 7 variants d'*A. baumannii* NDM 

Unité de transmission



*Poster et communication
Sophie Baranovsky*

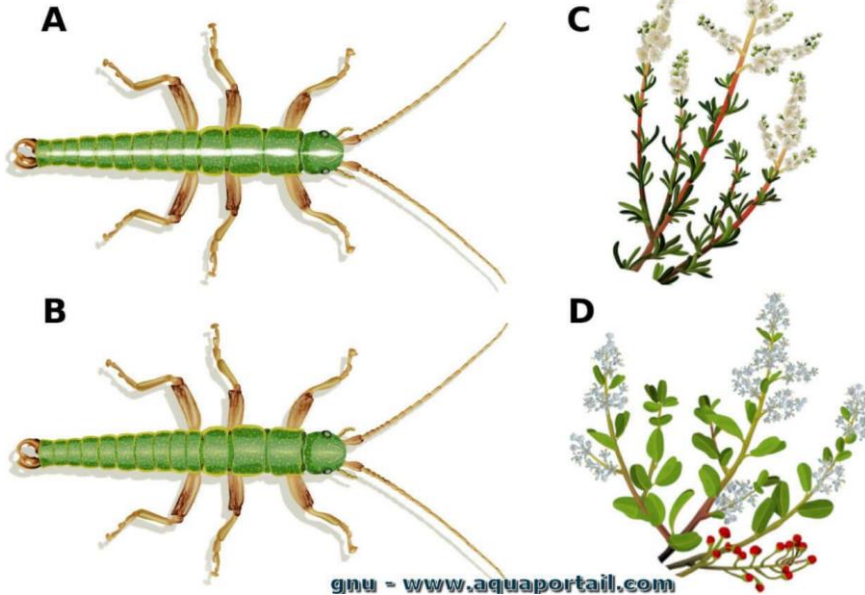
Hypothèse: hygiène hospitalière souffre d'un manque de données en microbiologie environnementale pour une meilleure argumentation microbiologique des mécanismes de transmission.

EN PRATIQUE QUOTIDIENNE
SURVEILLANCE DE L'ENVIRONNEMENT HOSPITALIER : FRANCHIR LES LIMITES

EN RECHERCHE
DE L'ESPÈCE BACTÉRIENNE À L'ECOTYPE: POUR NE PLUS NÉGLIGER LA DIVERSITÉ DES BACTÉRIES HOSPITALIÈRES

Ecotype: population (au sein d'une espèce) qui est adaptée à des conditions environnementales spécifiques

écotypes Timema cristinae

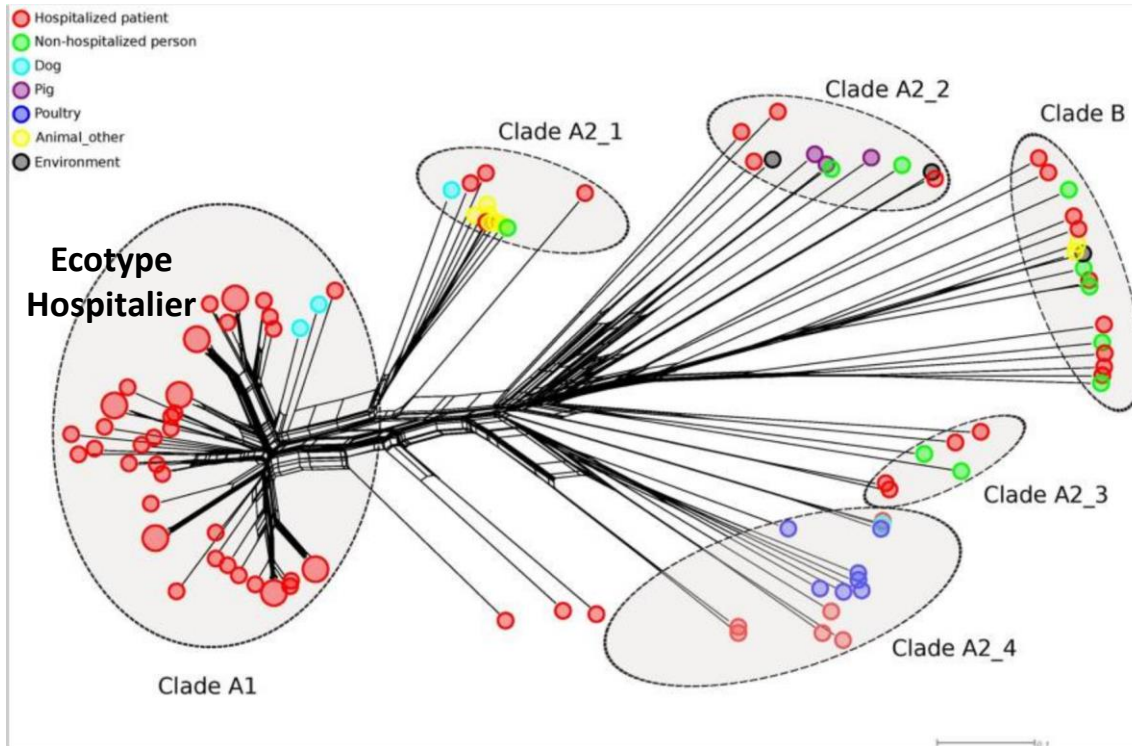


Chez les bactéries, la génétique des populations permet de détecter des écotypes.

- MultiLocus Sequence Typing MLST
 - ST = Sequence Type
- NGS des génomes
 - GT = Genome Type

gnu - www.aquaportail.com

Structuration génétique des populations par Multi-Locus Sequence Typing
D'après Guzman Prieto et al., 2016



Le clade A1 est un écotype.

Isolement génétique.

Capitalisation génétique de l'écotype:

- résistance
- virulence

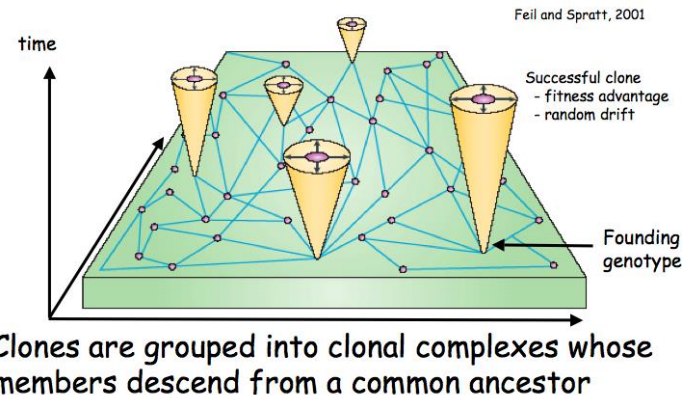
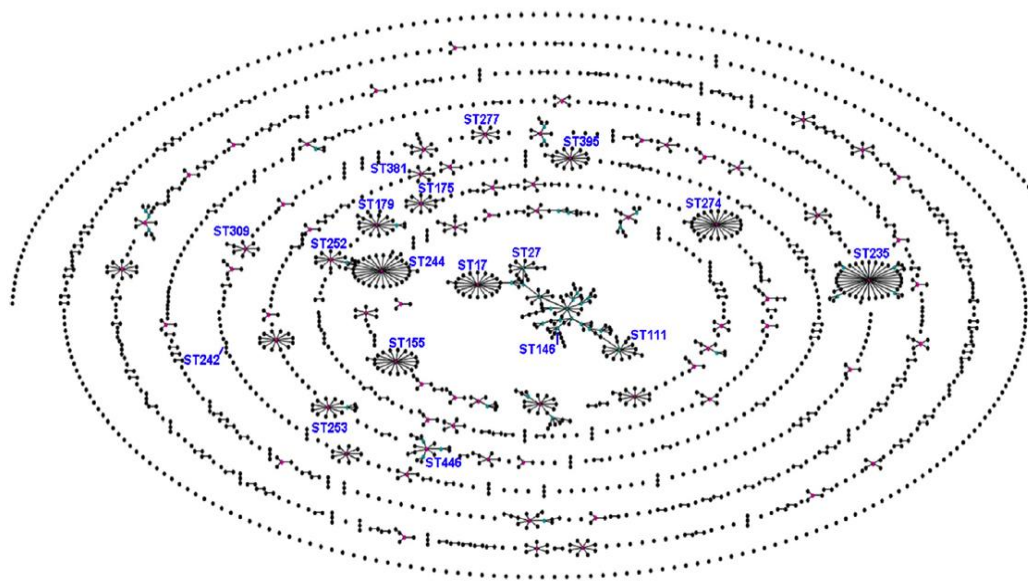
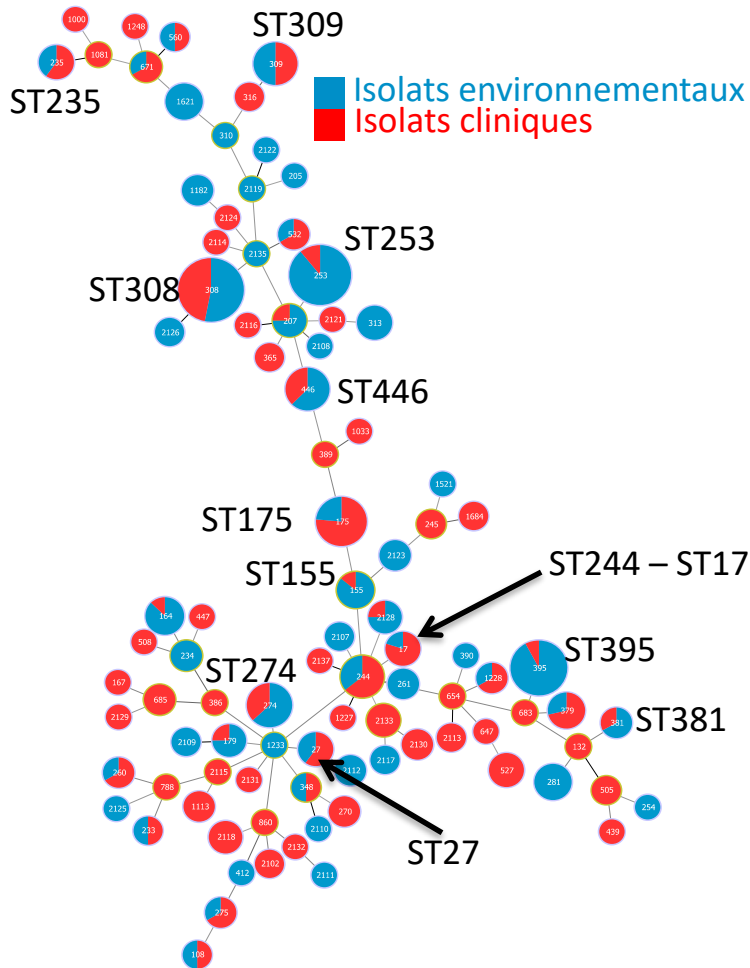


Fig. 1. Population snapshot of *P. aeruginosa*. The 2106 sequence types listed on the *P. aeruginosa* PubMLST database (<http://pubmlst.org/paeruginosa>, 2015/06/03) are displayed in a single eBURST diagram by setting the group definition to zero of seven shared alleles. Each dot represents a ST, and lines connect single-locus variants. In each group of related STs the predictive primary founder is shown in pink, and subgroup founders are shown in blue. STs detected in at least 3 different countries with more than 10 isolates recorded are indicated; note that the ST corresponds to the primary founder or subgroup founder of the clonal complex.

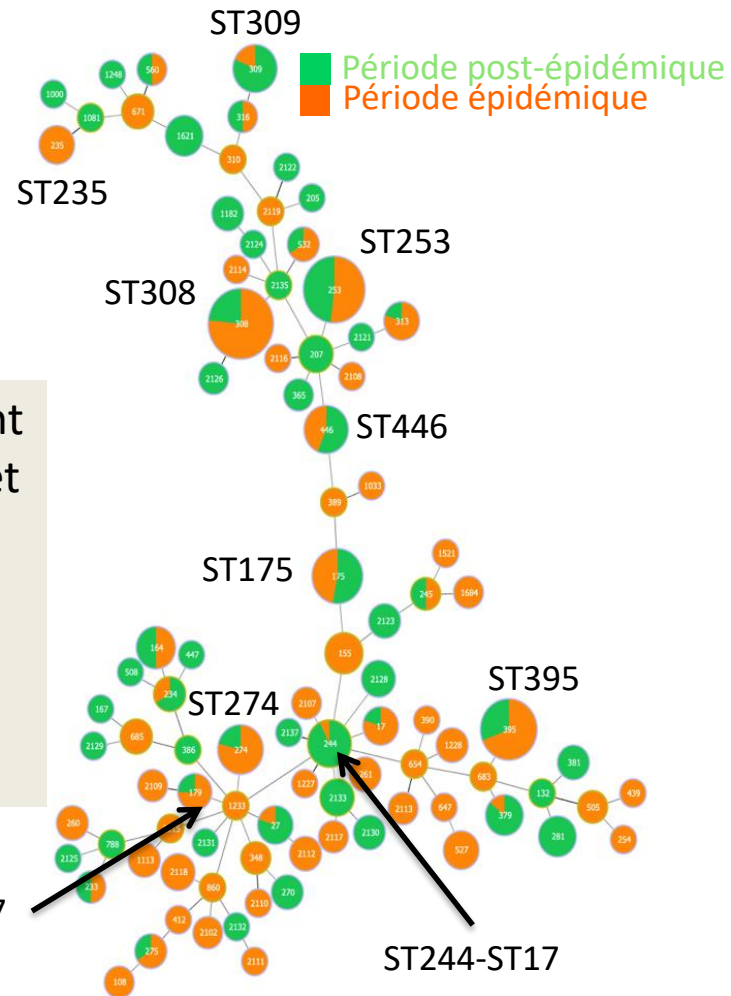


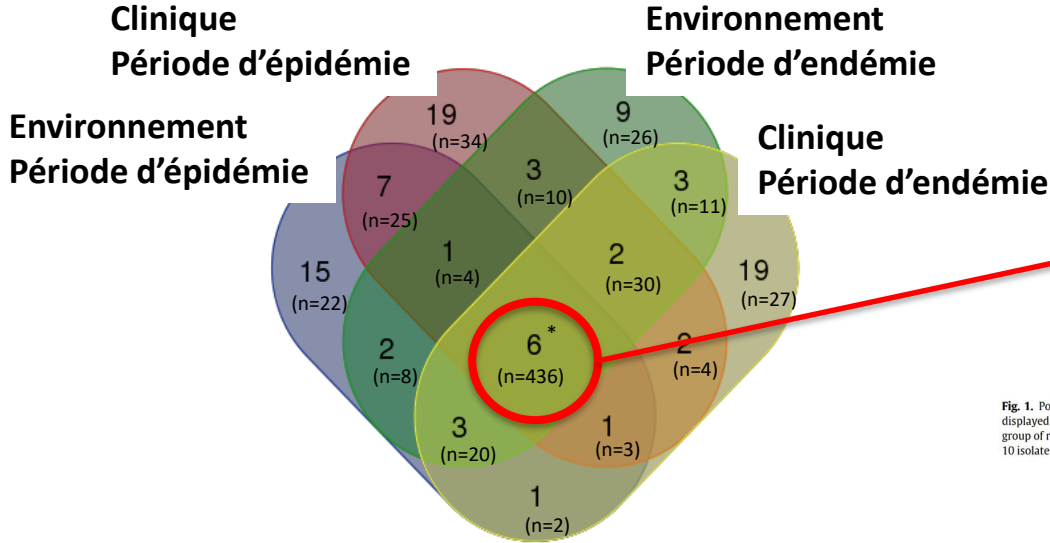
662 *P. aeruginosa*

- 403 env.
- 259 clin.

396 en période
épidémique
266 en post-
épidémie (endémie)

Les EHR réussissent
chez les patients et
dans
l'environnement,
en période
d'épidémie ou
d'endémie





Environ 2/3 des souches du CHU de Montpellier sont polyvalentes et appartiennent à 6 clones EHR à succès mondial.

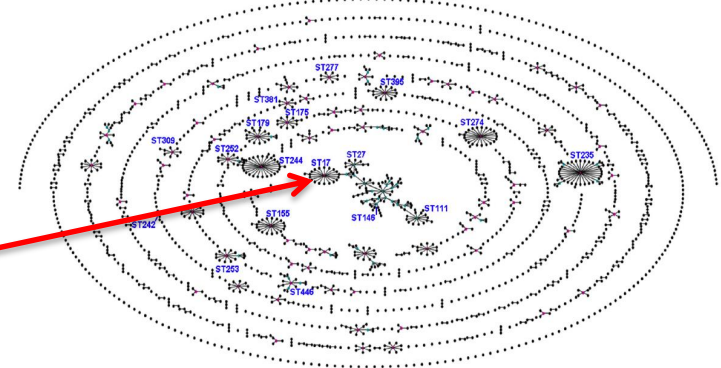
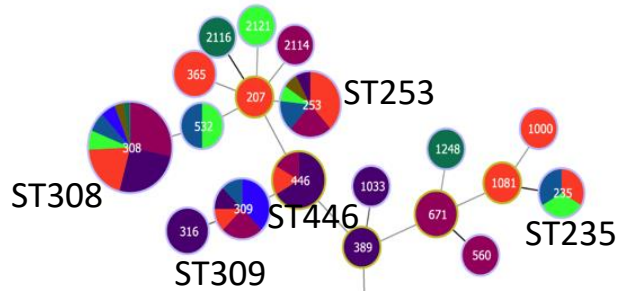


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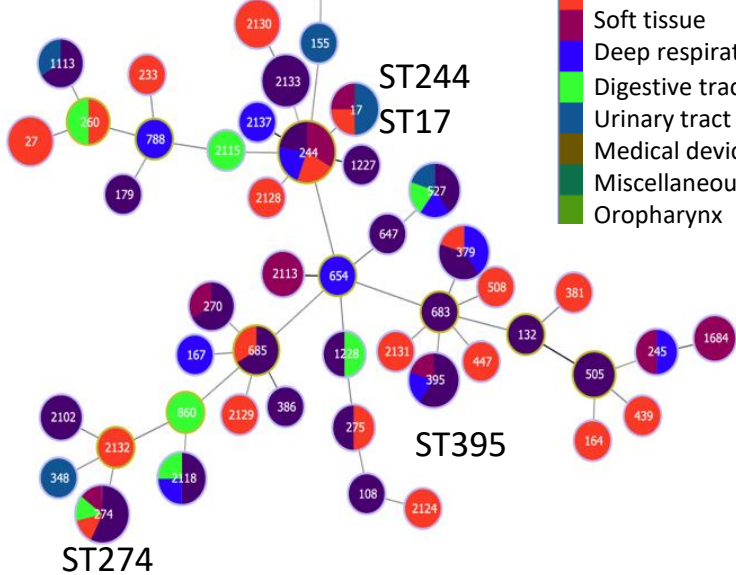
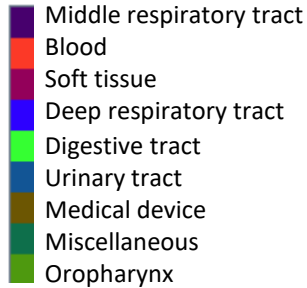
Structure de population mondiale
=
Structure de population locale
Globalisation des pressions de sélections



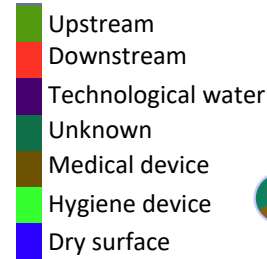


Les géotypes qui réussissent chez les patients (EHR), réussissent aussi dans l'environnement.

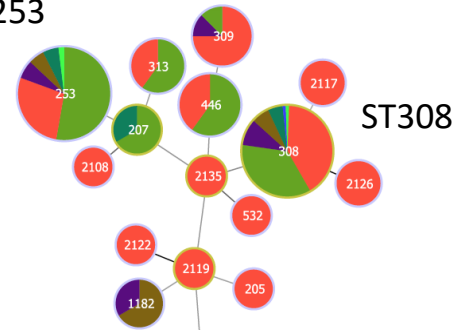
Souches cliniques



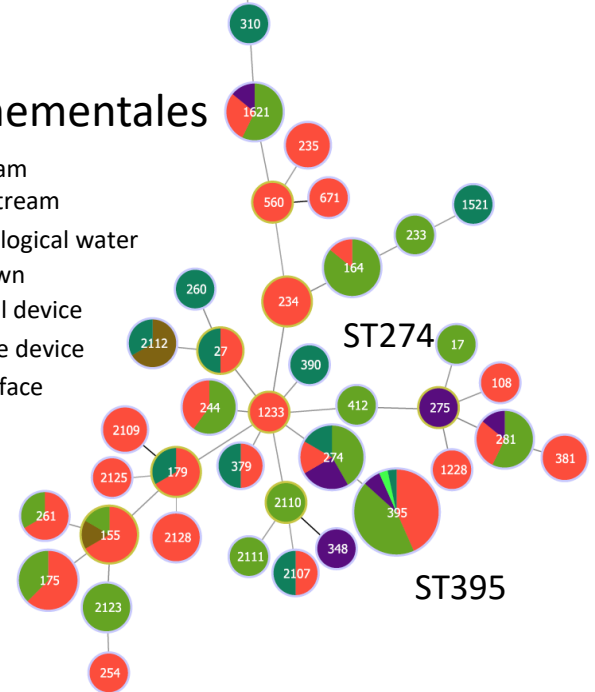
Souches environnementales

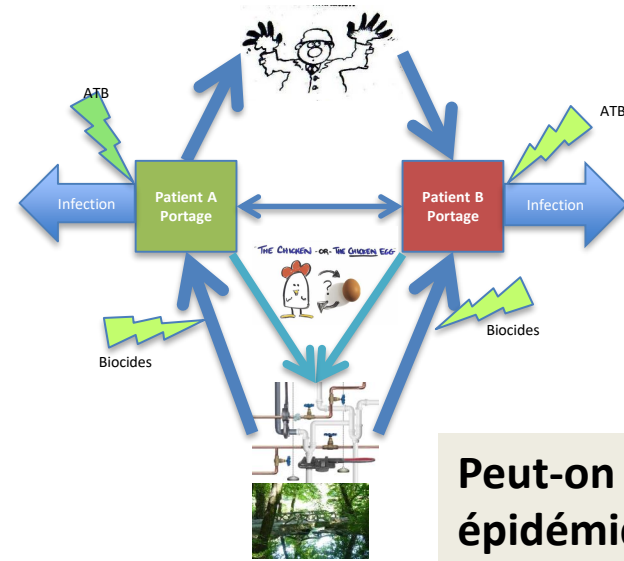


ST253



ST175





Polyvalence et persistance environnementale des souches EHR :

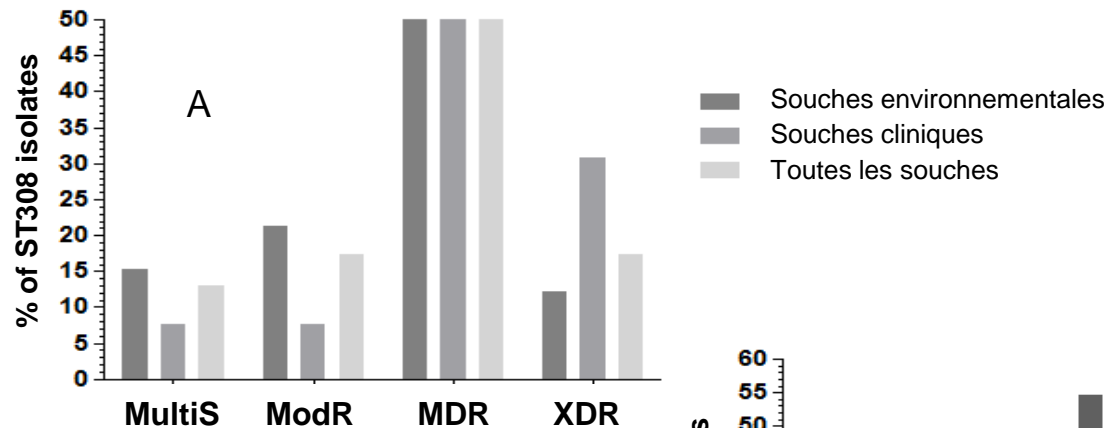
- Adaptation à la complexité du cycle de transmission
- Plaide en faveur des approches d'HH intégrées Patient/Environnement

Peut-on trouver des caractères bactériologiques prédictifs du risque épidémique de *P. aeruginosa*?

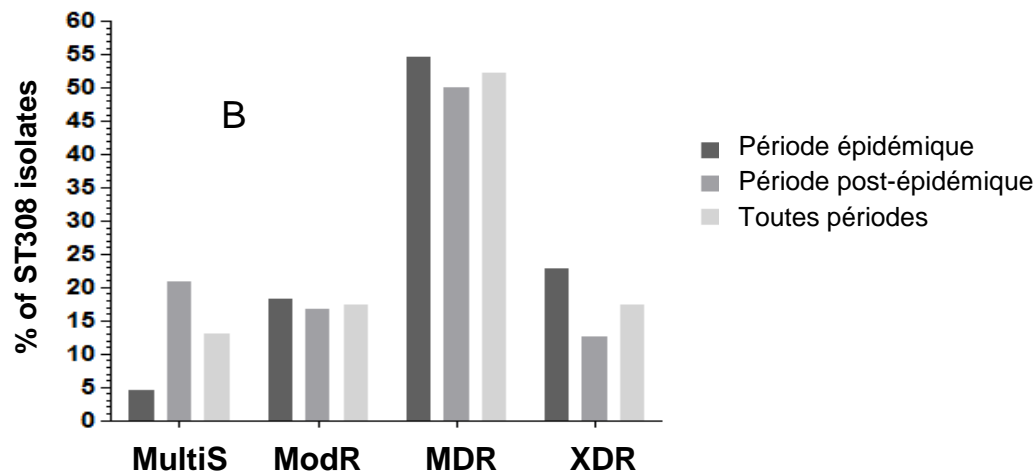
Mulet et al., AAC, 2013 définissent les EHR: XDR, biofilm ++, mobilité –

Nous avons étudié ces caractères dans la population ST308 du CHU de Montpellier

Abdouchakour et al. IJMM, 2017



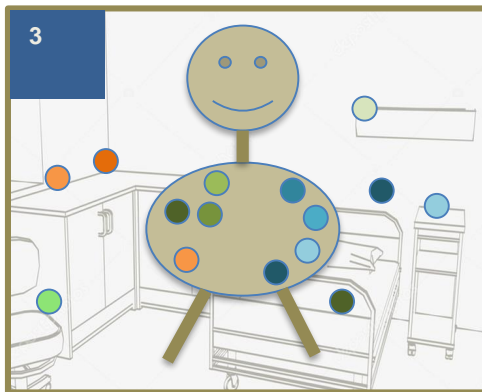
Abdouchakour
IJMM; 2017

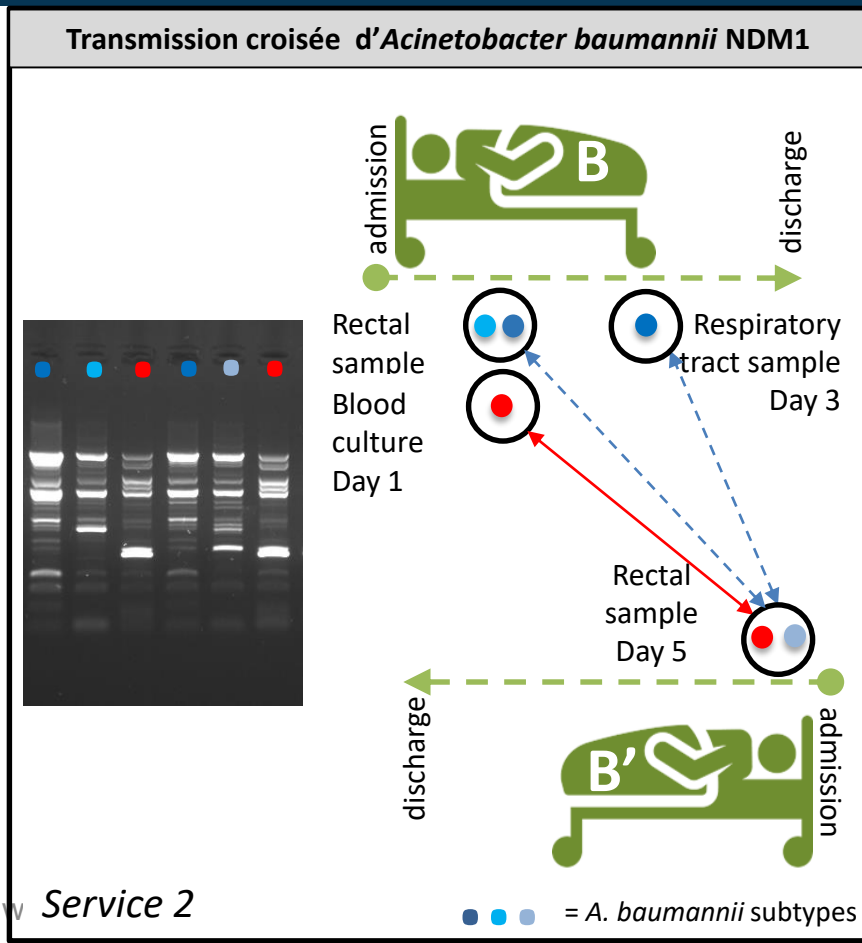
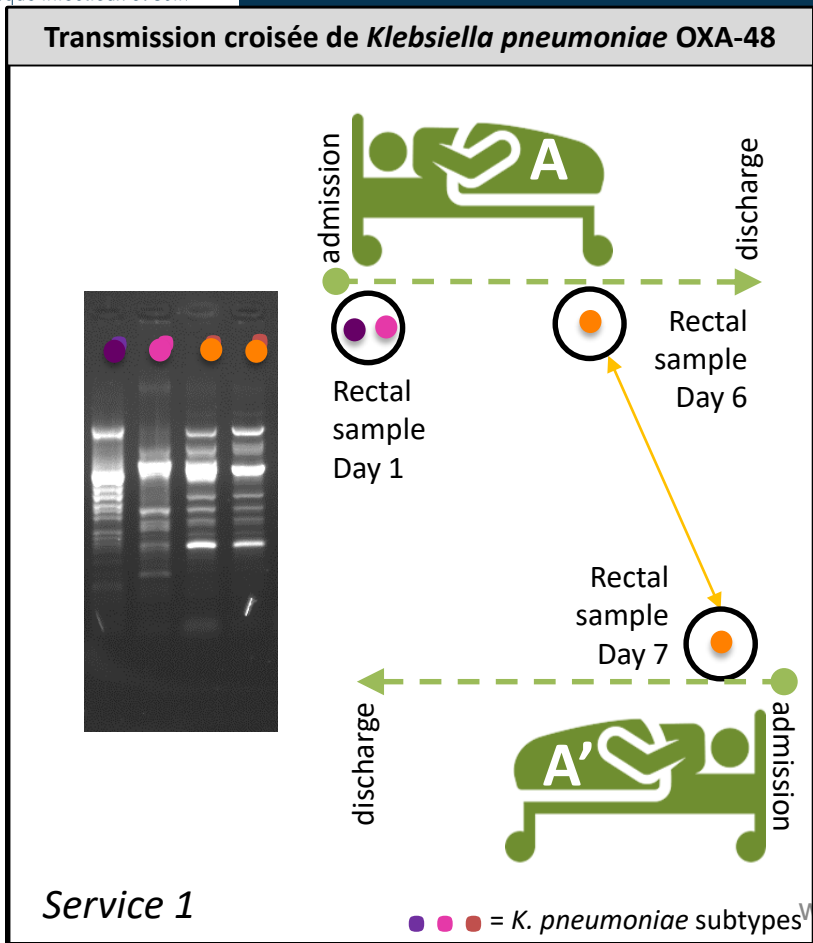


- Caractère principal de la population ST308 = **la diversité**

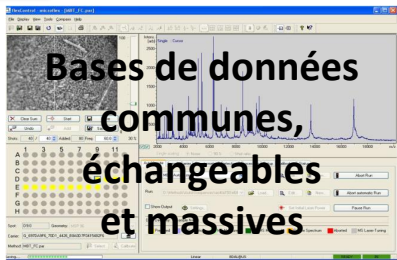
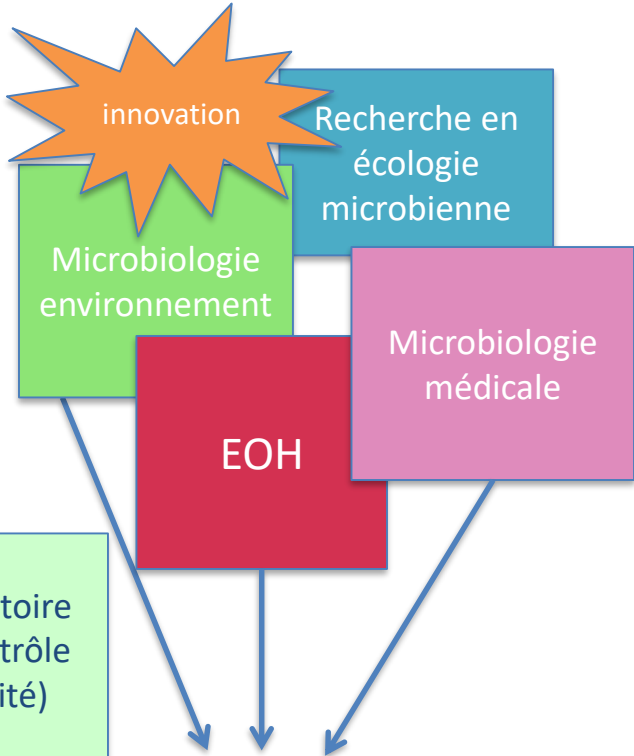
- **Clé du succès épidémique?**

*Assure l'adaptation et la persistance dans l'hôpital, quelles que soient les conditions environnementales ou cliniques = **radiation adaptative***





Organisation

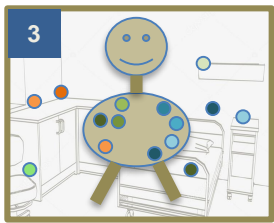


Bases de données communes, échangeables et massives

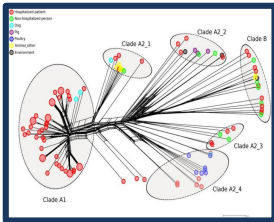


Renforcer les liens de causalité
Recommandations plus argumentées

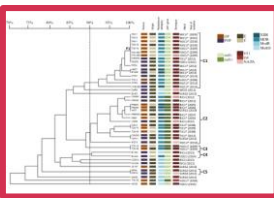
Concepts



Le patient dans son environnement:
une unité de transmission.

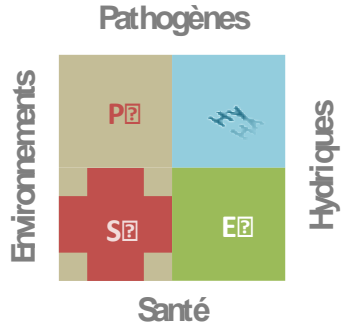


Connaître l'espèce bactérienne et la résistance ne suffit pas toujours: *vers l'écotype H*



La diversité c'est compliqué mais c'est la réalité: *une colonie, c'est fini...*





HydroSciences
Montpellier



Département
D'Hygiène Hospitalière

