Contrôle de l’antibio-résistance à l’hôpital : bon usage des antibiotiques

P. Lesprit

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CHU Grenoble Alpes
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Déclaration de liens

Mon intervention ne présente aucun conflit d’intérêt

CLINICAL MICROBIOLOGY REVIEWS, Oct. 2005, p. 638–656 Vol. 18, No. 4
0893-8512/05/$08.00+0 doi:10.1128/CMR.18.4.638–656.2005
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Antimicrobial Stewardship Programs in Health Care Systems

Conan MacDougall* and Ron E. Polk

Department of Pharmacy, School of Pharmacy, Virginia Commonwealth University, Medical College of Virginia Campus, Richmond, Virginia 23298

Collaboration EOH/EMA

- Dissémination hospitalière des BMR :

Transmission inter patients ← Contrôle = EOH

Sélection par les antibiotiques ← Contrôle = EMA

- « An absolute distinction is artificial and both transmission and selection play important roles in the spread of antimicrobial resistance »

McDougall C, Polk RE, Clin Microb Rev 2005

Curbing Methicillin-Resistant *Staphylococcus aureus* in 38 French Hospitals Through a 15-Year Institutional Control Program

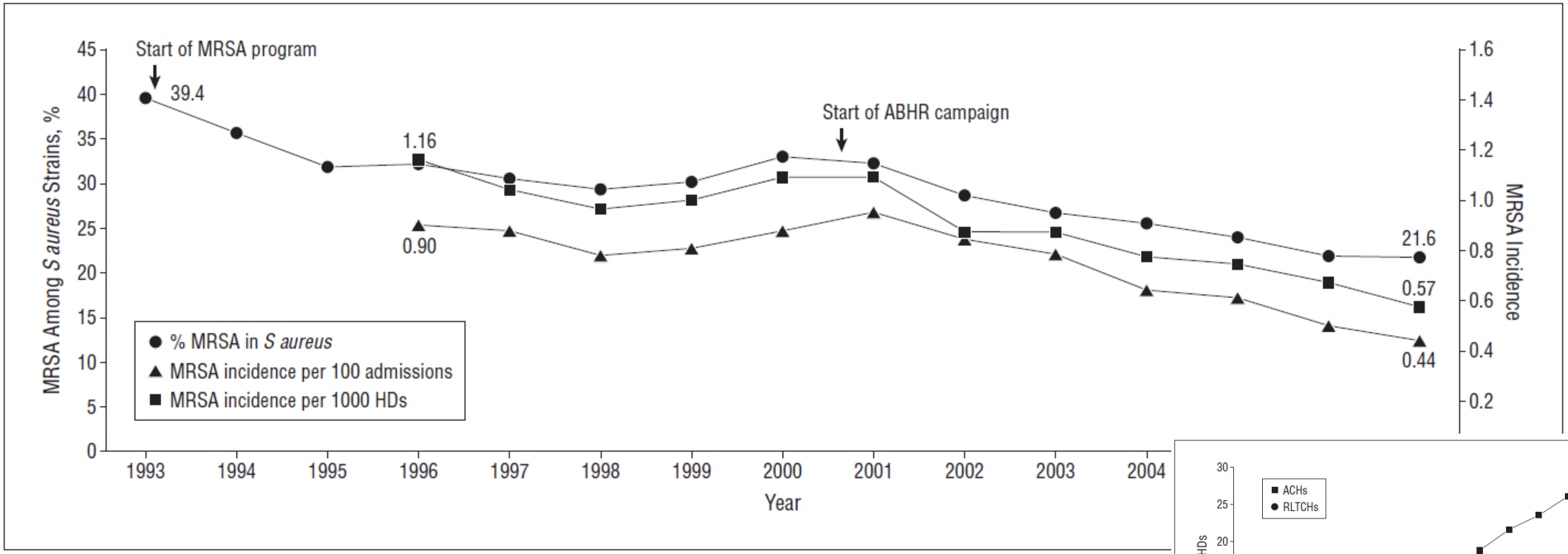


Figure 2. Change in methicillin-resistant *Staphylococcus aureus* (MRSA) rates from 1993 to 2007. Data are given as prop in *S aureus*, MRSA incidence per 1000 hospital days, and MRSA rate per 100 admissions.

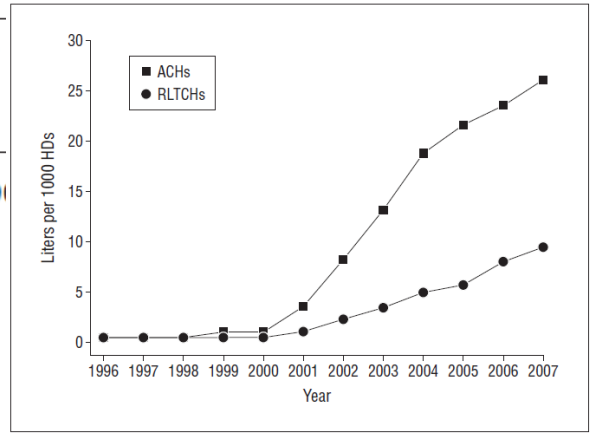
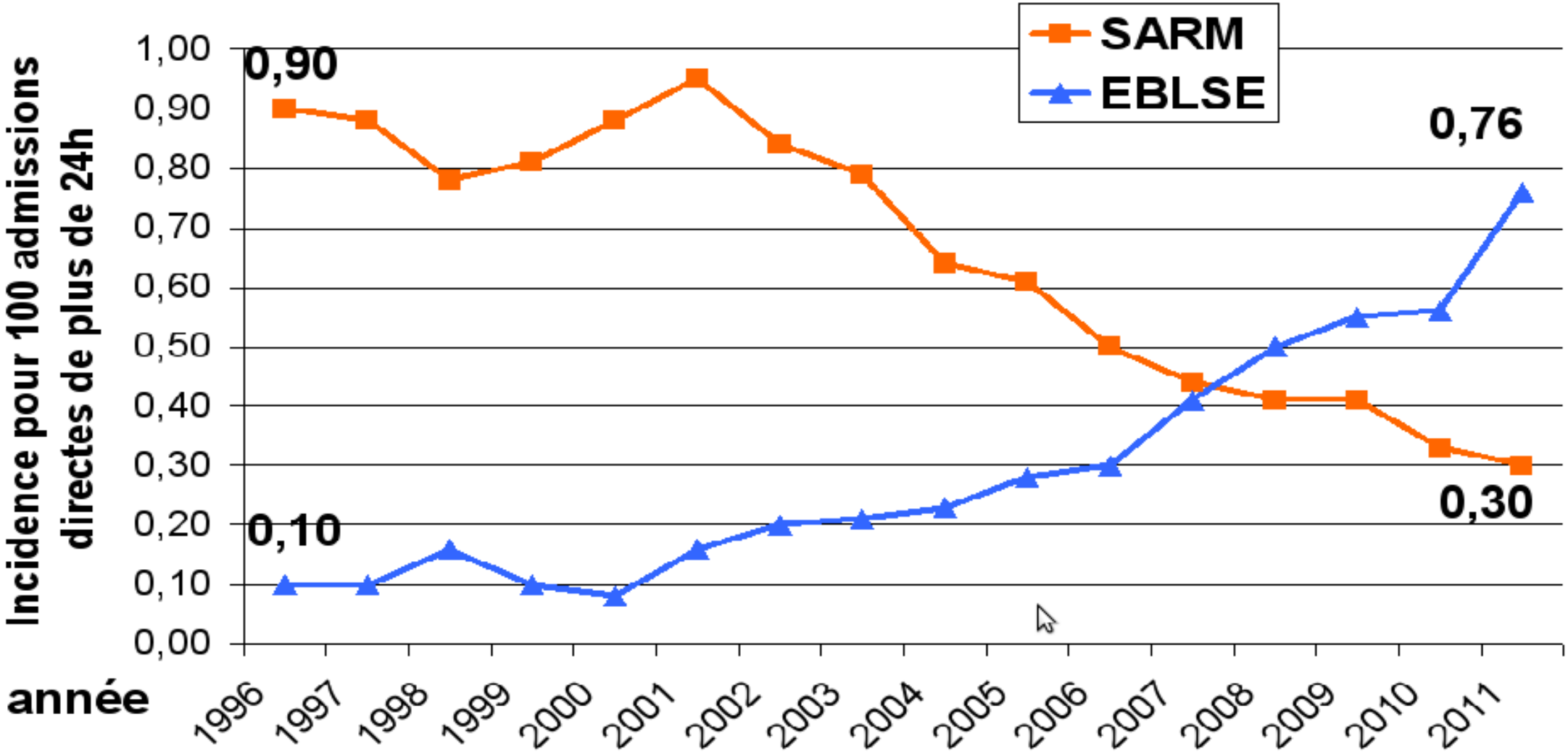


Figure 1. Changes in the use of alcohol-based hand-rub solutions (in liters per 1000 HDs) from 1993 to 2007. ACHs indicates acute care hospitals; RLTCHs, rehabilitation and long-term care hospitals; and HDs, hospital days.

Jarlier V, Arch Intern Med 2010

Évolution de 1996 à 2011 du taux d'attaque pour 100 admissions des SARM et EBLSE dans les hôpitaux de court séjour



D. Trystram, V. Jarlier. Enquête BMR APHP 2011

Résistance aux antibiotiques : attention aux entérobactéries

Homme

Animal

EN VILLE

Résistance à la méticilline chez le *Staphylococcus aureus* (SARM)

2008 : 8,9 % 2016 : 7,6 %

Source : Réseau Oscar via Onerba / Santé publique France[1]

Résistance aux céphalosporines de 3e génération chez *Escherichia coli*

2008 : 1,3 % 2016 : 4,2 %

Source : Réseau Oscar via Onerba / Santé publique France[1]

EN ÉTABLISSEMENTS DE SANTÉ

Résistance à la méticilline chez le *Staphylococcus aureus* (SARM)

2006 : 31,1 % 2016 : 13,8 %

Source : Réseau BMR-Raisin via Raisin / Santé publique France[2]

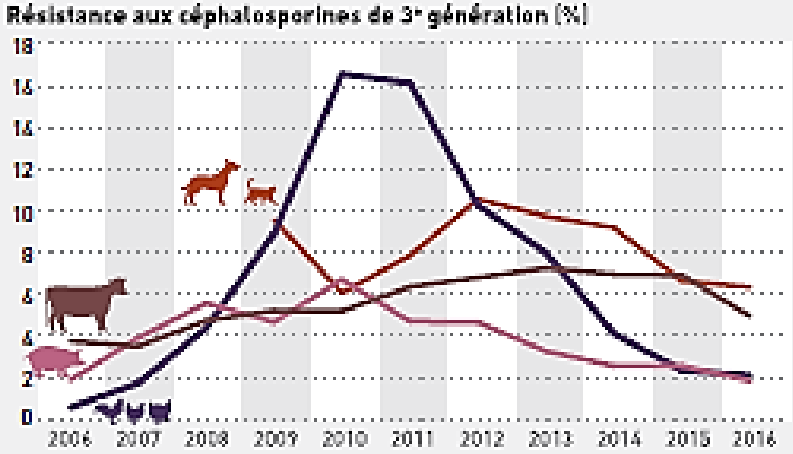
Résistance aux céphalosporines de 3e génération chez *Escherichia coli*

2006 : 2 % 2016 : 11,2 %

Source : EARS-Net France via Onerba / Santé publique France[4]

EN SANTÉ ANIMALE

Diminution drastique de la résistance aux céphalosporines de 3e génération chez *Escherichia coli*

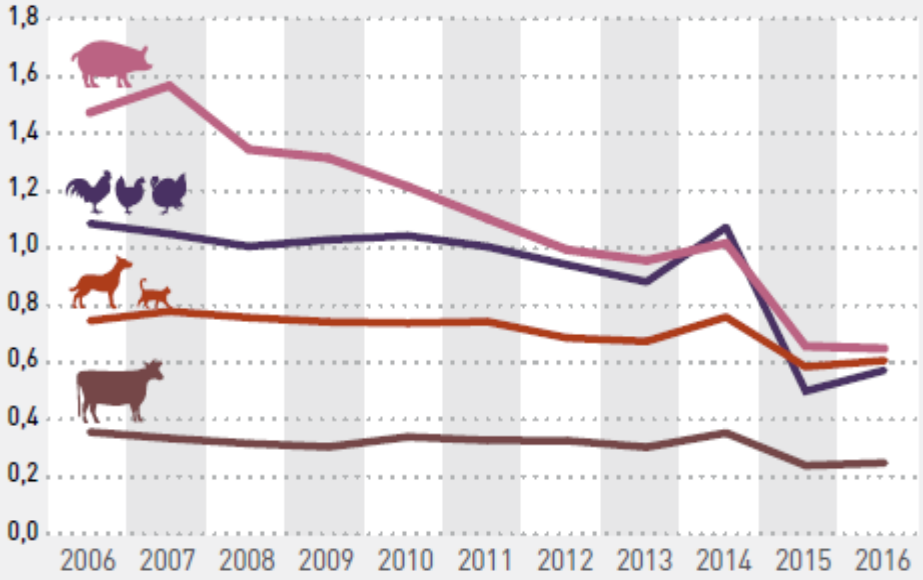


ansm 2017

Il serait bien de faire comme nos amis vétérinaires

En 10 ans, l'évolution des consommations d'antibiotiques est à la baisse pour l'ensemble des espèces animales.
Source : Anses

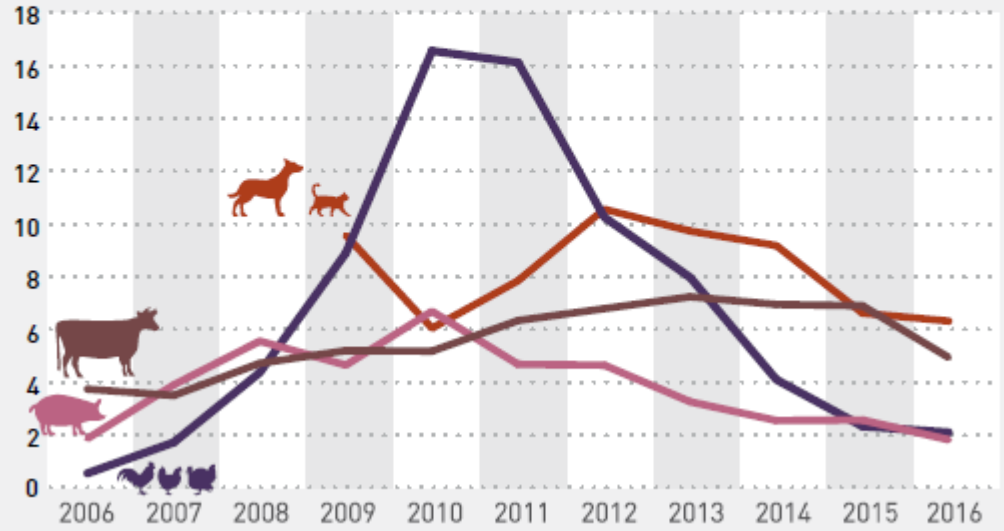
Estimation du nombre de traitements par animal (ALEA[1])



EN SANTÉ ANIMALE

Diminution drastique de la résistance aux céphalosporines de 3e génération chez *Escherichia coli*

Résistance aux céphalosporines de 3e génération (%)



Baisse de 37% de l'exposition des animaux aux antibiotiques !

ansm 2017

Juste utilisation des antibiotiques : une vraie marge d'amélioration dans tous les établissements de santé …

- 25-50% des patients reçoivent un antibiotique pendant leur séjour
- 25-50% des prescriptions peuvent être améliorées
- Prescription adaptée =

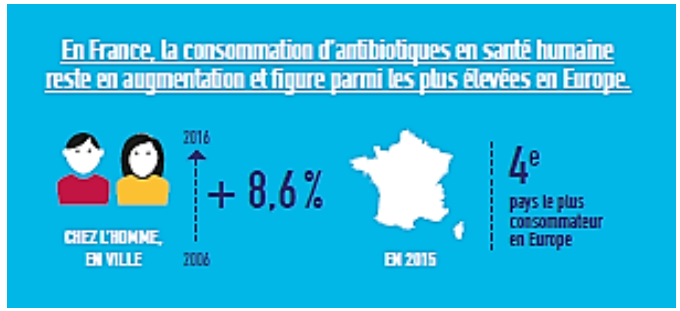
✓ **Indication**
✓ Molécule
✓ Modalité d'administration
✓ Posologie
✓ **Durée**

Réévaluer à J3 et à J7 et tracer dans le dossier médical

- La juste prescription des antibiotiques est un volet essentiel du programme de lutte contre les infections associées aux soins et de la maîtrise de la résistance aux antibiotiques

CONSOMMATION D'ANTIBIOTIQUES ET RÉSISTANCE AUX ANTIBIOTIQUES EN FRANCE: SOYONS CONCERNÉS, SOYONS RESPONSABLES!

Novembre 2017



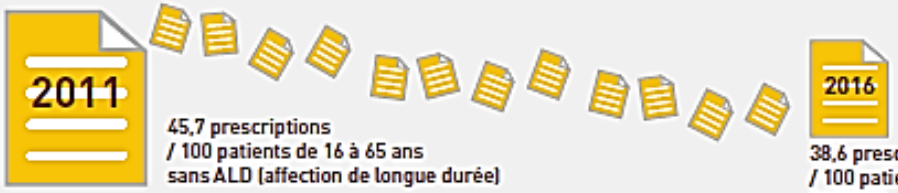
EN SANTÉ HUMAINE EN VILLE

90 %

2006
27,9 doses[1] / 1000 habitants / jour

2016
30,3 doses[1] / 1000 habitants / jour

En 10 ans, la consommation d'antibiotiques en ville a augmenté.
Source: ANSM



2011
45,7 prescriptions / 100 patients de 16 à 65 ans sans ALD (affection de longue durée)

2016
38,6 prescriptions / 100 patients de 16 à 65 ans sans ALD (affection de longue durée)
Source : Assurance Maladie

EN SANTÉ HUMAINE EN ÉTABLISSEMENTS DE SANTÉ (HÔPITAUX ET CLINIQUES)

10 %

2006
2,2 doses[1] / 1000 habitants / jour

2016
2,1 doses[1] / 1000 habitants / jour

En 10 ans, la consommation d'antibiotiques en établissements de santé est plutôt stable.
Source : ANSM

ansm 2017

Que faut il faire ?

- Tous les antibiotiques ont des conséquences écologiques
- Ces conséquences sont variables et de deux ordres
  - Sélection de souches résistantes préalablement présentes dans le TD
  - Mutation sous pression antibiotique
- Le poids des conséquences dépend aussi de la situation épidémiologique
- Les antibiotiques à activité anti anaérobies et à diffusion digestive ont des conséquences « plus importantes »

MOINS PRESCRIRE

Maitriser – Contrôler chaque gramme d'antibiotique prescrit

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Dec. 1986, p. 945–947
0066-4804/86/120945-03$02.00/0
Copyright © 1986, American Society for Microbiology
Vol. 30, No. 6

Epidemiology of Intestinal Colonization by Members of the Family *Enterobacteriaceae* Resistant to Cefotaxime in a Hematology-Oncology Unit

MARIE-HÉLÈNE PREVOT,[1] ANTOINE ANDREMONT,[1]* HÉLÈNE SANCHO-GARNIER,[2] AND CYRILLE TANCREDE[1]

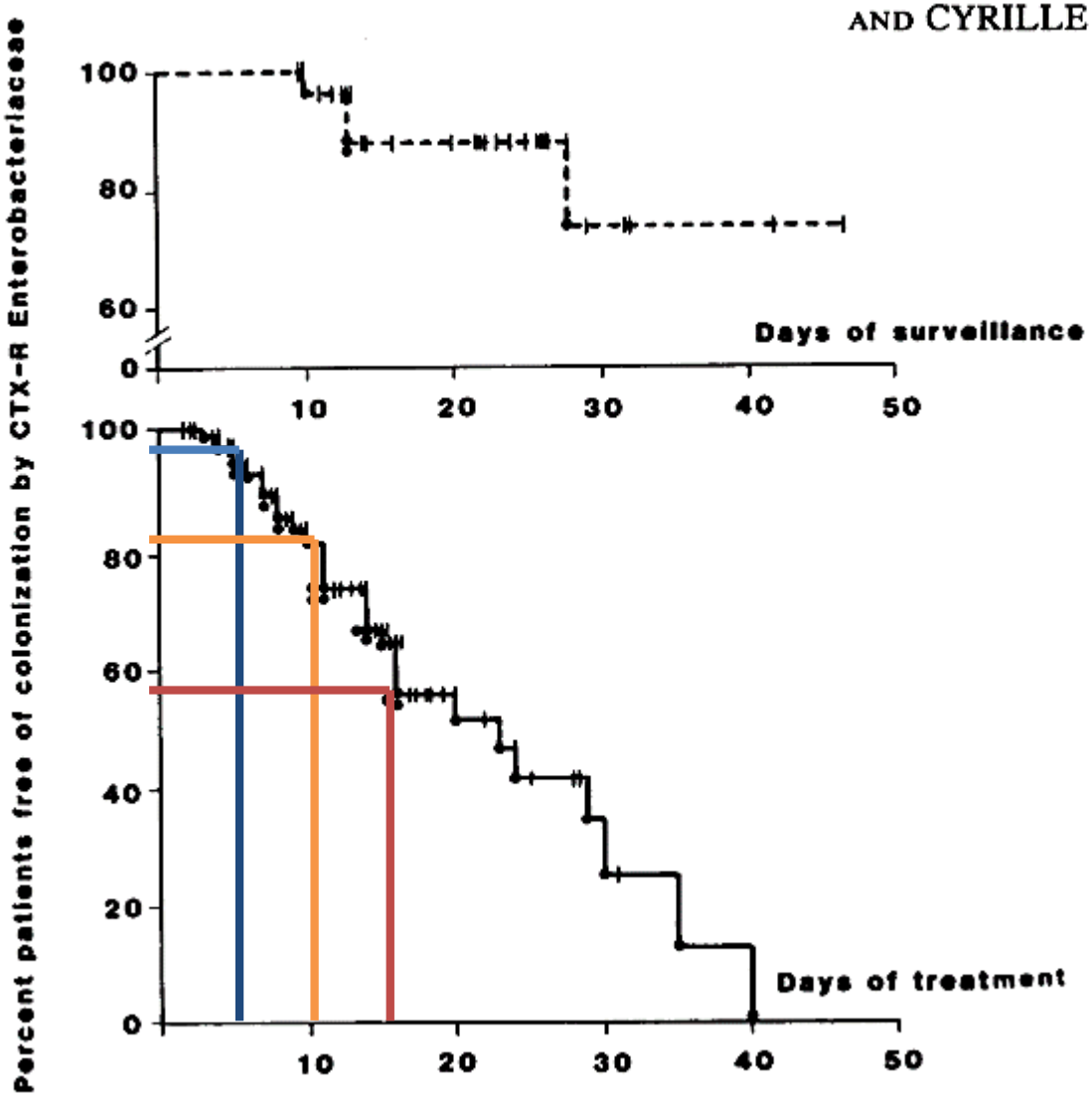


FIG. 1. Kaplan-Meïer curves for intestinal colonization by CTX-R strains of *Enterobacteriaceae* in 68 patients exposed to cefotaxime (——) and in 31 patients not exposed (– – –) in a hematology-oncology unit. Status at the end of the follow-up period: ●, colonized by CTX-R strains of *Enterobacteriaceae*; |, not colonized.

E-BLSE : le rôle des antibiotiques et de la FHA

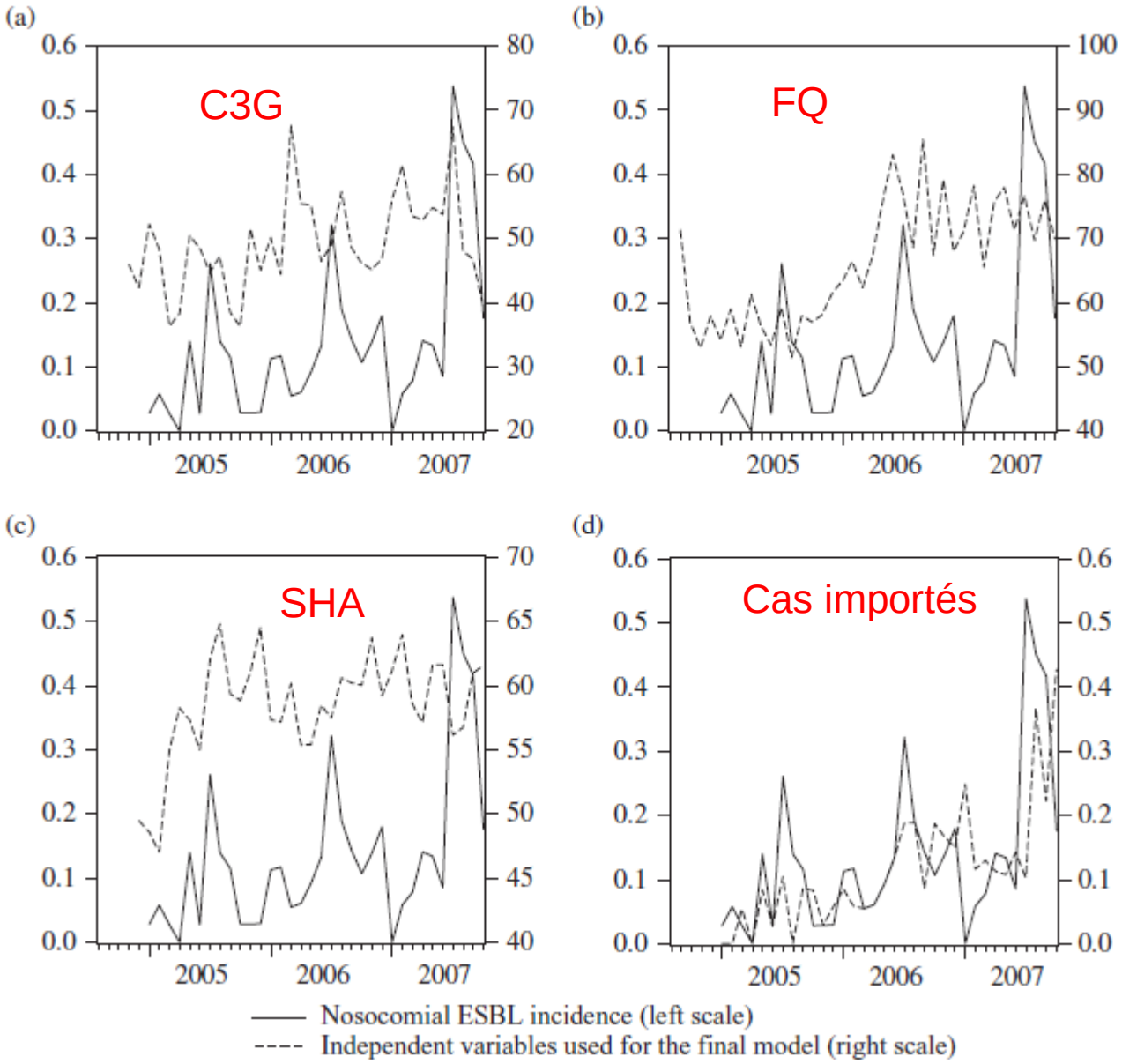


Table 2. Multivariate model to explain the monthly number of nosocomial ESBL cases/1000 patient-days (R^2=0.75)

Explanatory variable	Lag (months)	Coefficient	*T*-statistic	*P* value
Third-generation cephalosporins[a]	3	1.98	2.5	0.022
Fluoroquinolones[a]	1	4.43	3.82	0.001
Alcohol-based hand rub[b]	3–4	−6.73	−3.47	0.002
Patients admitted with ESBL[c]	0	0.90	4.35	<0.001
Autoregressive term[d]	1	0.63	3.48	0.003

Kaier K, J Antimicrob Chemother 2009

Que nous dit la bible ?

Cochrane Library

Cochrane Database of Systematic Reviews

Interventions to improve antibiotic prescribing practices for hospital inpatients (Review)

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S.
Interventions to improve antibiotic prescribing practices for hospital inpatients.
Cochrane Database of Systematic Reviews 2017, Issue 2. Art. No.: CD003543.
DOI: 10.1002/14651858.CD003543.pub4.

Que nous dit la bible ?

Cochrane Library

Cochrane Database of Systematic Reviews

There was very low-certainty evidence about the effect of the interventions on reducing *Clostridium difficile* infections (median -48.6%, interquartile range -80.7% to -19.2%; 7 studies). This was also the case for resistant gram-negative bacteria (median -12.9%, interquartile range -35.3% to 25.2%; 11 studies) and resistant gram-positive bacteria (median -19.3%, interquartile range -50.1% to +23.1%; 9 studies). There was too much variance in microbial outcomes to reliably assess the effect of change in antibiotic use.

Interventions to improve antibiotic prescribing practices for hospital inpatients (Review)

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S.
Interventions to improve antibiotic prescribing practices for hospital inpatients.
Cochrane Database of Systematic Reviews 2017, Issue 2. Art. No.: CD003543.
DOI: 10.1002/14651858.CD003543.pub4.

Impact d'une restriction des antibiotiques

Hôpital 575 lits – EMA 24/24

	Avant	Après	Différence
Coût des prescriptions ($)			
ATB restreints	130 302	41 576	- 68%
ATB non restreints	84 004	105 367	+ 25%
Total	224 044	152 118	- 32%
Sensibilité aux ATB (%)			
Pyocyanique/Imipénème	65-83	83-95	< 0.01
E. Coli/Ticarcilline-clav.	77-88	97-98	< 0.01
Bactériémie, survie à 30 j (%)	79	75	NS
Bactériémie, délai ATB appropriée (h)	5	5	NS

White CA, Clin Infect Dis 1997

Restriction des céphalosporines

	Avant	Après	Différence (%)	P
Consommation céphalosporines (g/mois)	5558	1106	- 80	< 0.001
Consommation imipénème (g/mois)	197	474	+ 140	0.05
Klebsiella sp. ceftazidime-R, n	150	84	- 44	< 0.05
P. aeruginosa imipénème-R, n	67	113	+ 68	< 0.01

Rahal JJ, JAMA 1998

J Antimicrob Chemother 2010; **65**: 1062–1069
doi:10.1093/jac/dkq058 Advance publication 9 March 2010

Journal of Antimicrobial Chemotherapy

Improved susceptibility of Gram-negative bacteria in an intensive care unit following implementation of a computerized antibiotic decision support system

M. K. Yong[1,2]*, K. L. Buising[1], A. C. Cheng[2,3] and K. A. Thursky[1]

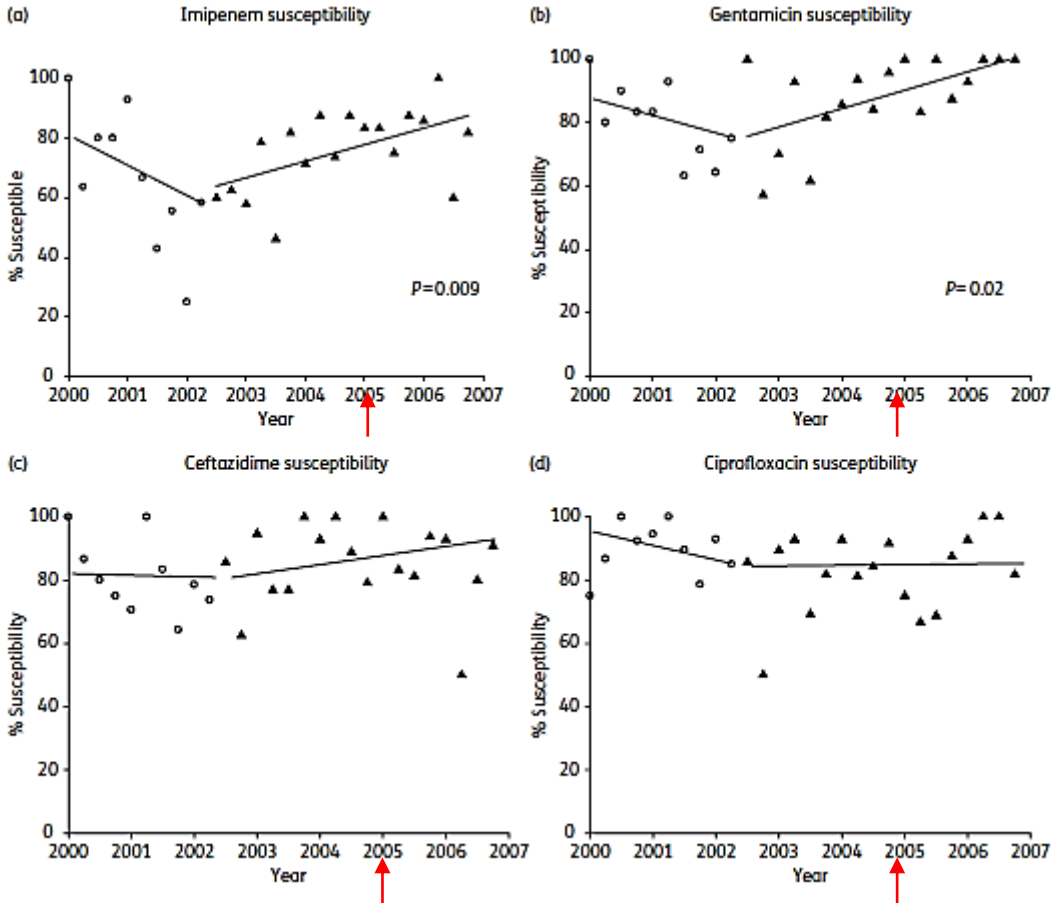


Figure 1. Changes in ICU *Pseudomonas* susceptibility pre- and post-intervention.

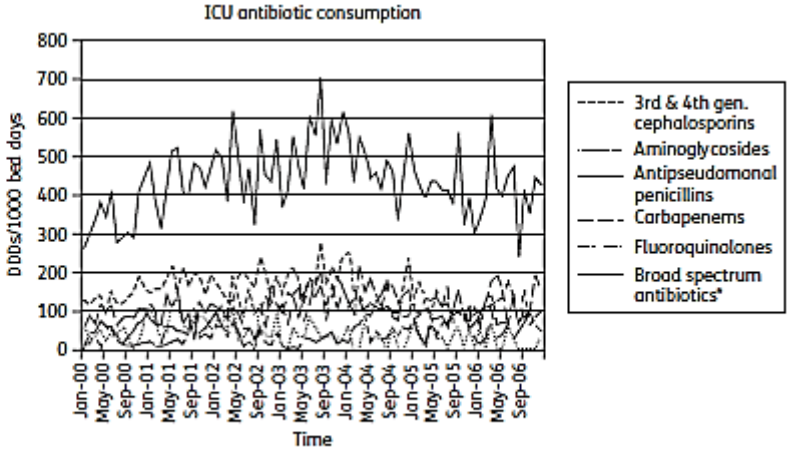
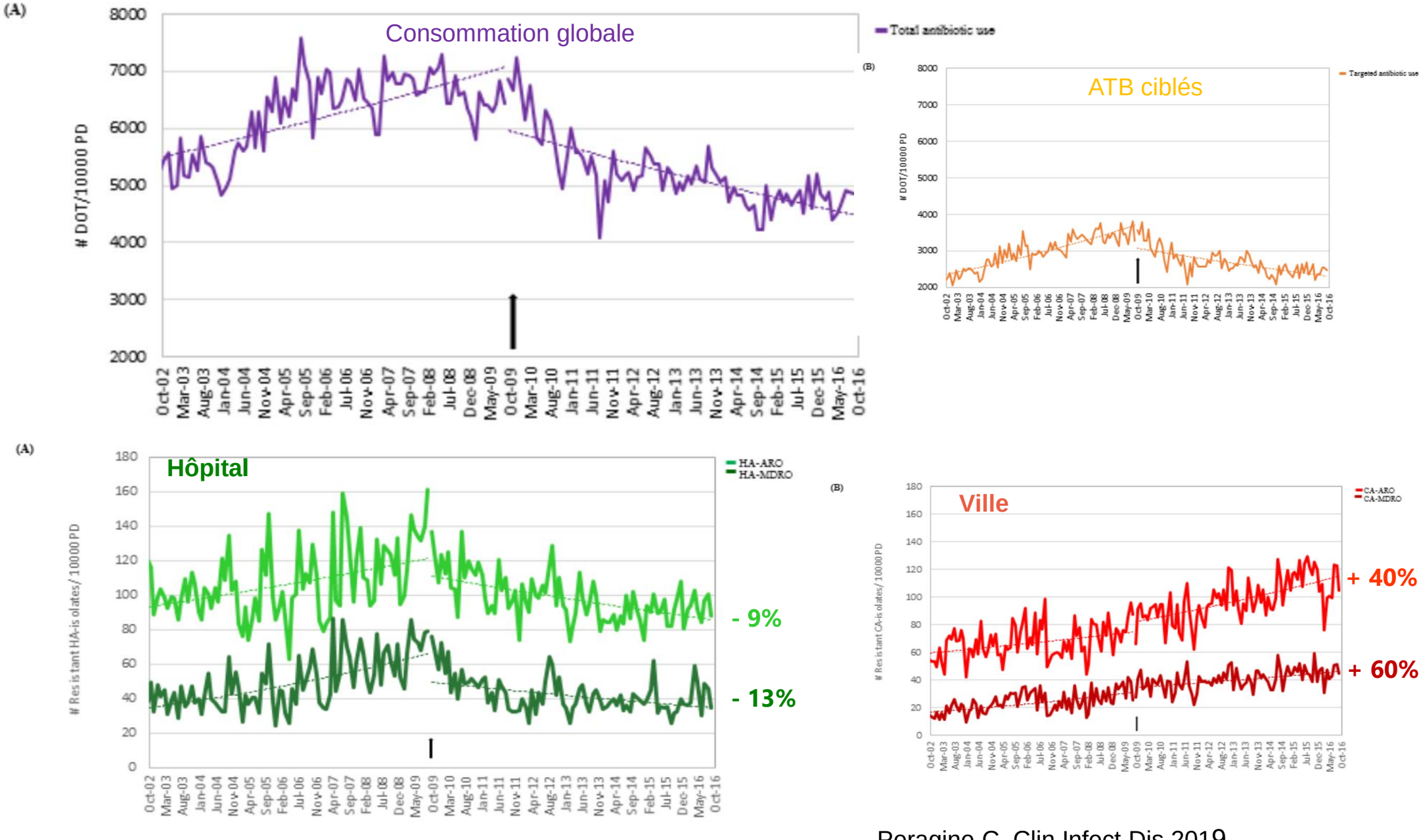


Figure 2. ICU-based antibiotic consumption. *Includes the sum total of all above stated antibiotics.

C3G - 0,38 DDJ/1000 JH
AG - 0,27 DDJ/1000 JH

↑ Campagne hygiène des mains

Impact à long terme (14 ans)



Peragine C, Clin Infect Dis 2019

Impact d'une utilisation restrictive des antibiotiques sur l'acquisition d'EBLSE en réanimation

- Etude avant/après, ICU 26 lits, prévalence élevée d'EBLSE
- Avant (1 an) : stratégie usuelle
- Après (1 an) : stratégie restrictive

Prescription probabiliste après documentation (sauf exceptions)

Association céphalosporines/aminosides

Pas de pipéra/tazo ou carbapénème en probabiliste

Limitation des antibiotiques actifs sur *P. aeruginosa* et les anaérobies

Monothérapie en traitement documenté

Posologie élevée, désescalade et durée courte

- Pas de modification des mesures de prévention de l'infection

Le Terrier C, Crit Care 2021

Impact d'une utilisation restrictive des antibiotiques sur l'acquisition d'EBLSE en réanimation

	Période contrôle	Période restrictive	P
N de patients	738	803	
N de patients sous ATB	427 (57,9%)	376 (46,8%)	< 0,01
Durée ATB, médiane	6 (4-10)	5 (3-8)	< 0,01
Pipéra/tazo Carbapénème Anti-anaérobie	170 (39,8%) 52 (12,2%) 279 (65,3%)	17 (4,5%) 13 (3,5%) 126 (33,5%)	< 0,01 < 0,01 < 0,01
Acquisition EBLSE	140 (19,0%)	97 (12,1%)	< 0,01
Infection EBLSE	61 (8,3%)	41 (5,1%)	0,01
Mortalité ICU	211 (28.6%)	181 (22.5%)	< 0,01

Nombre de jours en ICU sans EBLSE (médiane) 18 j *vs*. 22 j
Stratégie restrictive : HR 0,751 (0,578–0,977)

Le Terrier C, Crit Care 2021

Fluroquinolones, SARM et *P. aeruginosa*

FQ

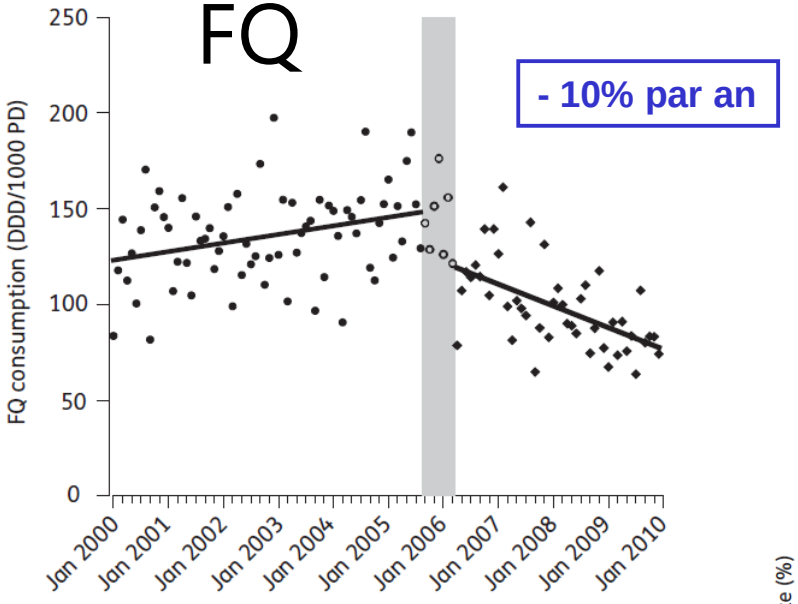


Figure 1. Monthly FQ consumption, expressed as DDD/1000 PD. Filled circles, pre-intervention period values; open circles, intervention period values; diamonds, post-intervention period values. Continuous lines represent predictions from the segmented regression model and the shaded area represents the intervention period.

P. aeruginosa

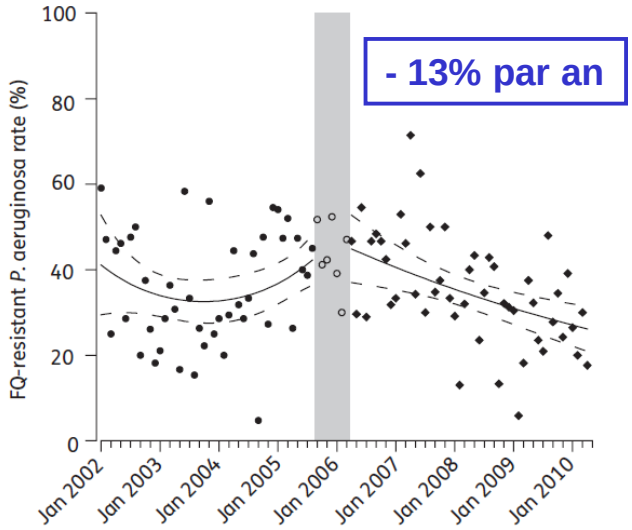


Figure 4. Change in monthly FQ-resistant *P. aeruginosa* rates, from 2002 to 2010. Filled circles, pre-intervention period values; open circles, intervention period values; diamonds, post-intervention period values. Continuous lines represent predictions from the segmented Poisson model and broken lines represent their pointwise 95% CIs. The shaded area represents the intervention period.

SARM

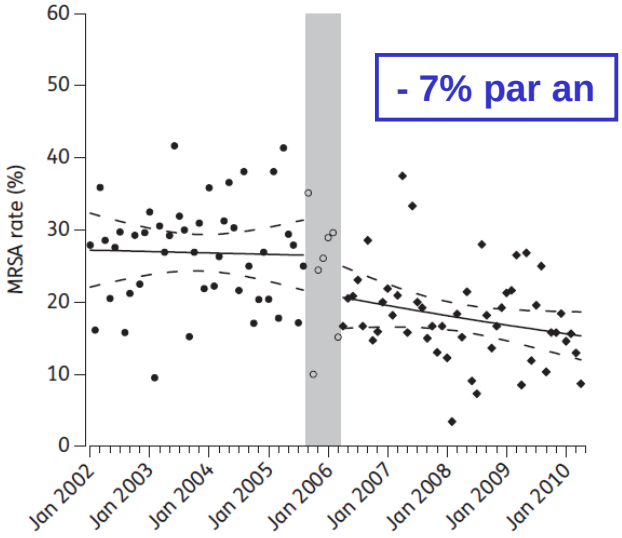


Figure 5. Change in monthly MRSA rates, from 2002 to 2010. Filled circles, pre-intervention period values; open circles, intervention period values; diamonds, post-intervention period values. Continuous lines represent predictions from the segmented Poisson model and broken lines represent their pointwise 95% CIs. The shaded area represents the intervention period.

Lafaurie M, J Antimicrob Chemother 2012

Fluroquinolones, SARM et *P. aeruginosa :* synergie avec la FHA

FQ

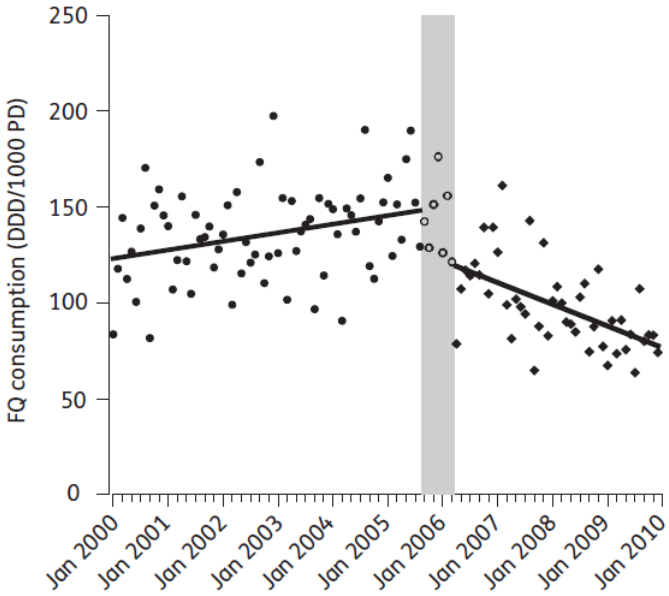
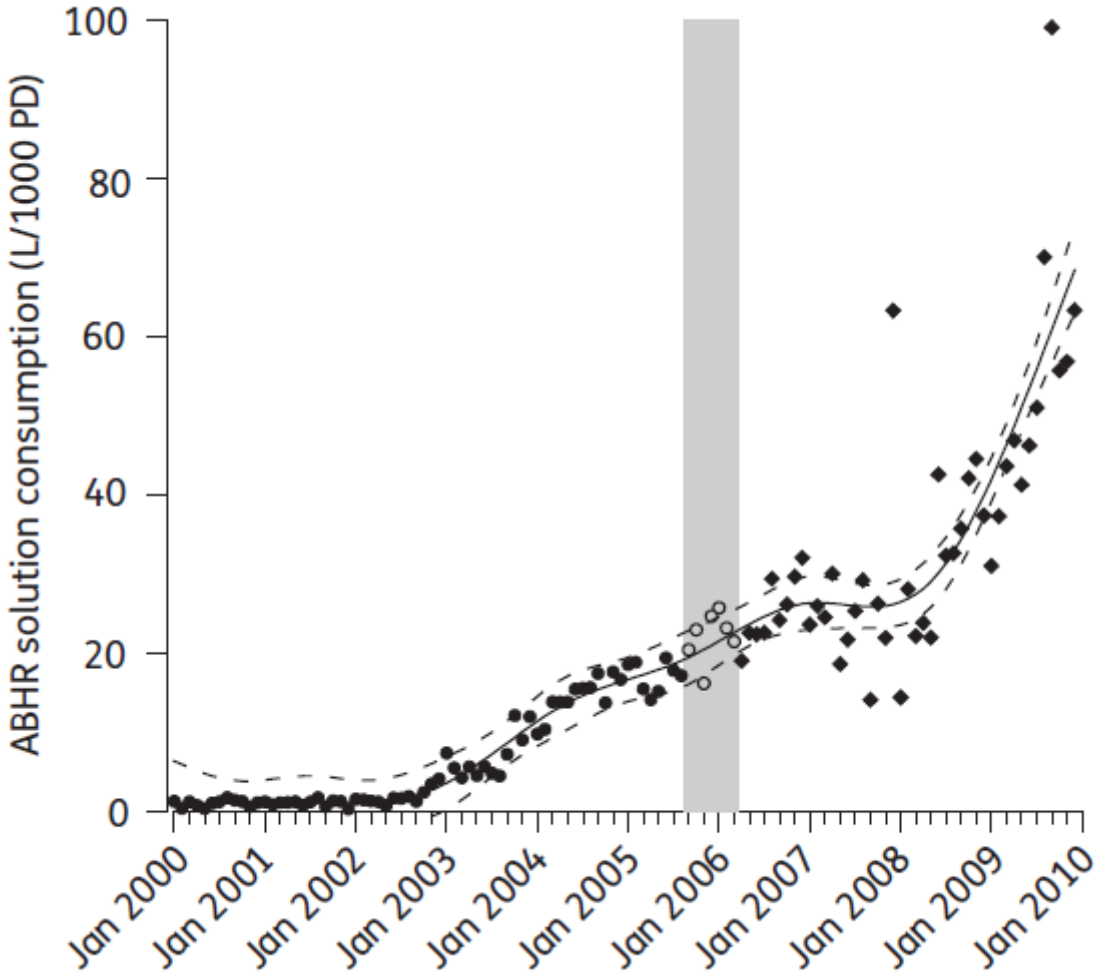


Figure 1. Monthly FQ consumption, expressed as DDD/1000 PD. Filled circles, pre-intervention period values; open circles, intervention period values; diamonds, post-intervention period values. Continuous lines represent predictions from the segmented regression model and the shaded area represents the intervention period.

FHA



Lafaurie M, J Antimicrob Chemother 2012

SARM, FQ et hygiène des mains

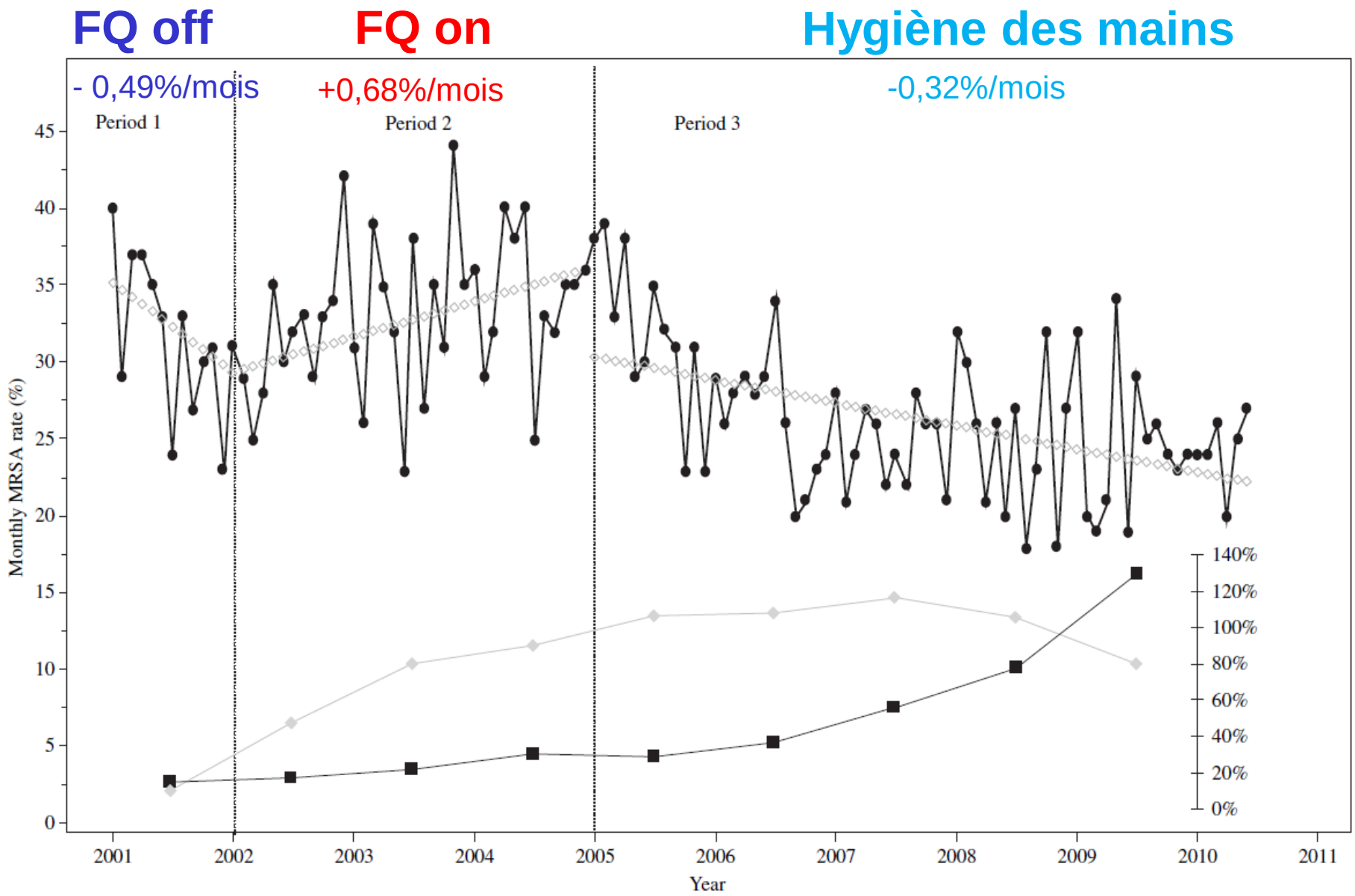


Figure 1. Actual (●) and segmented linear autoregression (◇) analysis of 2001–2011 monthly meticillin-resistant *Staphylococcus aureus* (MRSA) prevalence, fluoroquinolone (FQ) and alcohol-based hand-rub (ABHR) consumptions, Caen University hospital, France. ◆, percentage of FQ use vs before restriction (year 2000, expressed in defined daily dose per 1000 patient-days); ■, percentage of ABHRs considered optimal by the French ICSHA/ICALIN system; Period 1, FQ restriction; Period 2, FQ release; Period 3, hand-hygiene campaign with stable FQ use.

Parienti JJ, J Hosp Infect 2011

Restriction des carbapénèmes et résistance de *Pseudomonas aeruginosa*

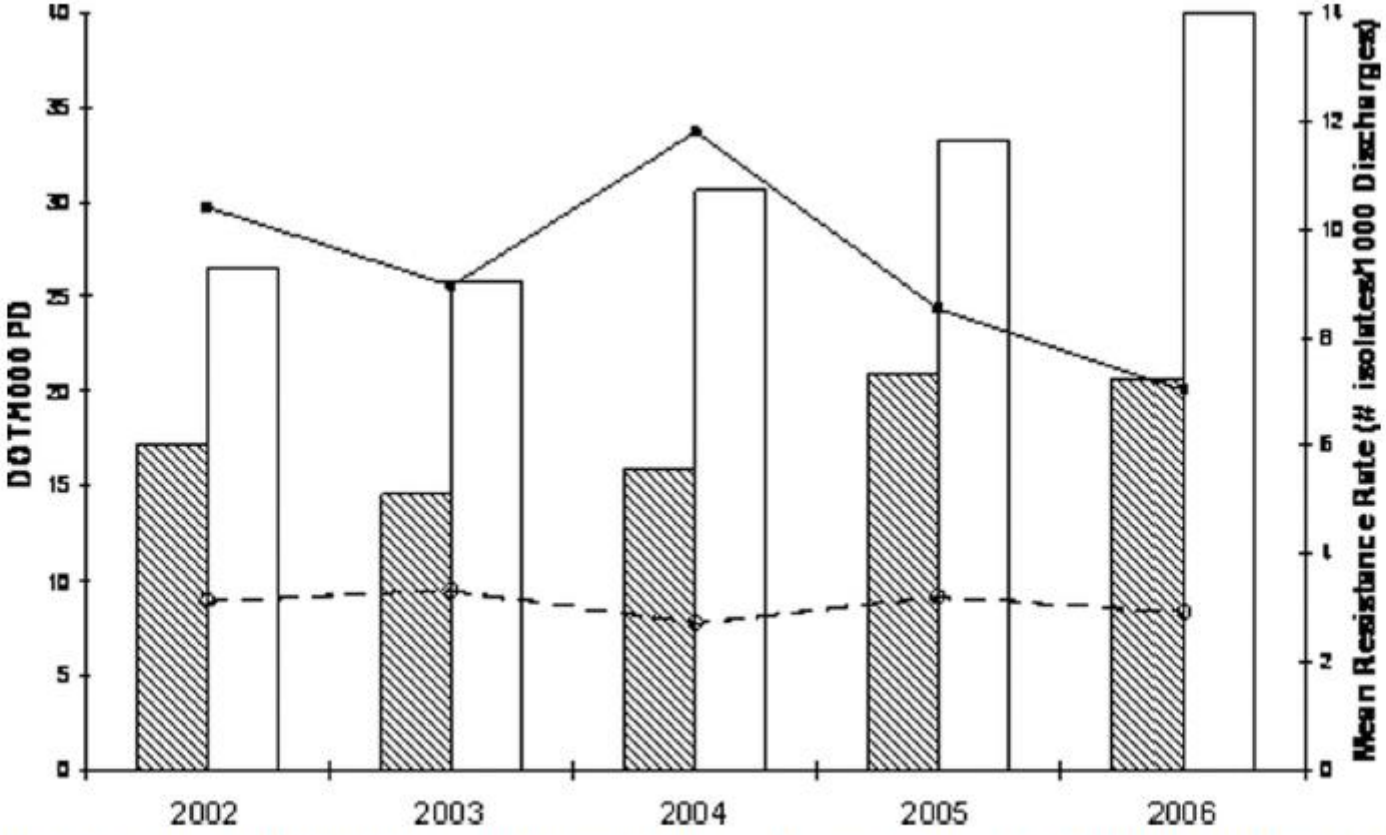
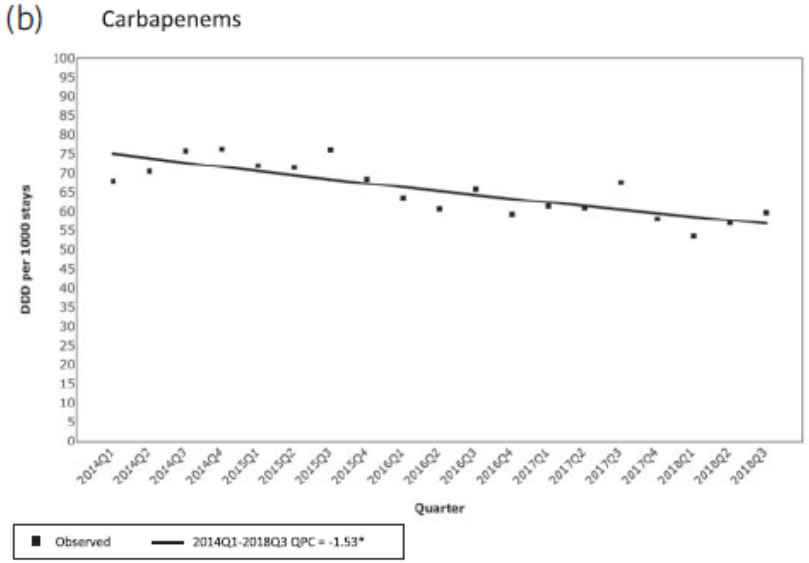
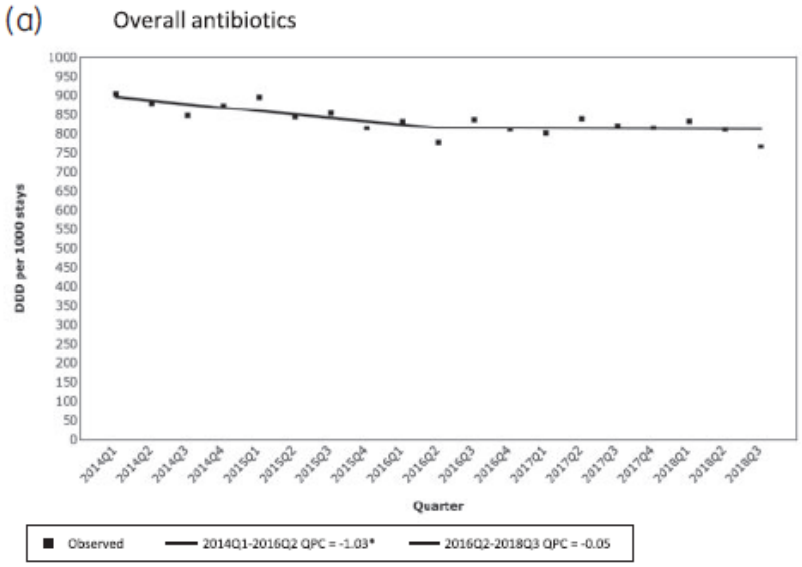


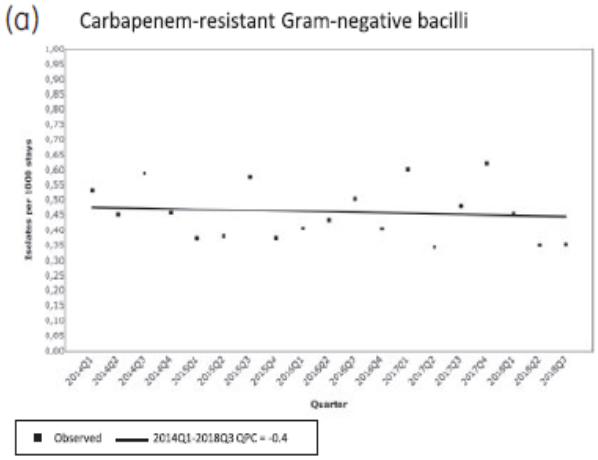
FIG. 1. Mean carbapenem use (DOT/1,000 PD) was significantly lower in hospitals that restricted (shaded bars) versus did not restrict (open bars) carbapenems ($P = 0.04$). Incidence rates of carbapenem-resistant *P. aeruginosa* (number of isolates/1,000 discharges) were lower for hospitals that restricted (dashed line) versus did not restrict (solid line) carbapenems ($P = 0.01$).

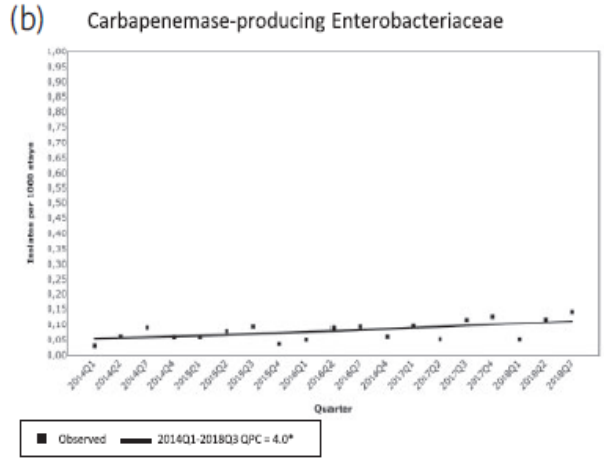
Pakyz AL, Antimicrob Agents Chemother 2009

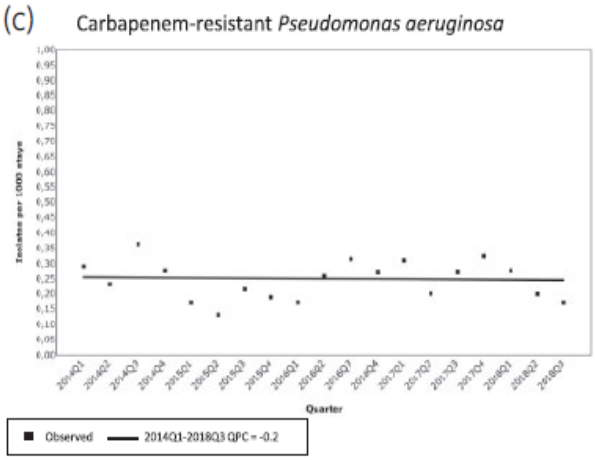
Meilleur usage des carbapénèmes

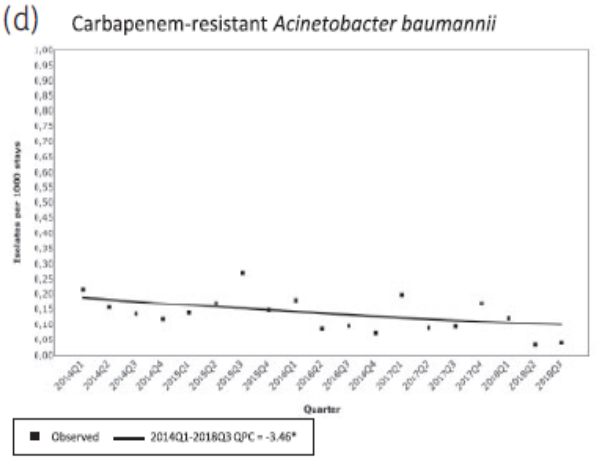






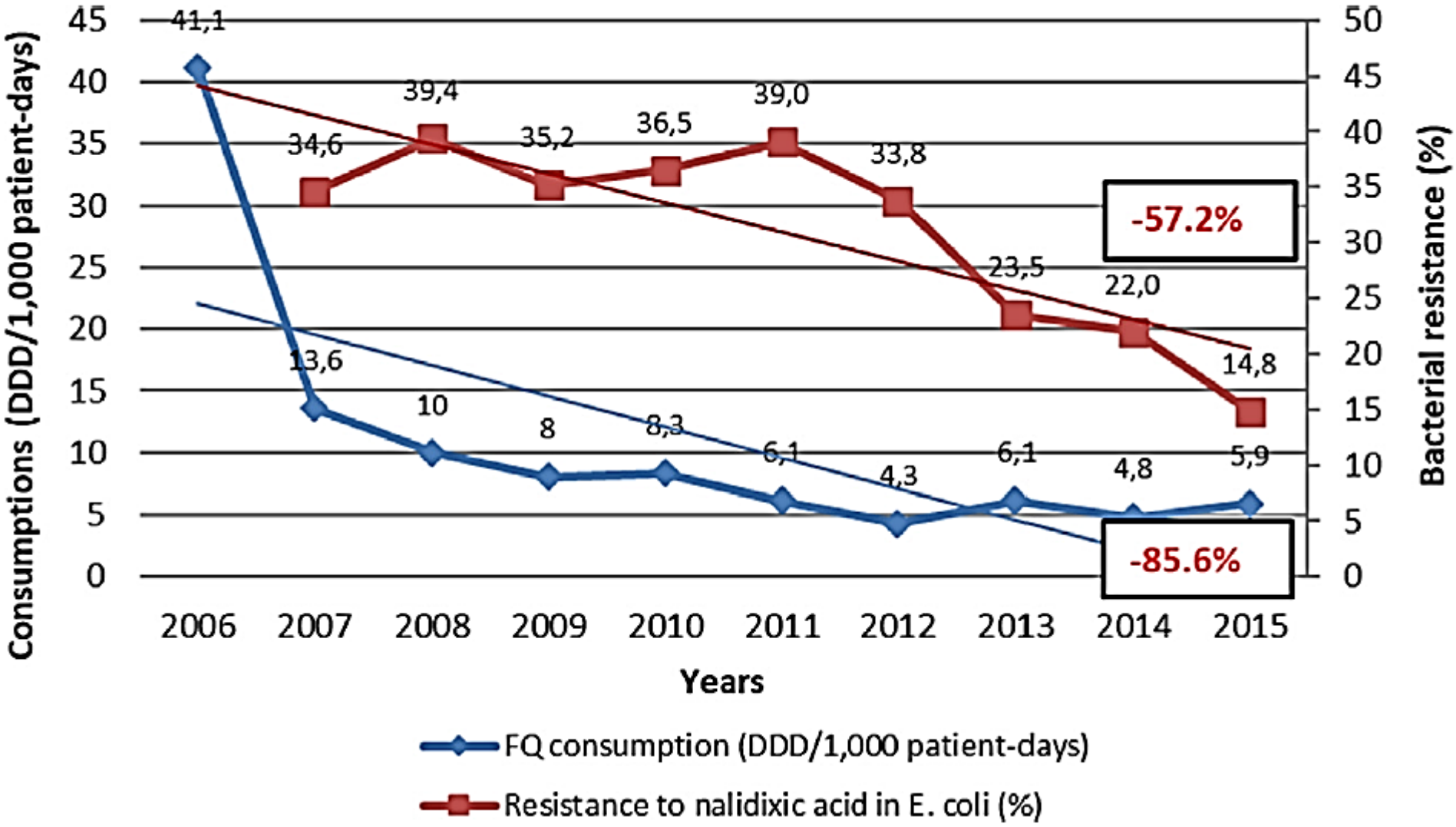






Alvarez Marin R, J Antimicrob Chemother 2021

Impact à long terme d'une politique d'épargne des FQ dans un hôpital local (français !)



Muller A, Med Mal Inf 2019

Contrôle de la résistance aux antibiotiques

Danemark : hôpital intervention (736 lits)

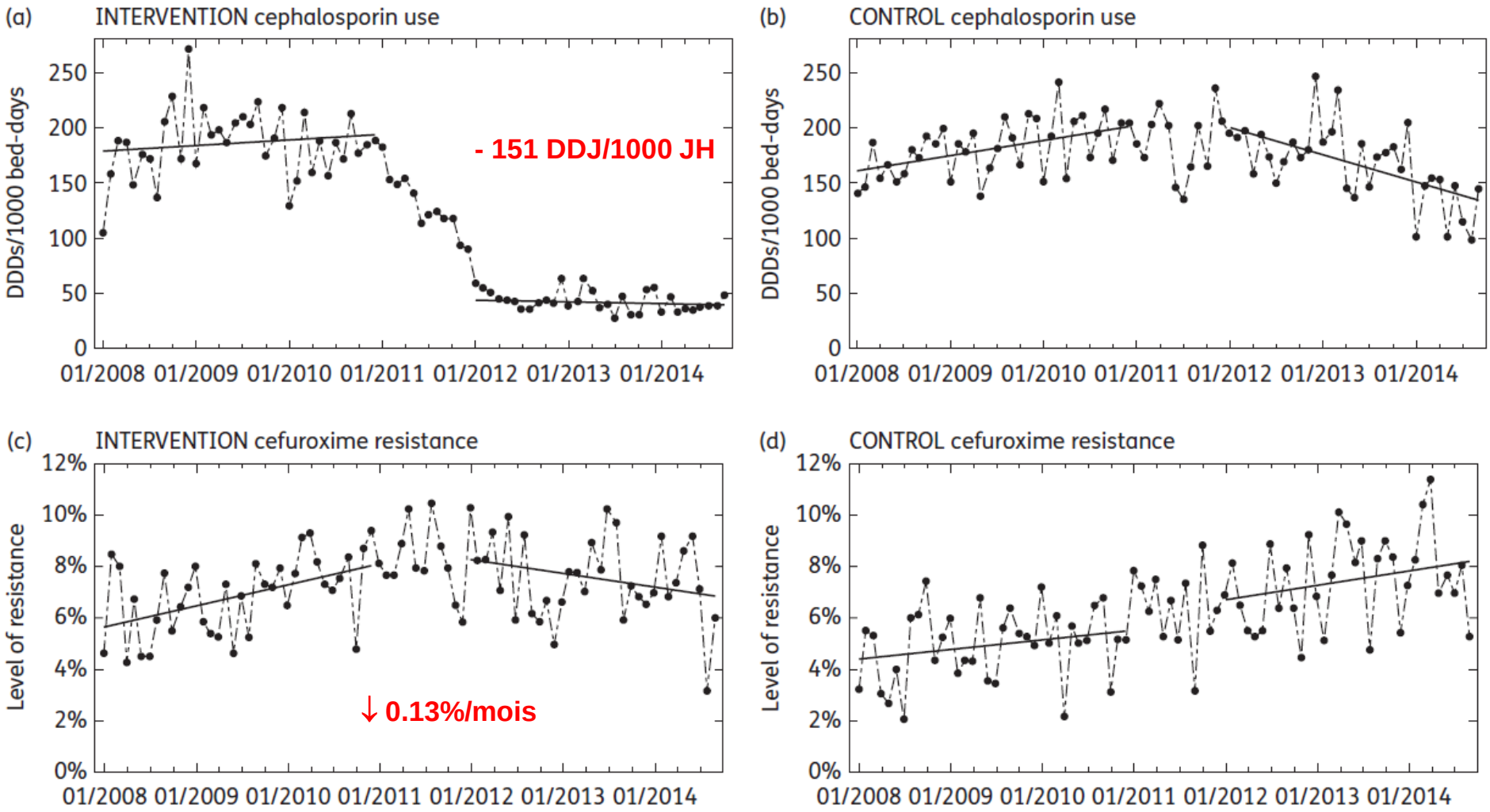
Mise en place du programme	Phases
Audit	Audit des prescriptions : binôme infectiologue/microbiologiste
Présentation des résultats	Ecrit/oral
Nouvelles recommandations antibiothérapie curative et prophylaxie	Remplacement des céphalosporines et FQ : pénicillines G, A, M et gentamicine Phase test : médecine et urgences
Mise en place d'une équipe mobile	Infectiologue, microbiologiste, pharmaciens
Retrait des molécules cibles	Suppression du formulaire et du stock des services, dispensation contrôlée
Audits	Audits mensuels dans les services
Feedback	Feedback mensuel des consommations des céphalosporines et FQ

Boel J, J Antimicrob Chemother 2016

Contrôle de la résistance aux céphalosporines

Hôpital intervention

Hôpital témoin

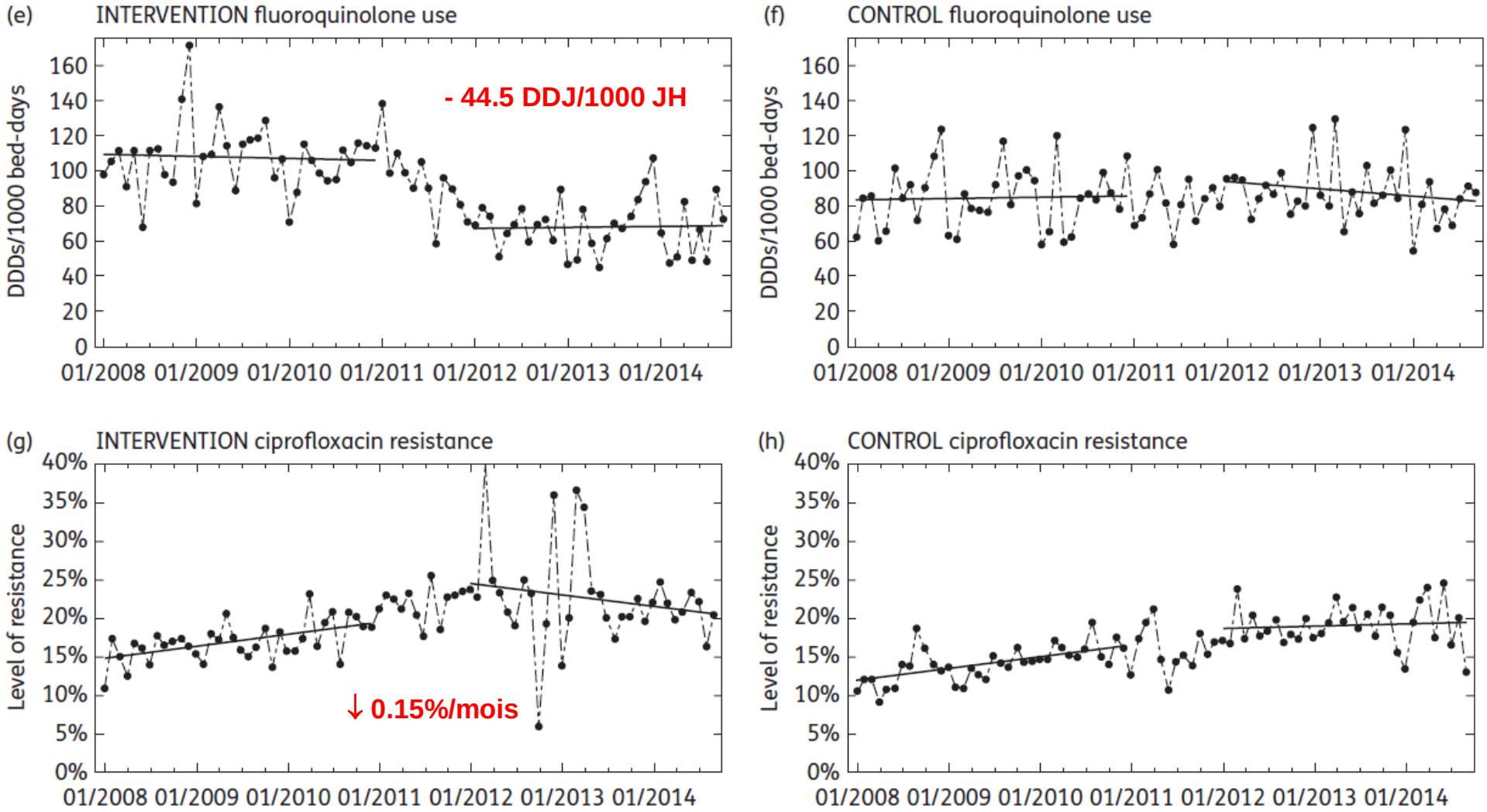


Boel J, J Antimicrob Chemother 2016

Contrôle de la résistance aux fluoroquinolones

Hôpital intervention

Hôpital témoin



Boel J, J Antimicrob Chemother 2016

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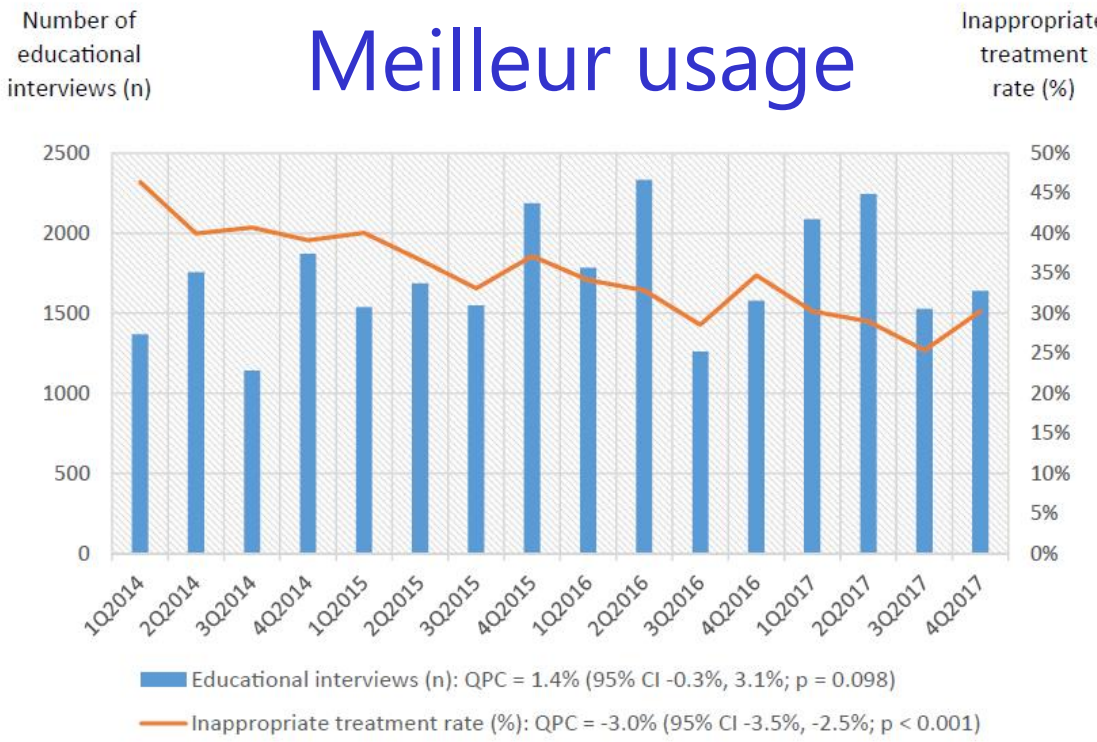
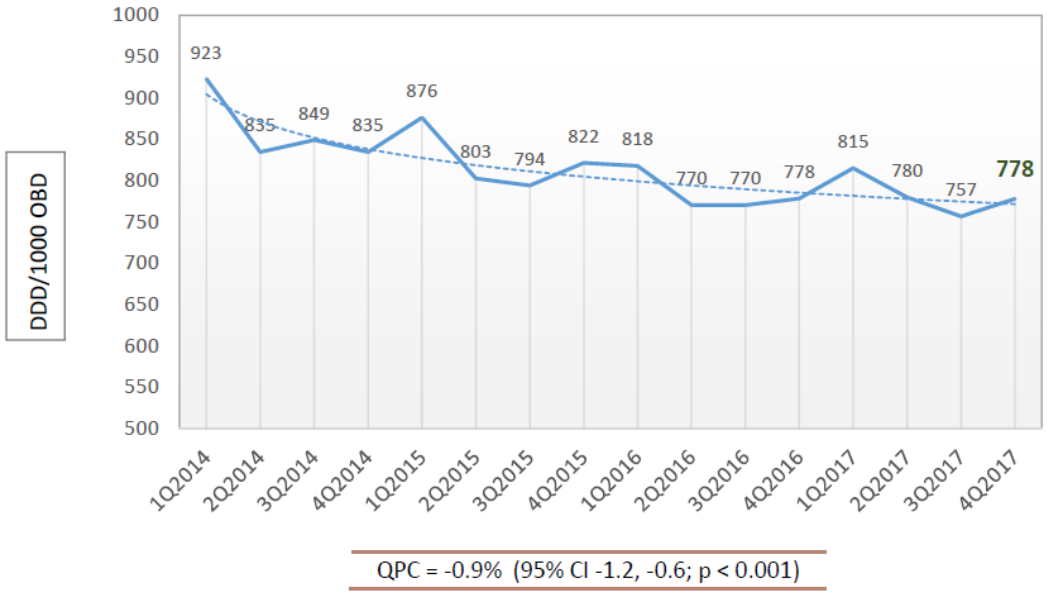
Original article

Outcomes of the PIRASOA programme, an antimicrobial stewardship programme implemented in hospitals of the Public Health System of Andalusia, Spain: an ecologic study of time-trend analysis

Meilleur usage

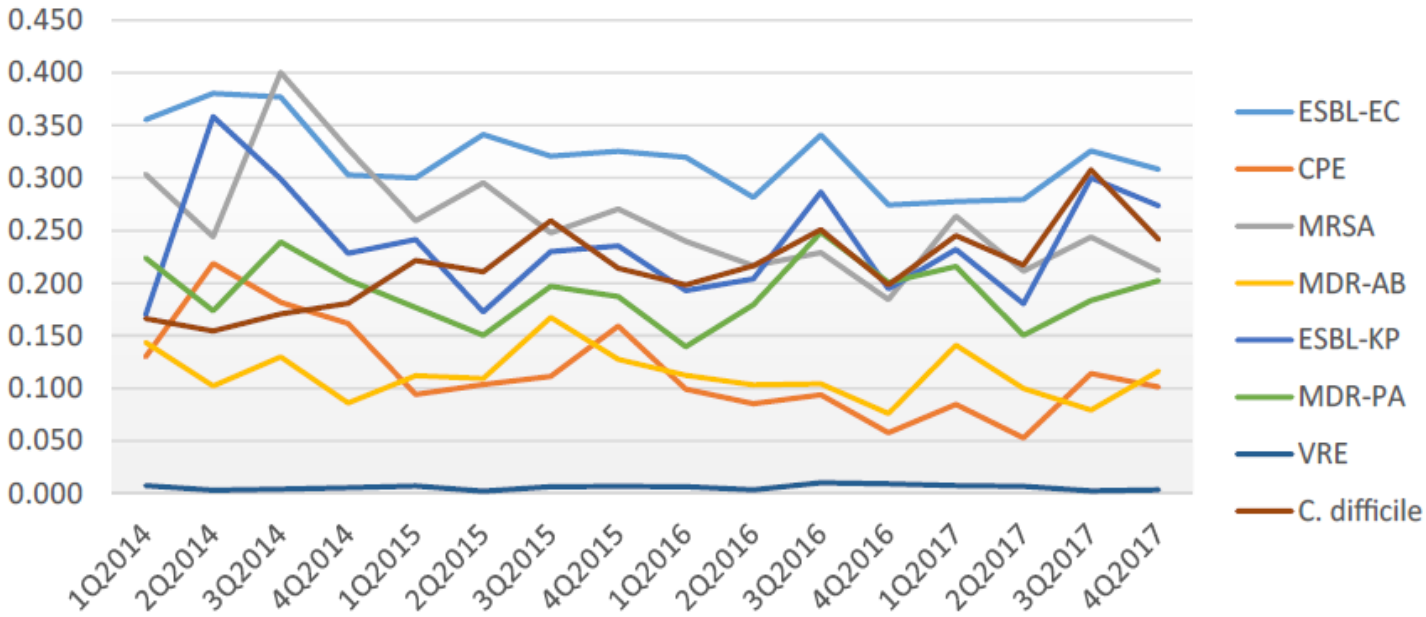


Moindre usage



Rodriguez-Bano J, Clin Microbiol Infect 2020

Bingo !



ID/1000 OBD	Trend QPC	95% CI	P value
ESBL-EC	**-1.4%**	(-2.2,-0.6)	0.001
CPE	**-5.6%**	(-8.2,-3.0)	< 0.001
MRSA	**-2.9%**	(-4.1,-1.7)	0.001
MDR-AB	-1.3%	(-3.1,0.6)	0.159
ESBL-KP	-0.6%	(-2.6,1.4)	0.504
MDR-PA	-0.4%	(-1.9,1.2)	0.638
VRE	2.6%	(1.5,6.9)	0.194
C. difficile	2.9%	(1.8,4.0)	< 0.001

Fig. 5. Trends in incidence density of multidrug-resistant bacteria and *Clostridium difficile* (DDD/1000 OBD). CPE, carbapenemase-producing *Enterobacteriaceae*; DDD/1000 OBD, defined daily dose per 1000 occupied bed-days; ESBL-EC, extended-spectrum β-lactamases-producing *Escherichia coli*; ESBL-KP, extended-spectrum βlactamases-producing *Klebsiella pneumoniae*; MDR-AB, multidrug-resistant *Acinetobacter baumannii*; MDR-PA, multidrug-resistant *Pseudomonas aeruginosa*; MRSA, methicillin resistant *Staphylococcus aureus*; VRE, vancomycin-resistant *Enterococcus* spp.

Rodriguez-Bano J, Clin Microbiol Infect 2020

Clinical Infectious Diseases

MAJOR ARTICLE

Long-Term Impact of an Educational Antimicrobial Stewardship Program on Hospital-Acquired Candidemia and Multidrug-Resistant Bloodstream Infections: A Quasi-Experimental Study of Interrupted Time-Series Analysis

José Molina,[1] Germán Peñalva,[1] María V. Gil-Navarro,[2] Julia Praena,[1] José A. Lepe,[1] María A. Pérez-Moreno,[2] Carmen Ferrándiz,[3] Teresa Aldabó,[3] Manuela Aguilar,[1] Peter Olbrich,[4] Manuel E. Jiménez-Mejías,[1] María L. Gascón,[3] Rosario Amaya-Villar,[3] Olaf Neth,[4] María J. Rodríguez-Hernández,[1] Antonio Gutiérrez-Pizarraya,[1] José Garnacho-Montero,[5] Cristina Montero,[6] Josefina Cano,[6] Julián Palomino,[1] Raquel Valencia,[1] Rocío Álvarez,[1] Elisa Cordero,[1] Marta Herrero,[1] and José M. Cisneros[1]; for the PRIOAM team

Departments of [1]Infectious Diseases, Microbiology and Preventive Medicine, [2]Pharmacy, [3]Critical Care, and [4]Pediatric Infectious Diseases and Immunodeficiency, Institute of Biomedicine of Seville, University Hospital Virgen del Rocio, Spanish National Research Council, University of Seville, and [5]Department of Critical Care, University Hospital Virgen Macarena, University of Seville and [6]Department of Pediatric Critical Care and Emergency, University Hospital Virgen del Rocio, Seville, Spain

Clinical Infectious Diseases® 2017;65(12):1992–9

Le top !

Clinical Infectious Diseases

MAJOR ARTICLE

Long-Term Impact of an Educational Antimicrobial Stewardship Program on Hospital-Acquired Candidemia and Multidrug-Resist A Quasi-Experimenta Analysis

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Departments of [1]Infectious Diseases, Microbiology and Preventive Me Seville, University Hospital Virgen del Rocio, Spanish National Researc and [5]Department of Pediatric Critical Care and Emergency, University H

Méthodes :

1. Equipe multidisciplinaire
2. Tirage au sort des prescriptions : interview des prescripteurs
3. Actualisation et diffusion du guide antibiotiques
4. Bilan trimestriel des consommations d'antibiotiques des services
5. Bilan annuel de la résistance bactérienne des services
6. Bilan annuel du programme dans chaque service

Support de l'institution et signature d'une convention entre les services et la direction

La preuve du concept : impact clinique et écologique

Consommation antibiotiques
↓ 18,3-21,5%

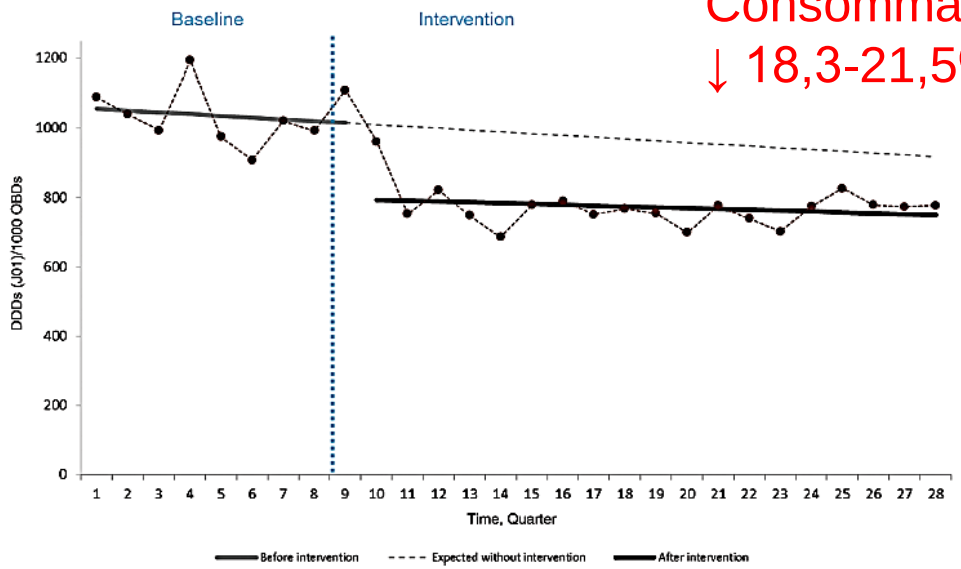
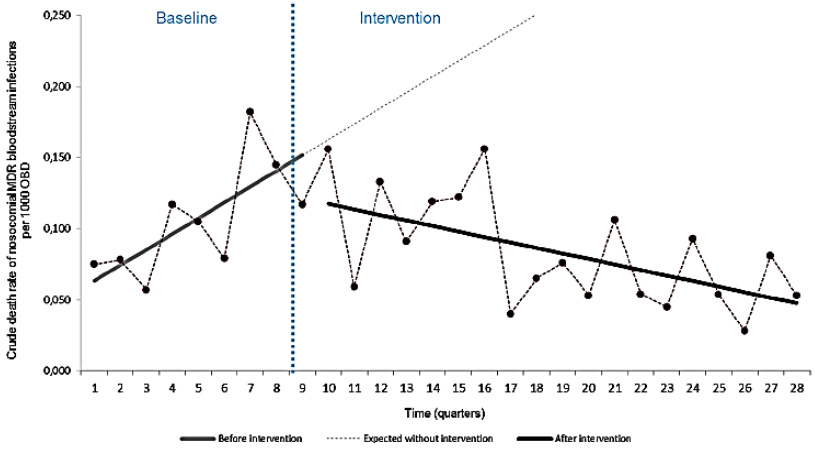


Figure 1. Changes in antibiotic consumption. ATC group J01 (antibacterials for systemic use); DDDs, defined daily doses; OBDs, occupied bed days.

Mortalité bactériémies BMR



Incidence bactériémies BMR et candidémies

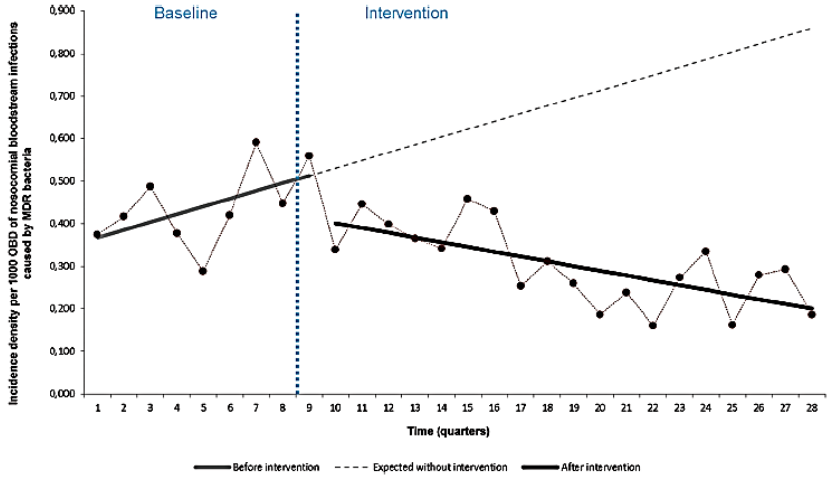


Figure 4. Changes in crude death rate for hospital-acquired multidrug-resistant (MDR) bacterial bloodstream infections (BSIs). OBDs, occupied bed days.

2. Impact on incidence of hospital-acquired candidemia and multidrug-resistant (MDR) bacterial bloodstream infections (BSIs). OBDs, occupied bed days.

Molina J. et al, Clin Infect Dis 2017

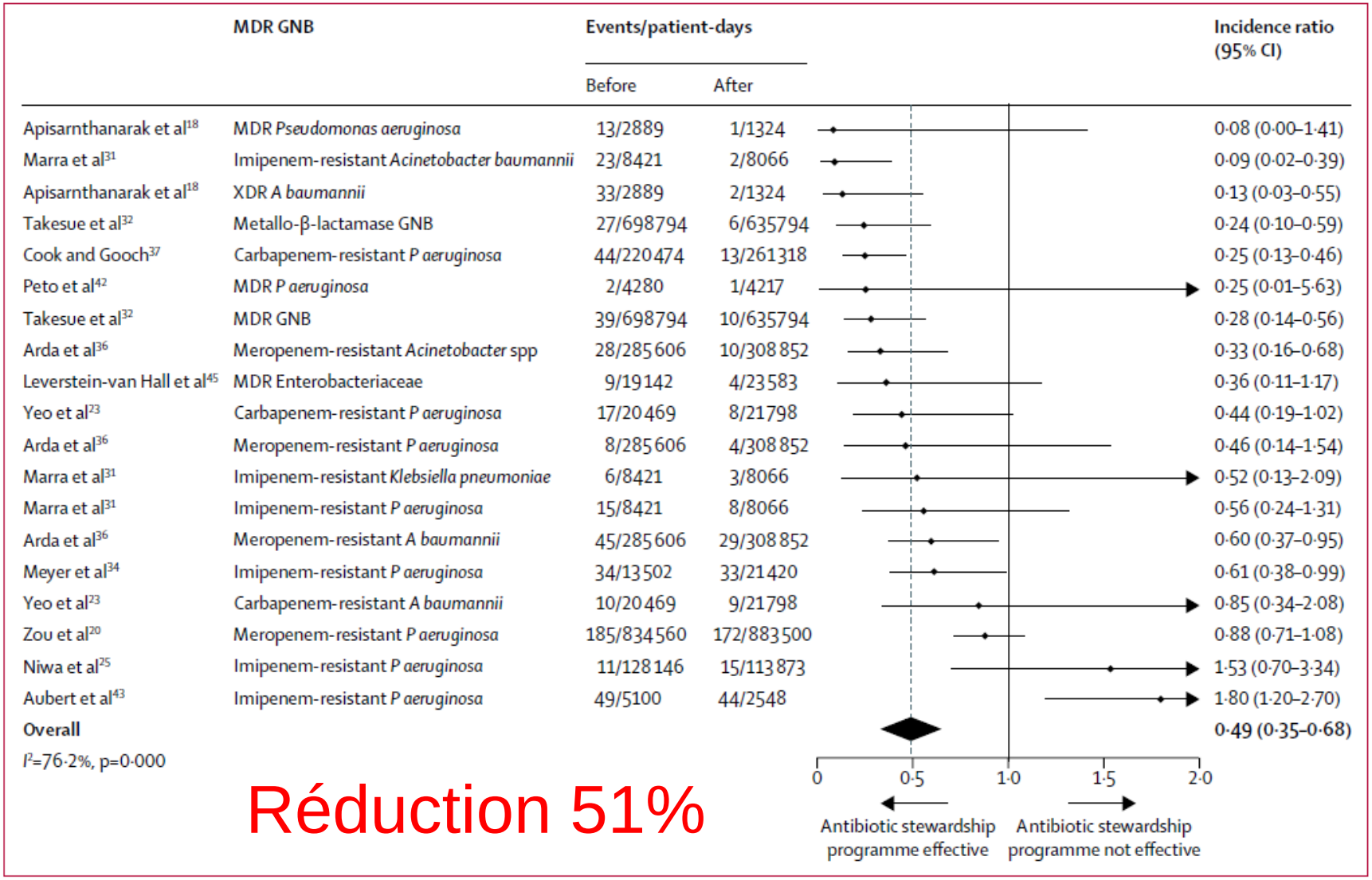
La réponse à la question ?

Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and *Clostridium difficile* infection: a systematic review and meta-analysis

- ✓ Méta-analyse 32 études
- ✓ Qualité modérée 26 (81%), « avant/après » 17 (53%)
- ✓ Audits 19 (59%), restriction 15 (47%)
- ✓ Mesures de contrôle de l'infection 10 (31%)

Baur D, Lancet Infect Dis 2017

Impact sur la résistance des BGN



	MDR GNB	Events/patient-days		Incidence ratio (95% CI)
		Before	After	
Apisarnthanarak et al[18]	MDR *Pseudomonas aeruginosa*	13/2889	1/1324	0·08 (0·00–1·41)
Marra et al[31]	Imipenem-resistant *Acinetobacter baumannii*	23/8421	2/8066	0·09 (0·02–0·39)
Apisarnthanarak et al[18]	XDR *A baumannii*	33/2889	2/1324	0·13 (0·03–0·55)
Takesue et al[32]	Metallo-β-lactamase GNB	27/698794	6/635794	0·24 (0·10–0·59)
Cook and Gooch[37]	Carbapenem-resistant *P aeruginosa*	44/220474	13/261318	0·25 (0·13–0·46)
Peto et al[42]	MDR *P aeruginosa*	2/4280	1/4217	0·25 (0·01–5·63)
Takesue et al[32]	MDR GNB	39/698794	10/635794	0·28 (0·14–0·56)
Arda et al[36]	Meropenem-resistant *Acinetobacter* spp	28/285606	10/308852	0·33 (0·16–0·68)
Leverstein-van Hall et al[45]	MDR Enterobacteriaceae	9/19142	4/23583	0·36 (0·11–1·17)
Yeo et al[23]	Carbapenem-resistant *P aeruginosa*	17/20469	8/21798	0·44 (0·19–1·02)
Arda et al[36]	Meropenem-resistant *P aeruginosa*	8/285606	4/308852	0·46 (0·14–1·54)
Marra et al[31]	Imipenem-resistant *Klebsiella pneumoniae*	6/8421	3/8066	0·52 (0·13–2·09)
Marra et al[31]	Imipenem-resistant *P aeruginosa*	15/8421	8/8066	0·56 (0·24–1·31)
Arda et al[36]	Meropenem-resistant *A baumannii*	45/285606	29/308852	0·60 (0·37–0·95)
Meyer et al[34]	Imipenem-resistant *P aeruginosa*	34/13502	33/21420	0·61 (0·38–0·99)
Yeo et al[23]	Carbapenem-resistant *A baumannii*	10/20469	9/21798	0·85 (0·34–2·08)
Zou et al[20]	Meropenem-resistant *P aeruginosa*	185/834560	172/883500	0·88 (0·71–1·08)
Niwa et al[25]	Imipenem-resistant *P aeruginosa*	11/128146	15/113873	1·53 (0·70–3·34)
Aubert et al[43]	Imipenem-resistant *P aeruginosa*	49/5100	44/2548	1·80 (1·20–2·70)
Overall				**0·49 (0·35–0·68)**
I^2=76·2%, p=0·000				

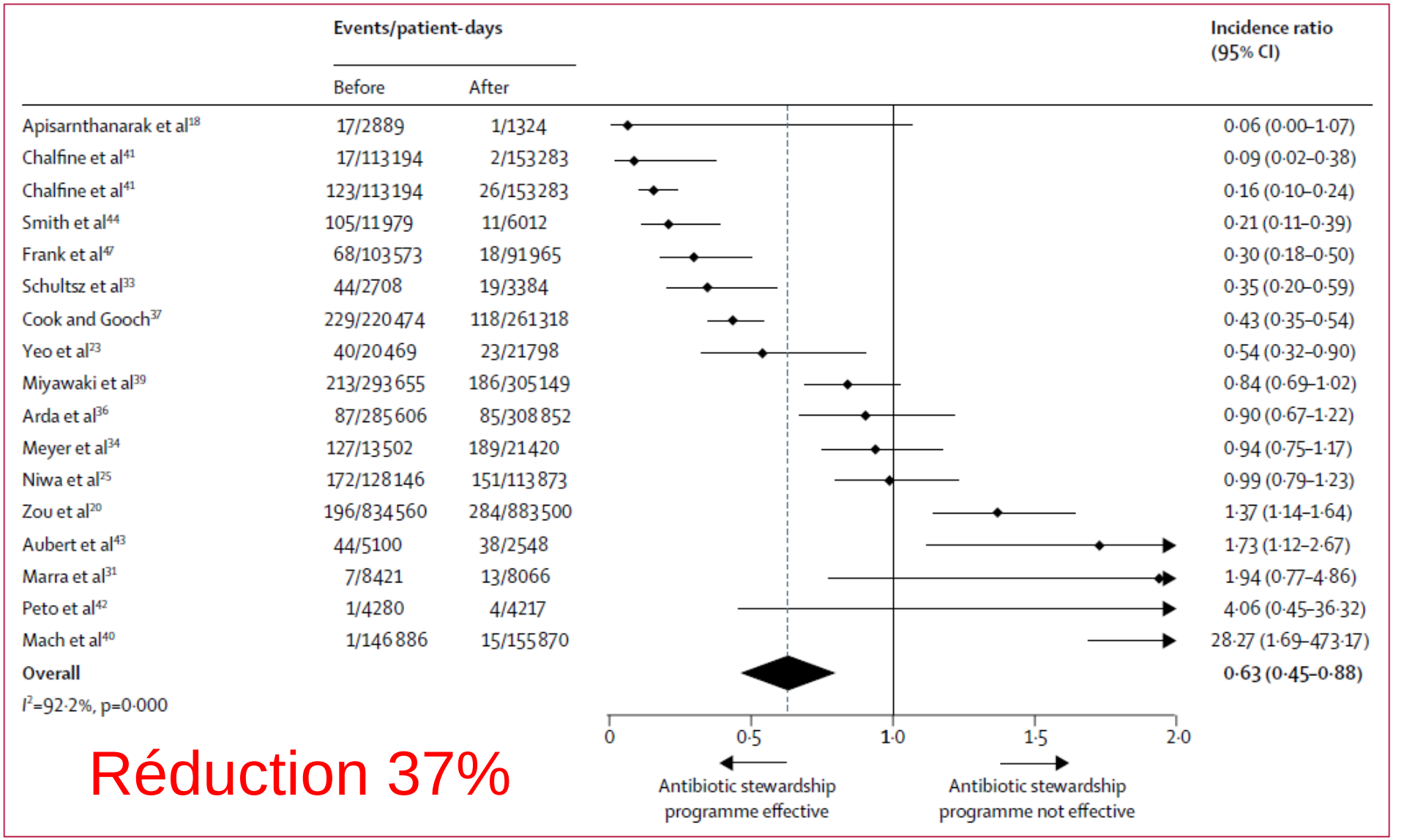
Réduction 51%

E-BLSE – 48% (0,27-0,98; p=0,0428)

Figure 2: **Forest plot of the incidence ratios for studies of the effect of antibiotic stewardship on the incidence of MDR GNB**
GNB=Gram-negative bacteria. MDR=multidrug-resistant. XDR=extensively drug-resistant.

Baur D, Lancet Infect Dis 2017

Impact sur les SARM



Réduction 37%

Figure 3: Forest plot of the incidence ratios for studies of the effect of antibiotic stewardship on the incidence of meticillin-resistant *Staphylococcus aureus*

Baur D, Lancet Infect Dis 2017

Added value of this study

This systematic review and meta-analysis showed, for the first time, the effectiveness of antibiotic stewardship programmes in reducing the incidence of infections and colonisation due to multidrug-resistant Gram-negative bacteria, extended-spectrum β-lactamase (ESBL)-producing Gram-negative bacteria, meticillin-resistant *Staphylococcus aureus*, and *C difficile*. The effect was increased in haematology-oncology settings and if antibiotic stewardship was co-implemented with hand-hygiene improvement measures.

Implications of all the available evidence

This meta-analysis provides stakeholders and policy makers with evidence for the effectiveness of antibiotic stewardship programmes in reducing the incidence of infection and colonisation with antibiotic-resistant bacteria, in particular ESBL-producing and carbapenem-resistant Gram-negative bacteria. The evidence of increased effect when co-implemented in association with interventions targeting hand hygiene provides important information for new antibiotic stewardship programmes.

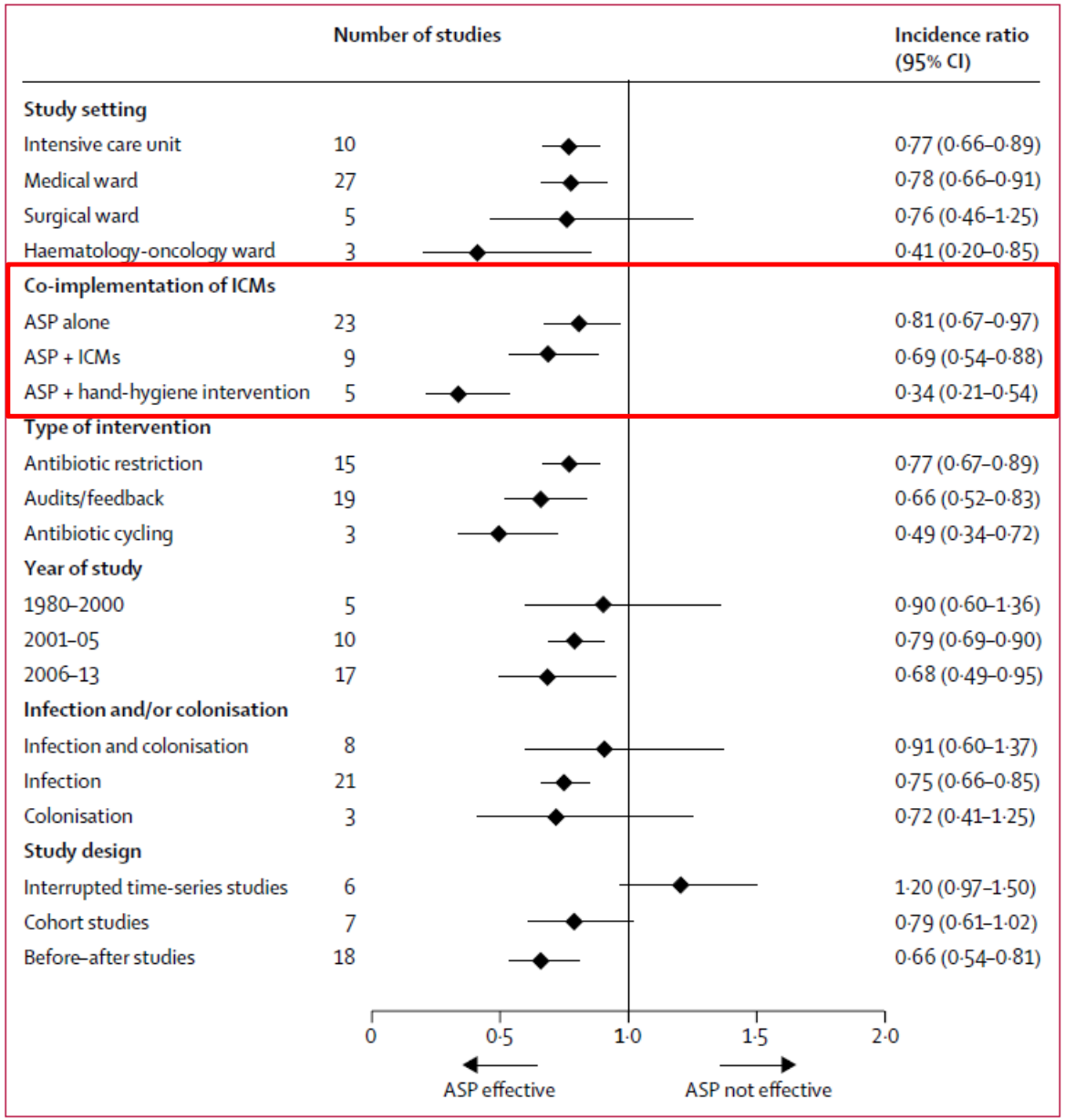


Figure 5: Summary forest plot of the incidence ratios for studies investigating the effect of ASPs on antibiotic resistance, according to study characteristics
ICM=infection control measure. ASP=antibiotic stewardship programme.

Baur D, Lancet Infect Dis 2017

Ne pas oublier la ville

Long-term impact of an educational antimicrobial stewardship programme in primary care on infections caused by extended-spectrum β-lactamase-producing *Escherichia coli* in the community: an interrupted time-series analysis

*Germán Peñalva, Rocío Fernández-Urrusuno, José María Turmo, Rocío Hernández-Soto, Ignacio Pajares, Lucía Carrión, Inmaculada Vázquez-Cruz, Blanca Botello, Beatriz García-Robredo, Manuel Cámara-Mestres, Juan Carlos Domínguez-Camacho, Manuel María Aguilar-Carnerero, José Antonio Lepe, Marina de Cueto, María Carmen Serrano-Martino, María Carmen Domínguez-Jiménez, Ana Domínguez-Castaño, José Miguel Cisneros, on behalf of the PIRASOA-FIS team**

Lancet Infect Dis 2019

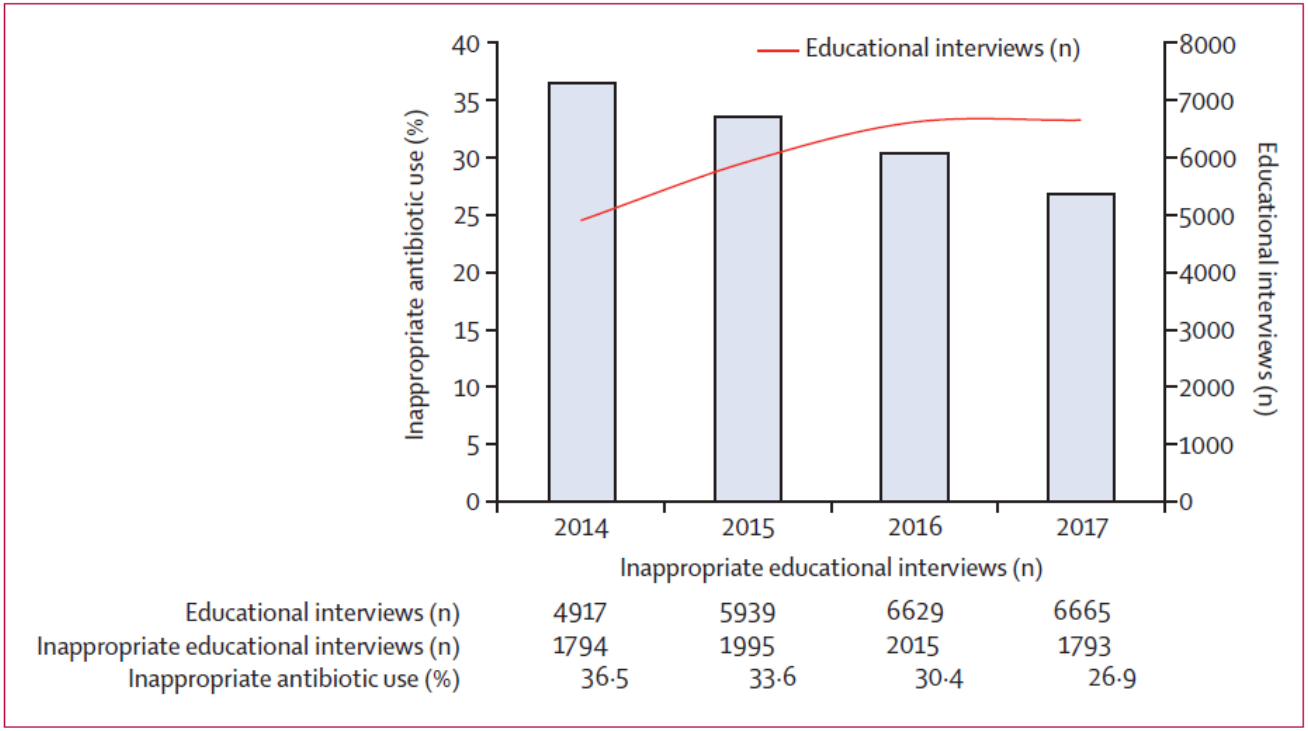


Figure 1: **Number of educational interviews and proportion of inappropriate antibiotic prescriptions during the intervention period**
Inappropriate antibiotic prescription was calculated as a proportion of the educational interviews for each year.

			Change in 1st quarter after the start of the intervention	Change in trend for the study period	Absolute effect*	Relative effect (%)*
Total antibiotics	20·980	−0·160 (−0·321 to 0·001)	−0·150 (−1·028 to 0·727)	−0·012 (−0·165 to 0·140)	−0·351 (−3·420 to 2·718)	−2·05 (−19·50 to 5·40)
Amoxicillin–clavulanic acid	11·073	−0·244 (−0·293 to −0·194)	−0·354 (−0·625 to −0·083)	0·015 (−0·038 to 0·067)	−0·116 (−1·097 to 0·865)	−2·21 (−20·51 to 16·08)
Fluoroquinolones	1·868	−0·010 (−0·023 to 0·002)	−0·162 (−0·230 to 0·017)	0·005 (−0·006 to 0·017)	−0·074 (−0·309 to 0·160)	−4·57 (−18·20 to 9·07)
Ciprofloxacin	1·406	−0·012 (−0·018 to −0·006)	−0·149 (−0·177 to −0·121)	−0·002 (−0·007 to 0·004)	−0·178 (−0·289 to −0·067)	−15·94 (−23·91 to −7·97)
Levofloxacin	0·433	0·008 (0·005 to 0·012)	−0·032 (−0·055 to −0·010)	0·001 (−0·003 to 0·004)	−0·019 (−0·090 to 0·053)	−2·93 (−13·83 to 7·97)
Cephalosporins	0·921	0·002 (−0·007 to 0·011)	0·009 (−0·039 to 0·057)	−0·014 (−0·024 to −0·005)	−0·217 (−0·392 to −0·043)	−22·56 (−35·88 to −9·24)
Cefuroxime	0·662	0·010 (−0·004 to 0·024)	0·030 (−0·046 to 0·024)	−0·023 (−0·038 to −0·008)	−0·339 (−0·615 to −0·063)	−37·79 (−55·02 to −20·57)
Third-generation cephalosporins	0·263	−0·008 (−0·012 to −0·003)	−0·048 (−0·072 to −0·025)	0·011 (0·006 to 0·015)	0·121 (0·040 to 0·202)	155·32 (−141·7 to 452·3)
Amoxicillin	4·891	0·024 (−0·013 to 0·061)	0·551 (0·335 to 0·766)	0·041 (0·011 to 0·072)	1·213 (0·547 to 1·879)	22·21 (6·41 to 38·01)
Fosfomycin trometamol	0·234	0·003 (0·002 to 0·003)	0·002 (−0·0004 to 0·005)	0·001 (0·0005 to 0·002)	0·018 (0·008 to 0·028)	6·08 (2·57 to 9·59)

Penalva G, Lancet Infect Dis 2019

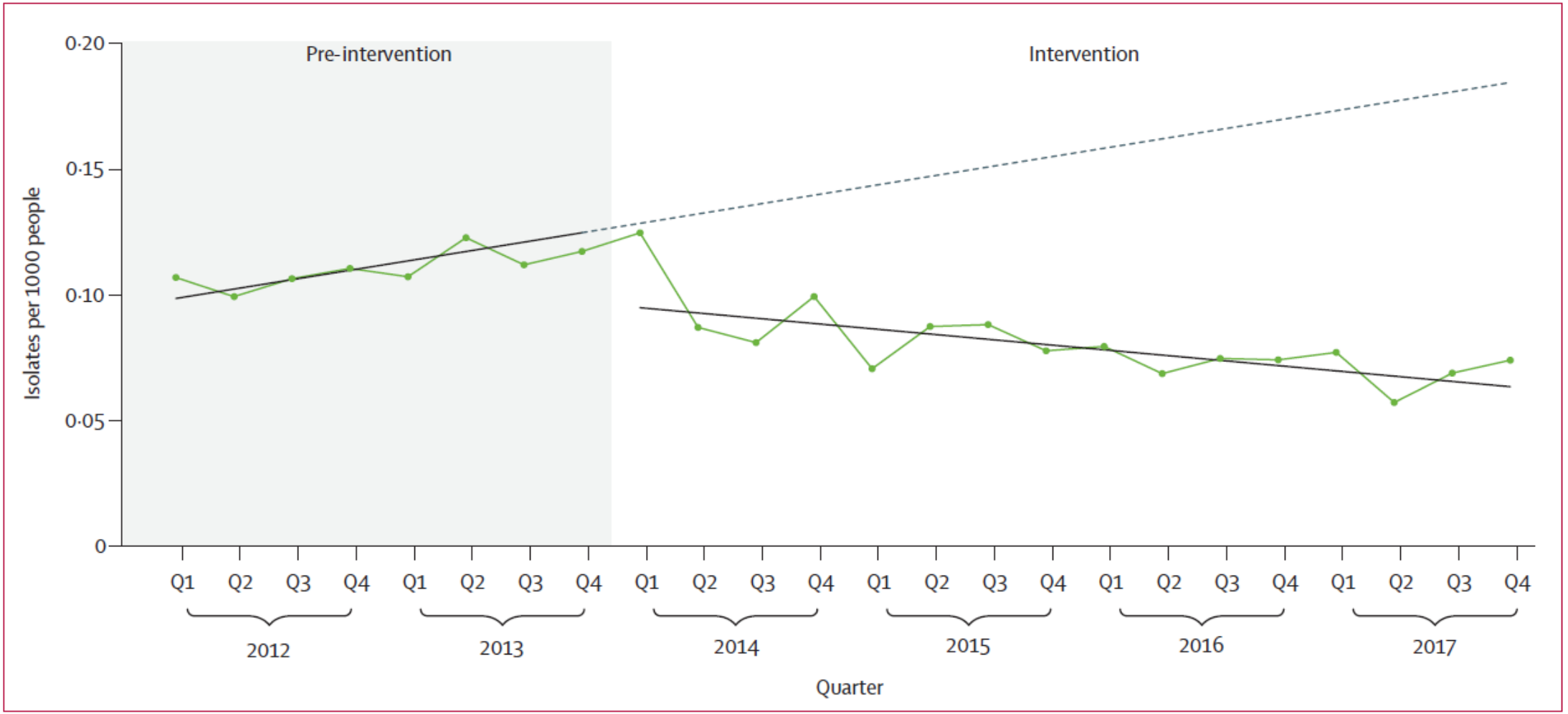
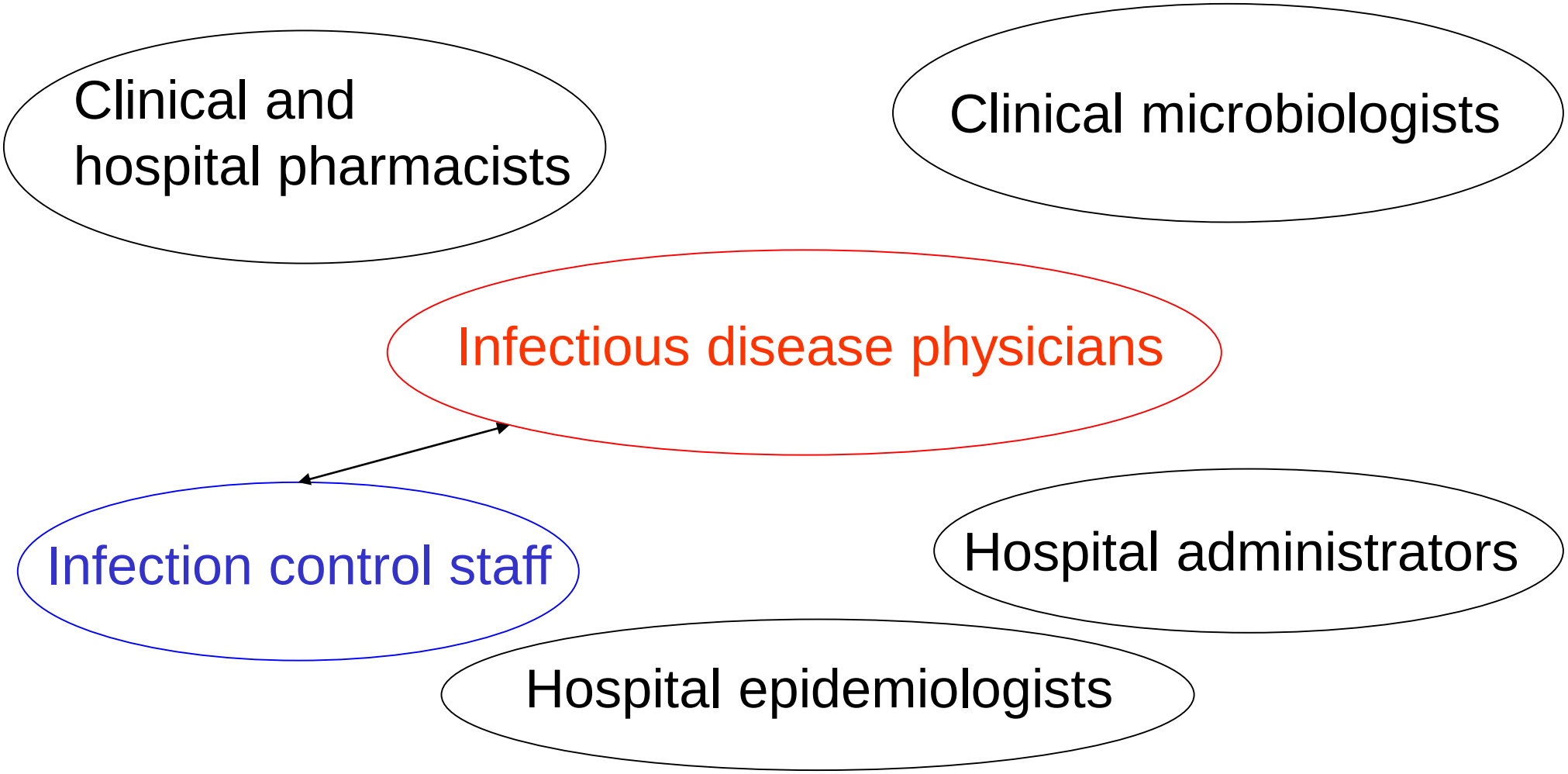


Figure 2: **Interrupted time-series analysis of ESBL-producing *Escherichia coli* incidence density**
ESBL=extended-spectrum β-lactamase.

Penalva G, Lancet Infect Dis 2019

Antimicrobial stewardship program



McDougall C, Polk RE, Clin Microb Rev 2005

Collaboration EOH/EMA

‘Any antimicrobial stewardship program should either be fully integrated with or work closely with a hospital’s infection control program;

such collaboration has the opportunity to synergistically reduce antimicrobial resistance and improve patient outcomes’

McDougall C, Polk RE, Clin Microb Rev 2005

IL N'Y A AUCUNE MAITRISE DU RISQUE SANS HYGIENE DES MAINS !!!!