



**17^{ème} Journée romande de formation en
Prévention de l'Infection
- vendredi 16 juin 2023 -**

Les bactéries multi-résistantes aux antibiotiques (BMR) aujourd'hui

Bruno Grandbastien
Unité HPCi – Service des maladies infectieuses

Unil
UNIL | Université de Lausanne



Plan

- Les enjeux de l'antibiorésistance
- *Staphylococcus aureus* résistant à la méticilline (MRSA)
- Entérobactéries productrices d'ESBL
- Entérobactéries productrices de carbapénémases
- Entérocoques résistants aux glycopeptides (VRE)

Les enjeux de l'antibiorésistance

canton de
vaud

www.bacterialphotos.com

Penicillium chrysogenum
(*Protopium*)

Staphylococcus aureus

Penicillin G
(benzylpenicillin)

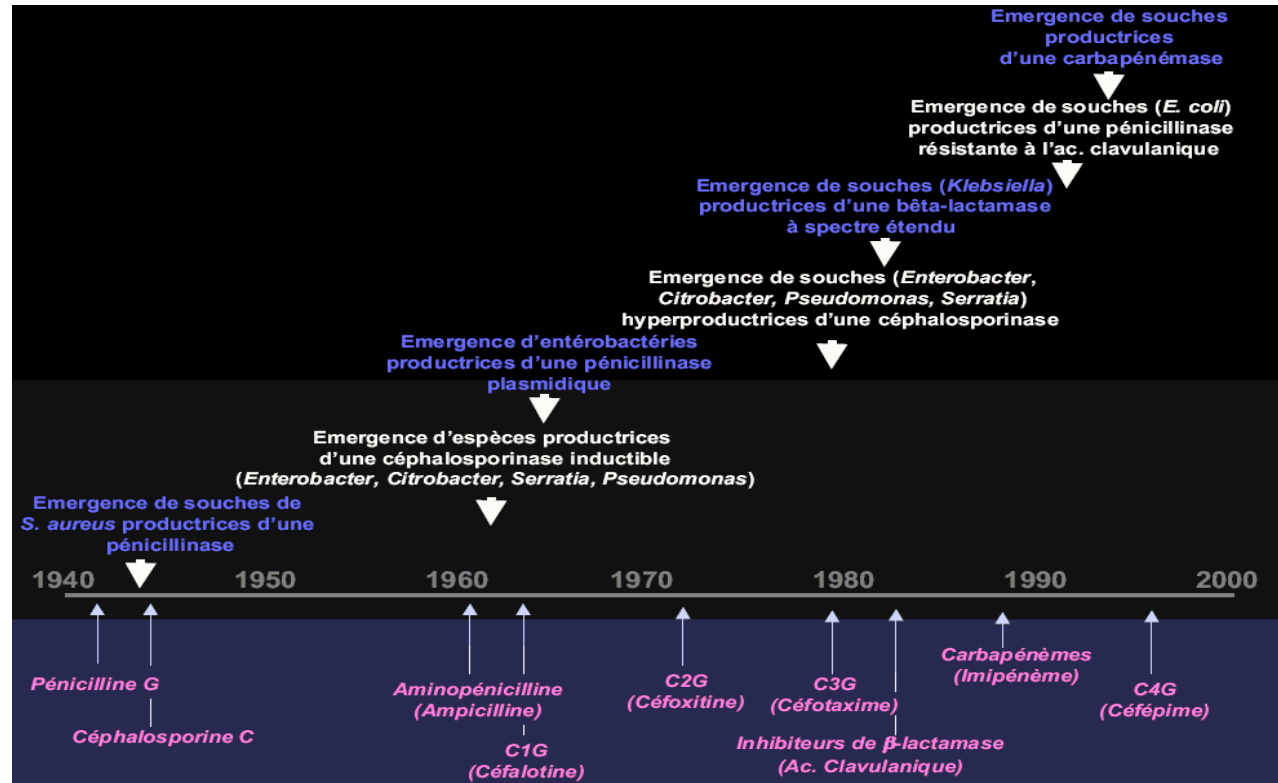
Staphylococcus

Penicillium

Christine L. Case
Skyline College

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Timeline de l'antibiorésistance

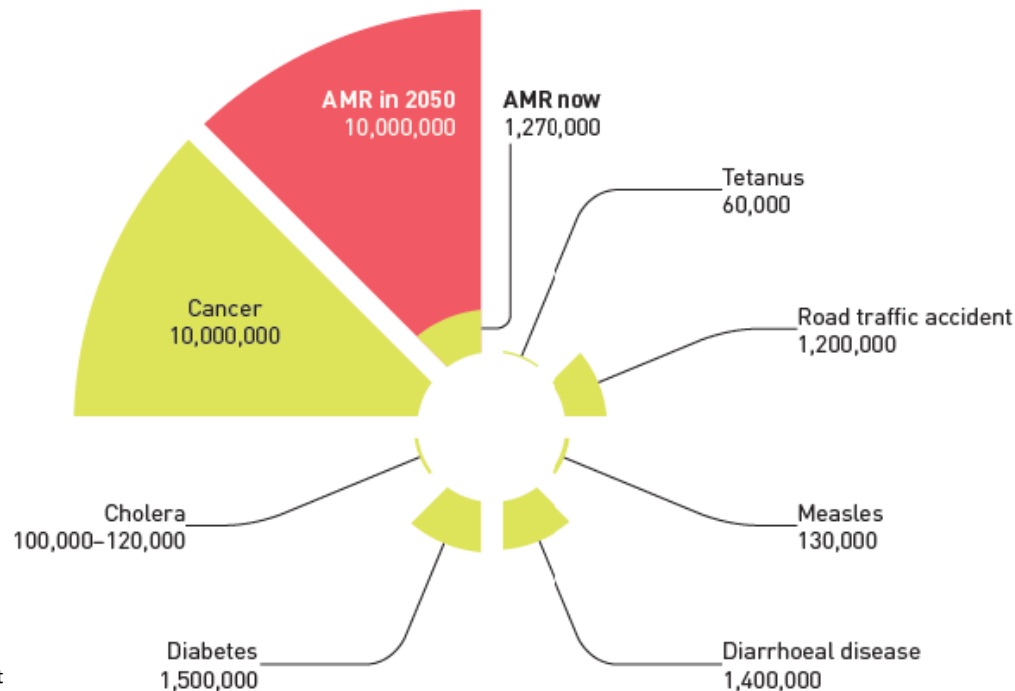


Estimation de la mortalité en 2050



Nations Unies, 07.02.2023

<https://www.unep.org/resources/superbugs/environmental-action#:~:text=The%20report%20Bracing%20for%20Superbugs,key%20part%20of%20the%20solution.>

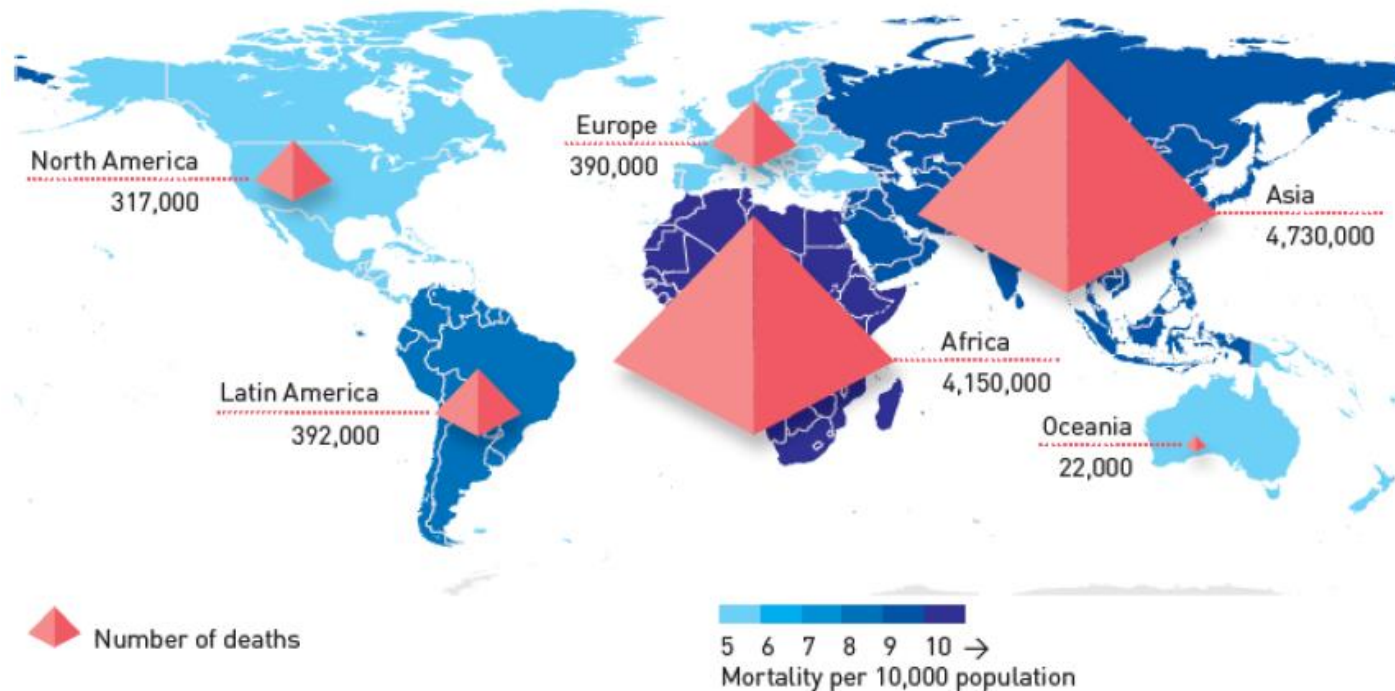


Estimation de la mortalité en 2050

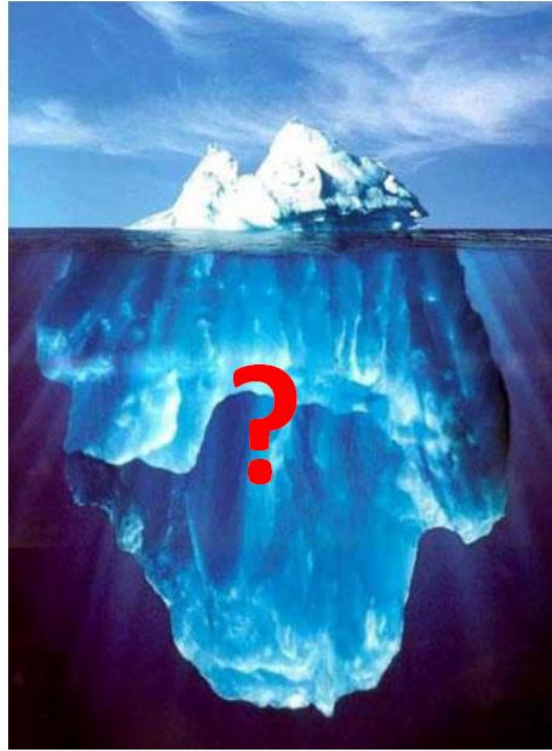


Nations Unies, 07.02.2023

<https://www.unep.org/resources/superbugs/environmental-action#:~:text=The%20report%20Bracing%20for%20Superbugs,key%20part%20of%20the%20solution.>



Infections / colonisations



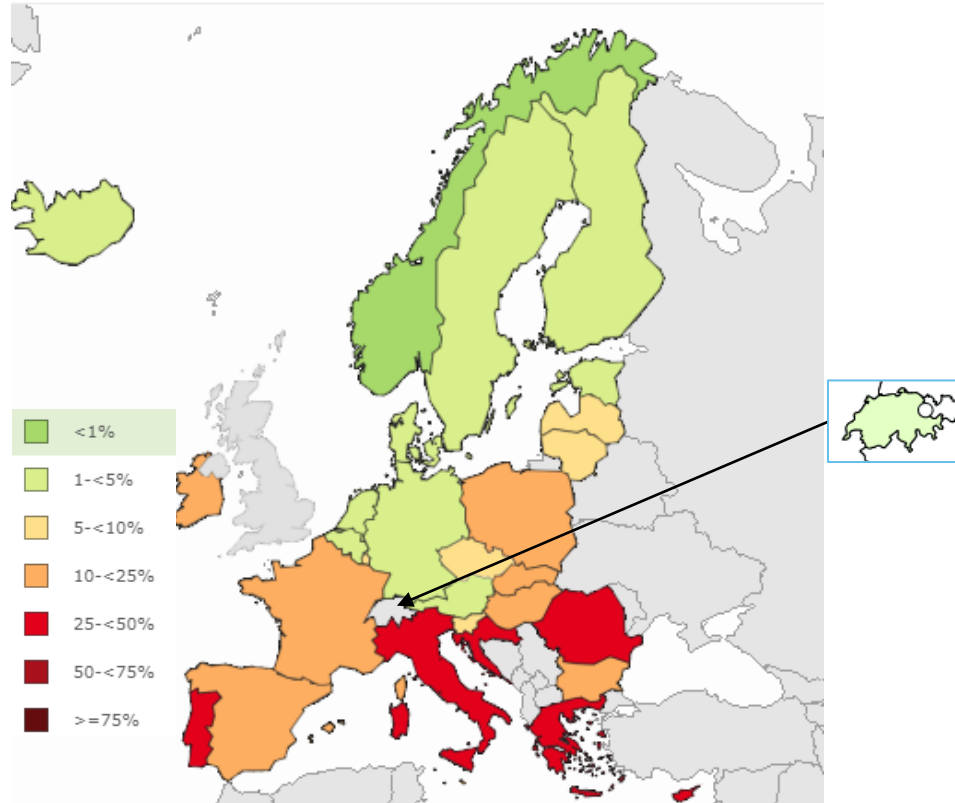
Patients infectés

Patients colonisés

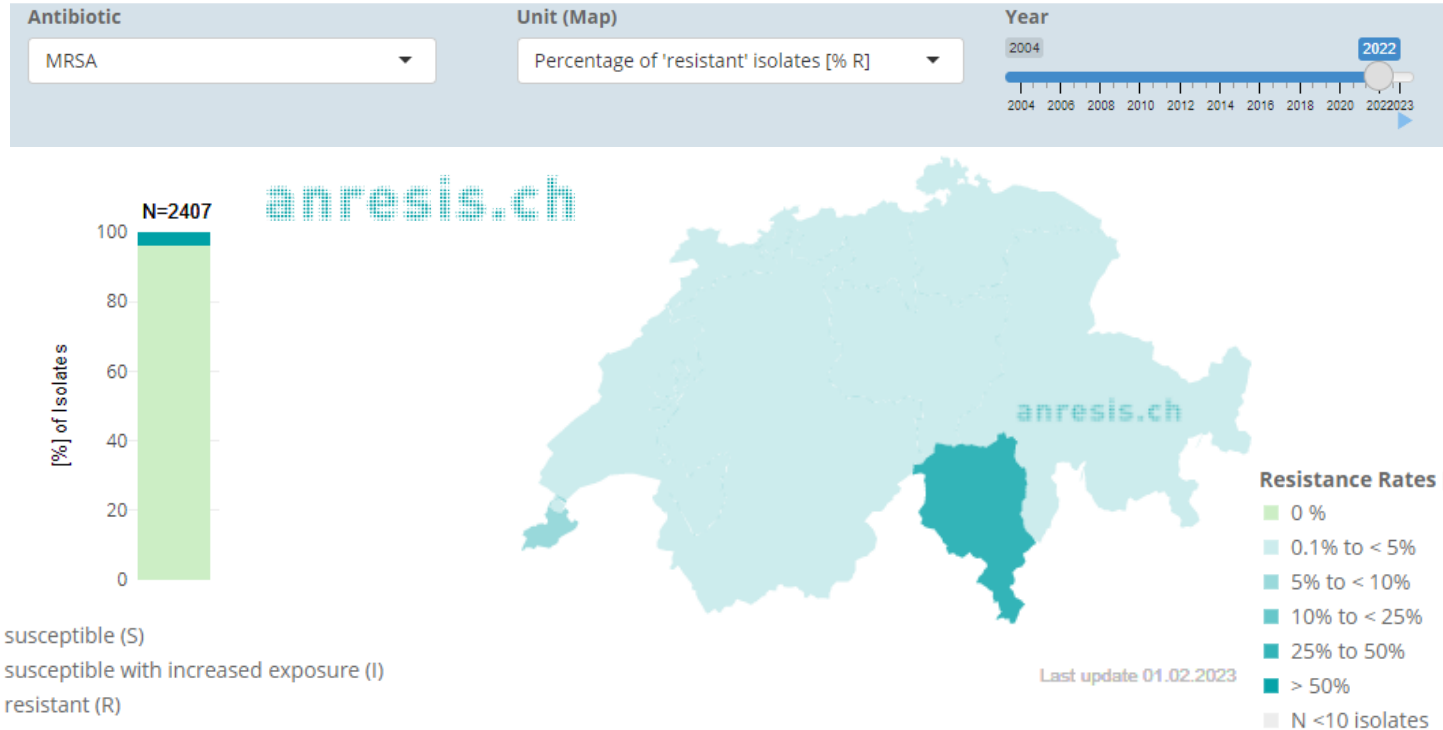
Staphylococcus aureus résistant à la méticilline

S. aureus résistant à la méticilline (MRSA) : données hospitalières

(données 2021)



MRSA en Suisse en 2022



<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

MRSA en EMS : enquêtes valaisannes

	2006-2007	2013-2014
Prévalence	1.7%	3.9%
Proportion de MRSA dans l'espèce <i>S. aureus</i>	6.5%	11.4%



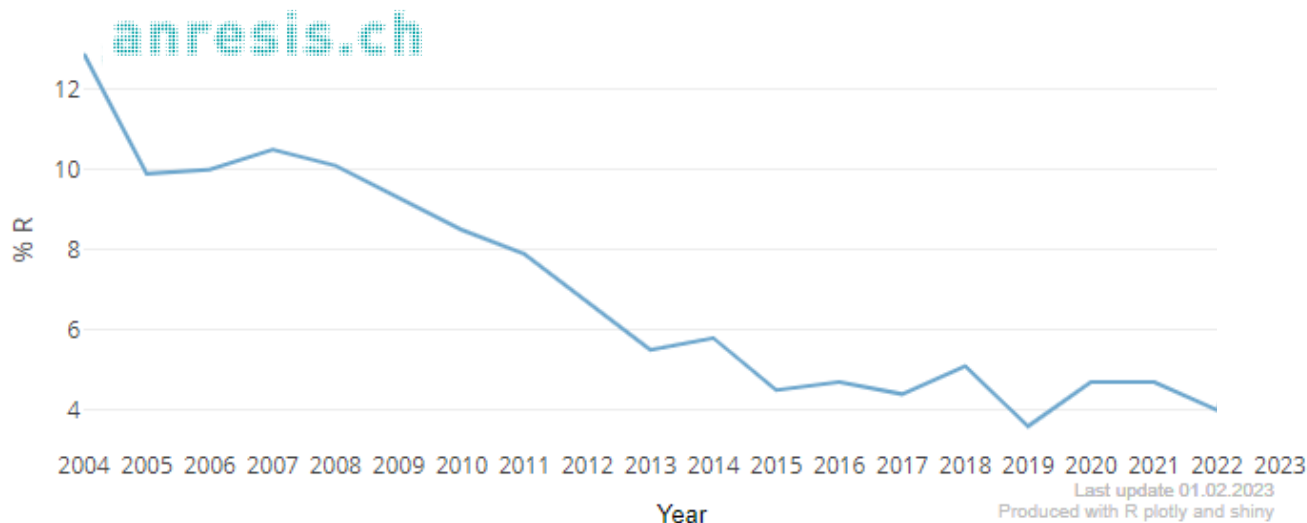
Hôpital du Valais (RSV) – Institut Central
Avenue du Grand Champsec 86, CH-1951 Sion

Prévalence du portage de *Staphylococcus aureus* résistant à la méthicilline (MRSA) chez les résidents des établissements médico-sociaux du canton du Valais

Marguerite Métral, Catherine Schüttel, Daniela Obi-Hutter, Nicolas Troillet

Service des maladies infectieuses, Institut Central des Hôpitaux, Sion

MRSA en Suisse : évolution 2004 - 2022

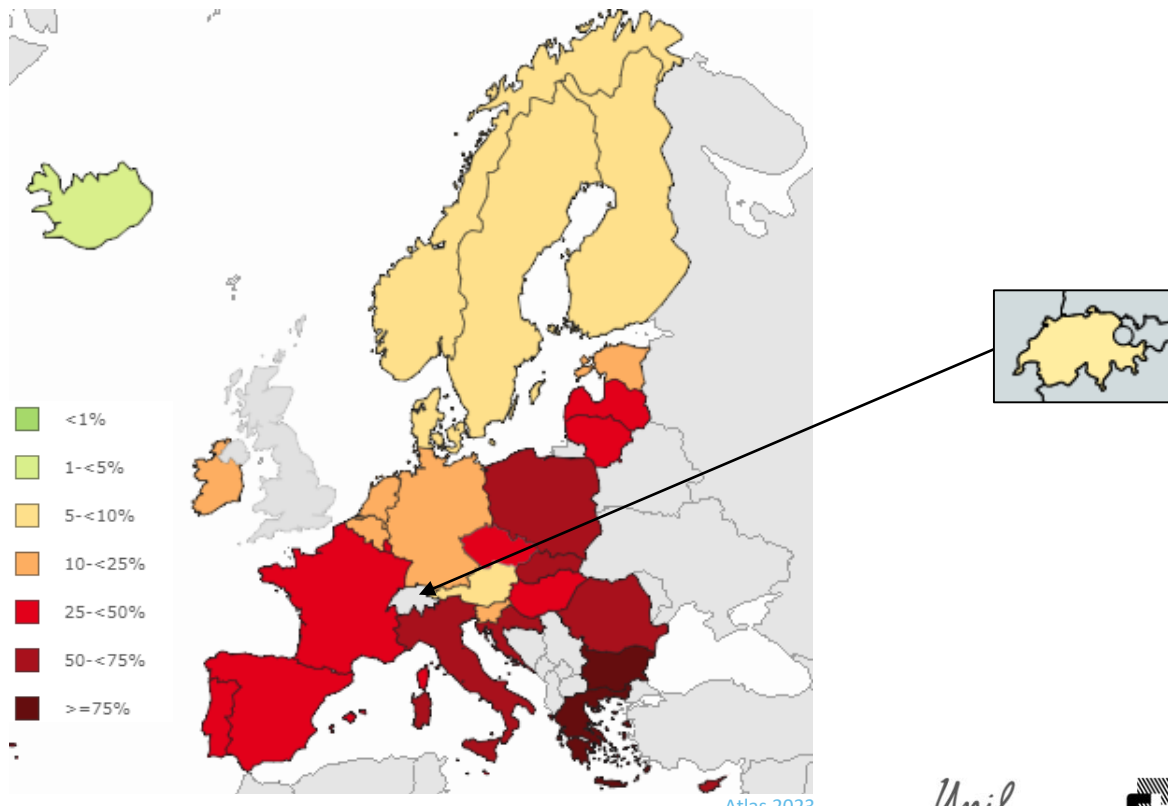


<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

Entérobactéries productrices de bêta-lactamases à spectre étendu (ESBL)

K. pneumoniae résistant aux C3G (≈ producteur d'ESBL) : données hospitalières

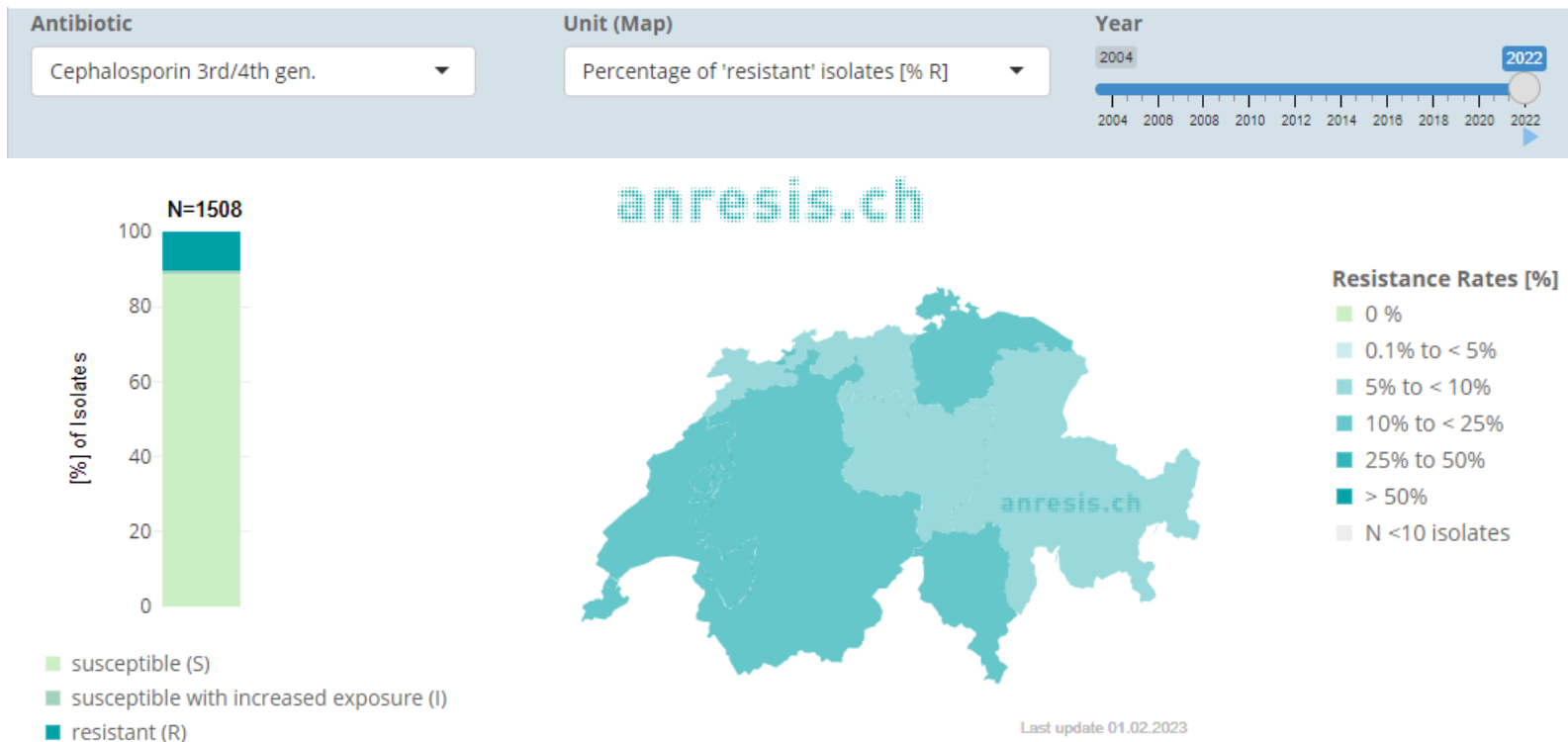
(données 2021)



Atlas 2023

<https://atlas.ecdc.europa.eu/public/index.aspx?Dataset=27&HealthTopic=4>

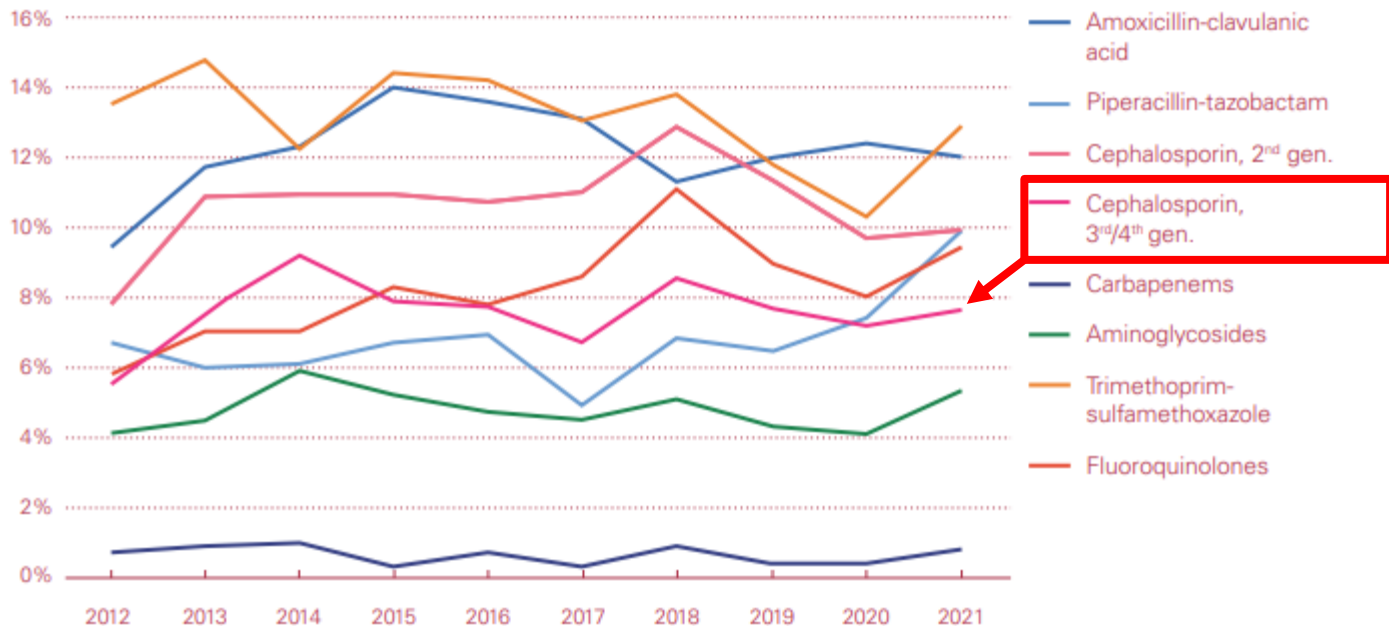
K. pneumoniae C3G-R en Suisse en 2022



<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

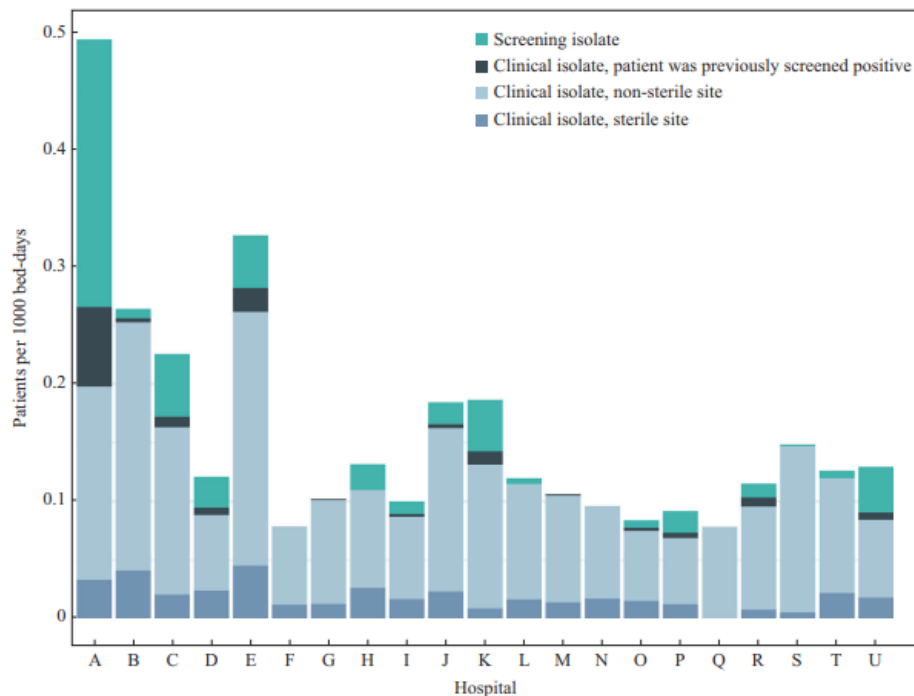
Evolution de l'antibiorésistance chez *K. pneumoniae* en Suisse

anresis.ch



Source : ANRESIS, rapport 2022

Evolution de l'incidence de *K. pneumoniae* en Suisse : typologie des prélèvements



Journal of Hospital Infection 120 (2022) 36–42
Available online at www.sciencedirect.com
Journal of Hospital Infection
Journal homepage: www.elsevier.com/locate/jhin

Temporal and structural patterns of extended-spectrum cephalosporin-resistant *Klebsiella pneumoniae* incidence in Swiss hospitals

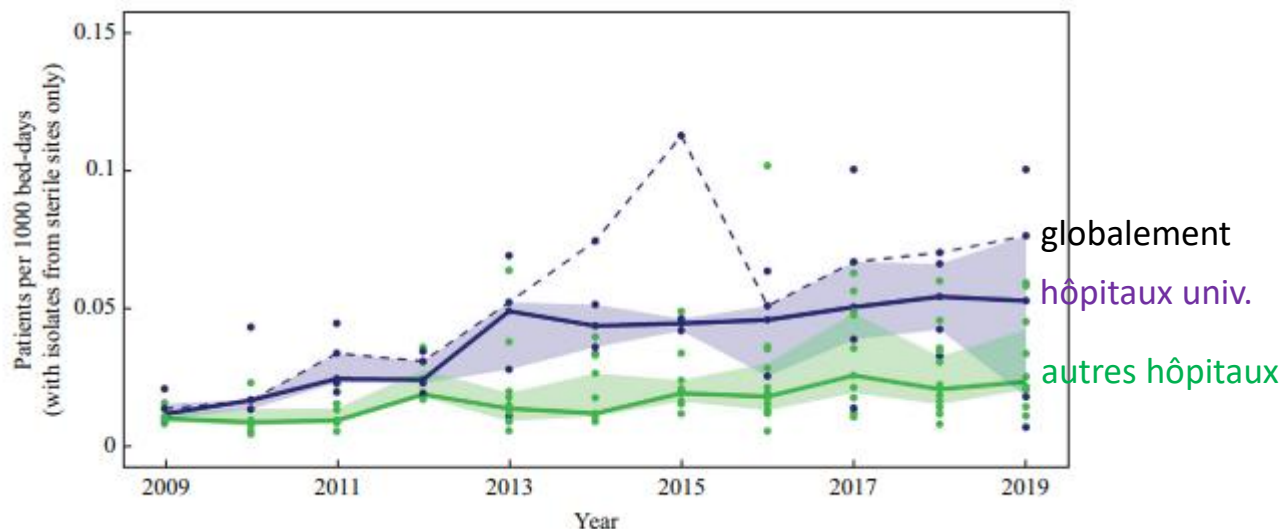
L. Renggli^{a,*}, M. Gasser^{b,1}, C. Plüss-Suard^b, S. Harbarth^b, A. Kronenberg^a

^a Swiss Centre for Antibiotic Resistance (ANRES), Institute for Infectious Diseases, University of Bern, Bern, Switzerland
^b Infection Control Programme, University of Geneva Hospitals and Faculty of Medicine, WHO Collaborating Centre, Geneva, Switzerland

Hôp. univ

Renggli N et al, J Hosp Infect 2022

Evolution de l'incidence de *K. pneumoniae* en Suisse : infections invasives



Temporal and structural patterns of extended-spectrum cephalosporin-resistant *Klebsiella pneumoniae* incidence in Swiss hospitals

L. Renggli^{a,*}, M. Gasser^{b,c}, C. Plüss-Suard^a, S. Harbarth^b, A. Kronenberg^a

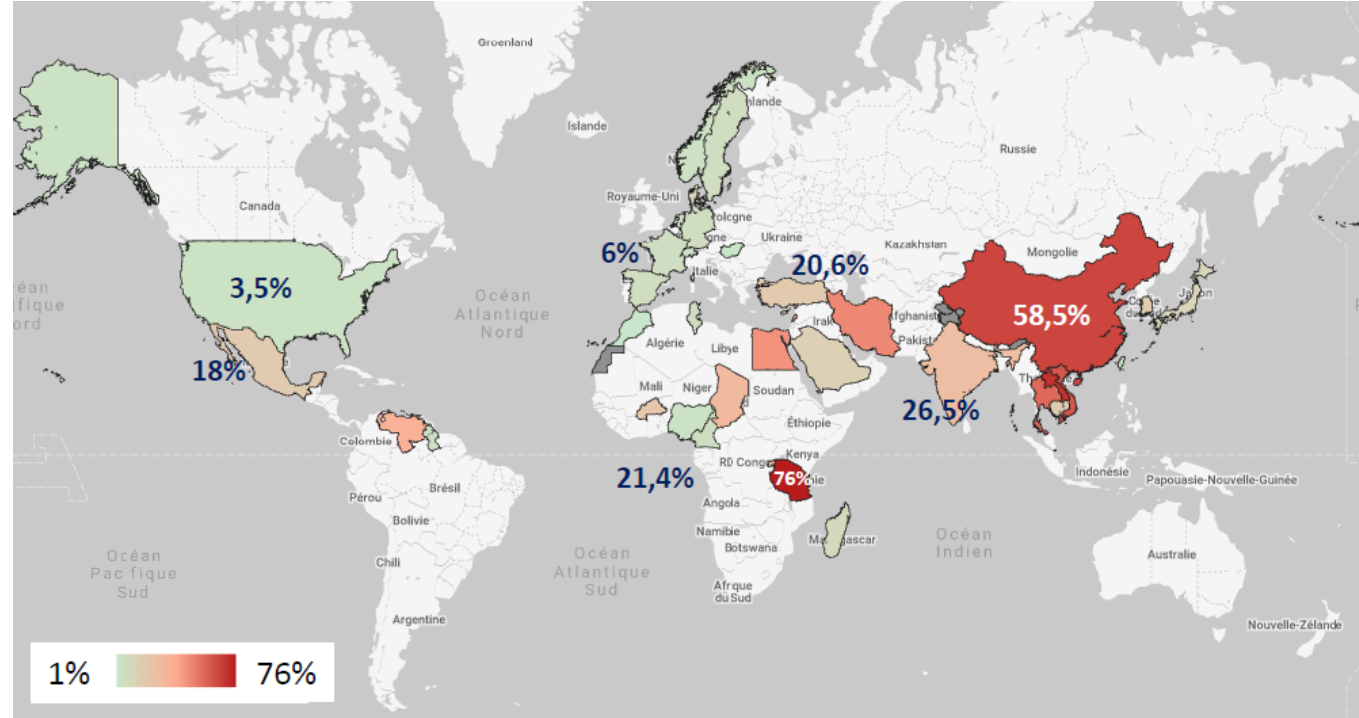
^aSwiss Centre for Antibiotic Resistance (SANRES), Institute for Infectious Diseases, University of Bern, Bern, Switzerland
^bInfection Control Programme, University of Geneva Hospitals and Faculty of Medicine, WHO Collaborating Centre, Geneva, Switzerland

Renggli N *et al*, J Hosp Infect 2022

Surveillance de *E. coli* ESBL dans la communauté

Pays	Nom	Secteur	Cible	<i>E.coli</i> C3G-R
Suisse	ANRESIS	Hôpital/Communauté	Toutes bactéries, urine vs autres	2021 : 5.8% urine
UK	ESPAUR	Hôpital/Communauté	BSI, CRE incidence	2019 : 15% bactériémies
England, West Midlands	AmSurv	Hôpital/Communauté	Tous résultats	2013 : 5.5% urine
Australie	AURA	Hôpital/Communauté	Tous résultats	2019 : 7.8% urine
Hong Kong	CHP	Communauté	<i>E.coli</i> urinaire	2020 : 11.8% urine
France	PRIMO	Communauté	<i>E.coli</i> urinaire	2017 : 2,8% urine 2019 : 3,5% urine 2021 : 3,2% urine

Portage digestif d'*E.coli* ESBL

Journal of
Antimicrobial
Chemotherapy

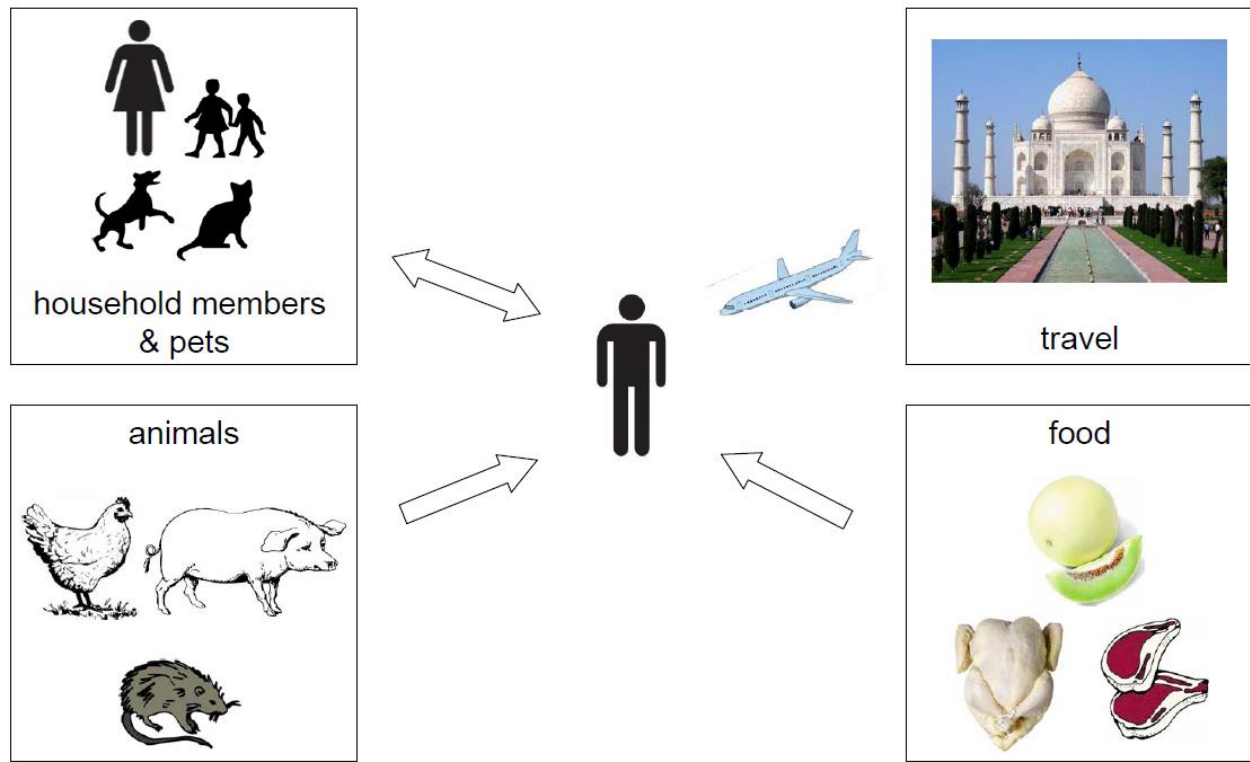
The global prevalence and trend of human intestinal carriage of ESBL-producing *Escherichia coli* in the community

Yihienew M. Bezabih^{1*}, Wilber Sabiti², Endalkachew Alamneh³, Alamneh Bezabih⁴, Gregory M. Peterson³,
Wolde Sellassie M. Bezabhe³ and Anna Roujeinikova⁵

¹Arsi University College of Health Sciences, Arsi University, PO Box 0193, Asella, Ethiopia; ²School of Medicine, University of St Andrews, St Andrews KY16 9TF, UK; ³School of Pharmacy and Pharmacology, University of Tasmania, Australia; ⁴École nationale vétérinaire, agroalimentaire et de l'alimentation, Nantes-Atlantique, BIOEPAR (UMR1300 INRA/ONIRIS), Nantes, France; ⁵Department of Microbiology, Monash University, Clayton, Victoria 3800, Australia

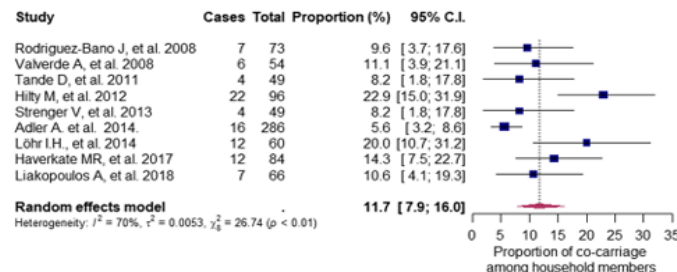
Bezabih YM *et al*, JAC 2021

Voies d'acquisition des ESBL



Transmission d'ESBL au sein des foyers

- Revue systématique ; 13 études
- Co-portage : 12%
- Acquisition : sur 5 études, suivi de 1 à 23 mois
→ taux = 1,56 à 2,03 /1 000 pers.sem de suivi
- Clonalité : sur 2 études
 - *E.coli* : 10 et 20%
 - *K. pneumoniae* : 20 et 25%



Infection Control & Hospital Epidemiology (2020), 41, 286–294
doi:10.1017/hce.2020.106

Original Article

Household carriage and acquisition of extended-spectrum β -lactamase-producing Enterobacteriaceae: A systematic review

Romain Martischang MD¹, Maria E. Riccio PhD¹, Mohamed Abbas MD, MS¹, Andrew J. Stewardson MD, MS¹, Jan A. J. W. Kluytmans MD, PhD¹ and Stephan Harbarth MD, MS¹

¹Infection Control Program and WHO Collaborating Centre on Patient Safety, University of Geneva Hospitals and Faculty of Medicine, Geneva, Switzerland, ²Department of Infectious Diseases, Monash University and Alfred Health, Melbourne, Australia and ³Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, the Netherlands

Martischang R et al, ICHE 2019

Niche écologique des entérobactéries ESBL

- Excreta

$\approx 10^{10}$ ESBL excrétées dans les selles chaque jour
et $\approx 10^9$ dans les urines
vs $\approx 10^7$ bactéries sur la peau

- Gestion souvent inadéquate des bassins

71% vidés et rincés avant laveur-désinfecteur
dont 62% dans les toilettes
de la chambre



Evaluation of excreta management in a large French multi-hospital institution

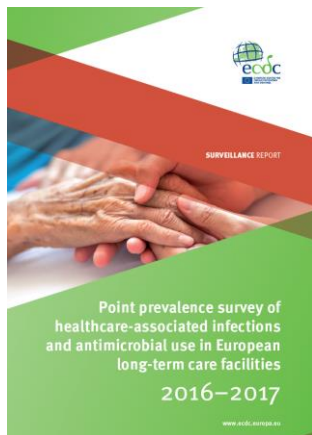
M. Lepainteur^{a,*}, S. Nérome^b, G. Bendjelloul^c, C. Montell^a, B. Cottard-Bouille^d,
M. Nion-Huang^a, V. Jarlier^{a,e}, S. Fournier^a, the Network of Infection Control
Teams of Assistance Publique – Hôpitaux de Paris

Lepainteur M *et al*, J Hosp Infect 2015

BMR dans les secteurs de soins de longue durée

Enquête HALT 2016-2017
% de prélèvements avec une
résistance (1^{er} niveau) :

- MRSA
- entérobactéries ESBL

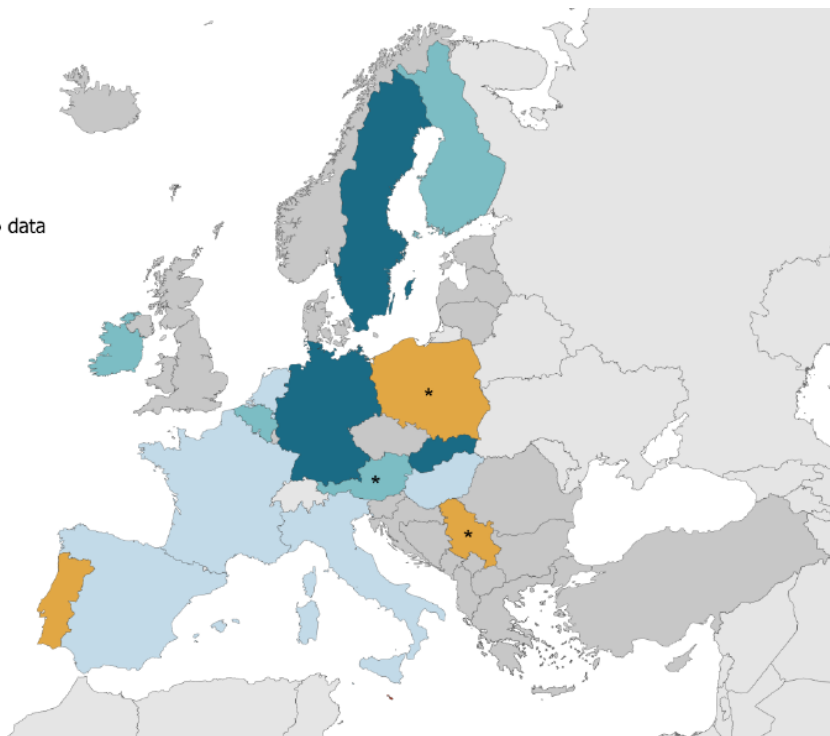


Non-susceptible isolates (%)

- <5%
- 5 to <20%
- 20 to <35%
- 35 to <50%
- >=50%
- <10 isolates or no data
- Not invited

Countries not visible in the main map extent

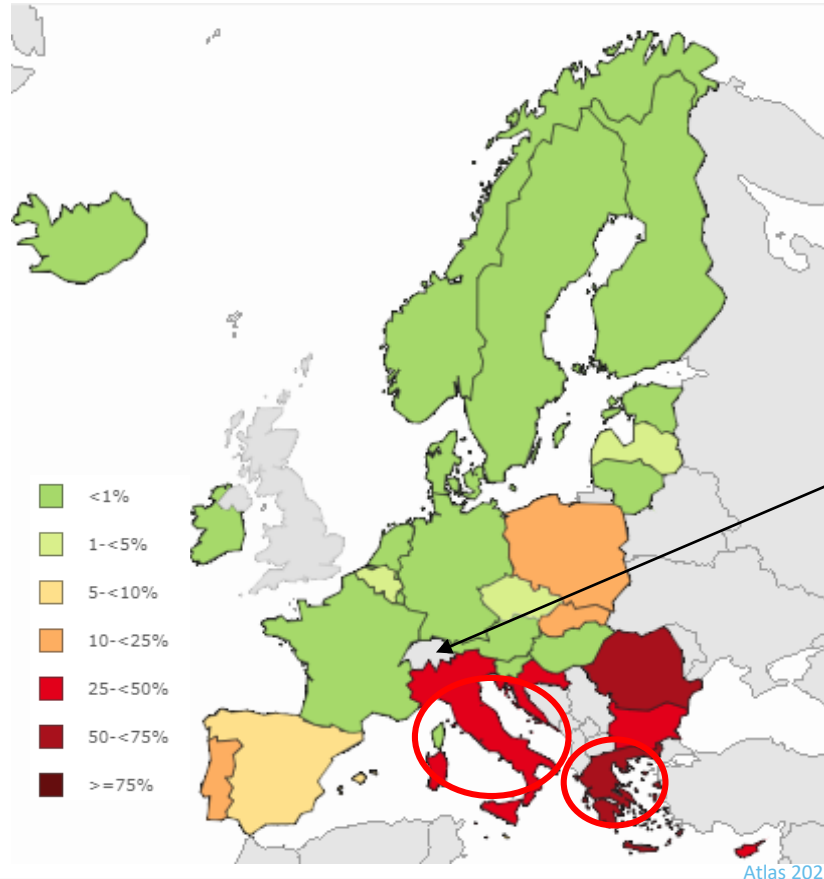
- Liechtenstein
- * Luxembourg
- * Malta



Entérobactéries productrices de carbapénémase (EPC)

K. pneumoniae IPM-R en Europe

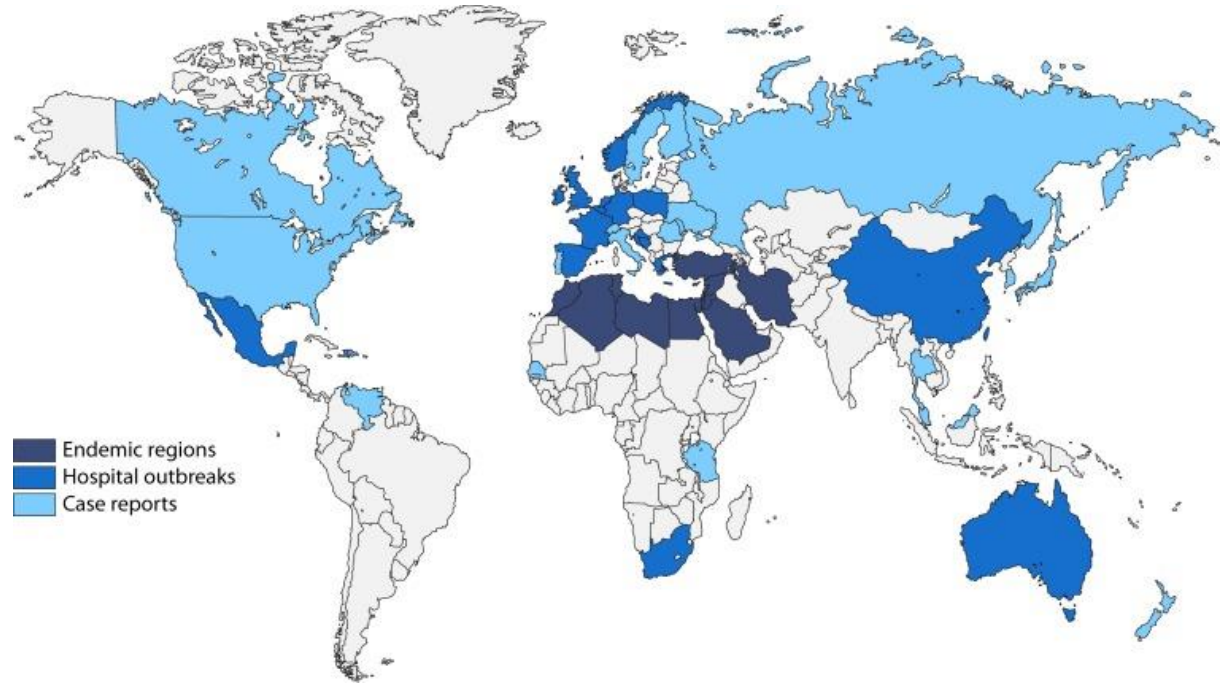
(donnée 2021)



Atlas 2023

<https://atlas.ecdc.europa.eu/public/index.aspx?Dataset=27&HealthTopic=4>

... et plus globalement : exemple des entérobactéries *oxa48*



The Global Ascendancy of OXA-48-Type Carbapenemases

Johann D. D. Pitout,^{a,b,c,d} Gisele Peirano,^{a,b} Marleen M. Kock,^{d,e} Kathy-Anne Strydom,^{d,e,f} Yasufumi Matsumura^g

^aDivision of Microbiology, Alberta Public Laboratories, Edmonton, Alberta, Canada

^bDepartment of Pathology & Laboratory Medicine, University of Calgary, Cumming School of Medicine, Calgary, Alberta, Canada

^cDepartment of Microbiology, Immunology and Infectious Diseases, University of Calgary, Cumming School of Medicine, Calgary, Alberta, Canada

^dDepartment of Medical Microbiology, University of Pretoria, Pretoria, Gauteng, South Africa

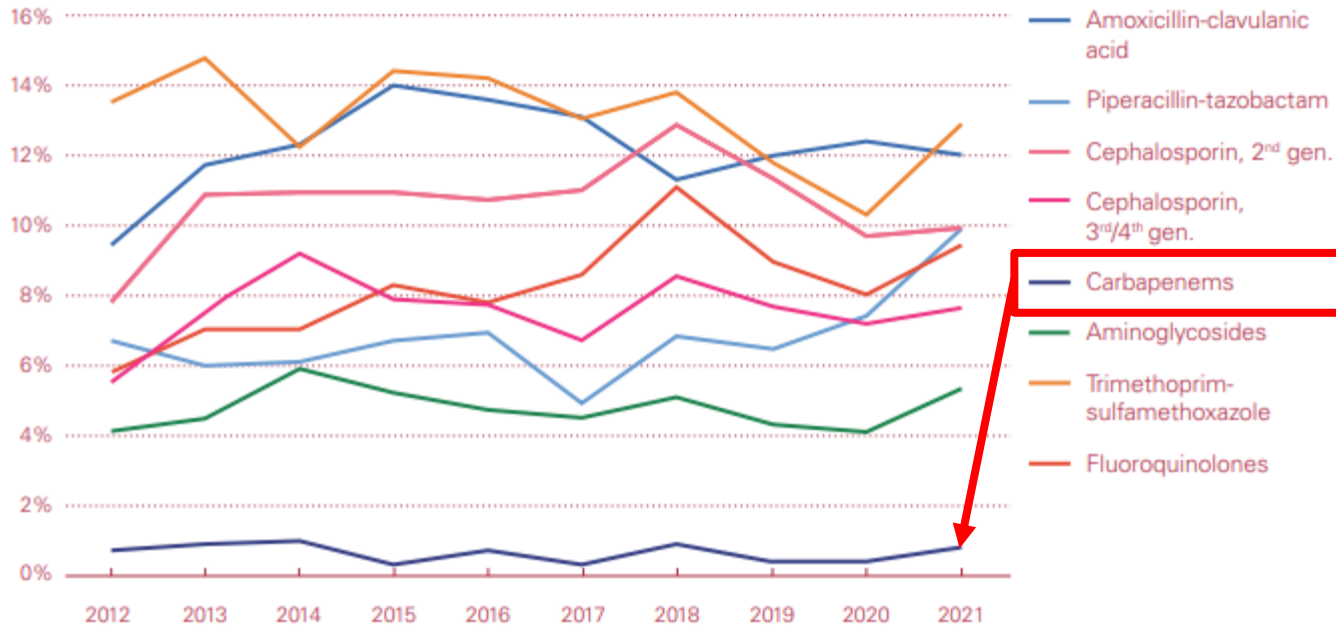
^eNational Health Laboratory Service, Pretoria, Gauteng, South Africa

^fKyoto University Graduate School of Medicine, Kyoto, Japan

Pitout JDD *et al.* Clin Microbiol Rev 2020

Evolution de l'antibiorésistance chez *K. pneumoniae* en Suisse

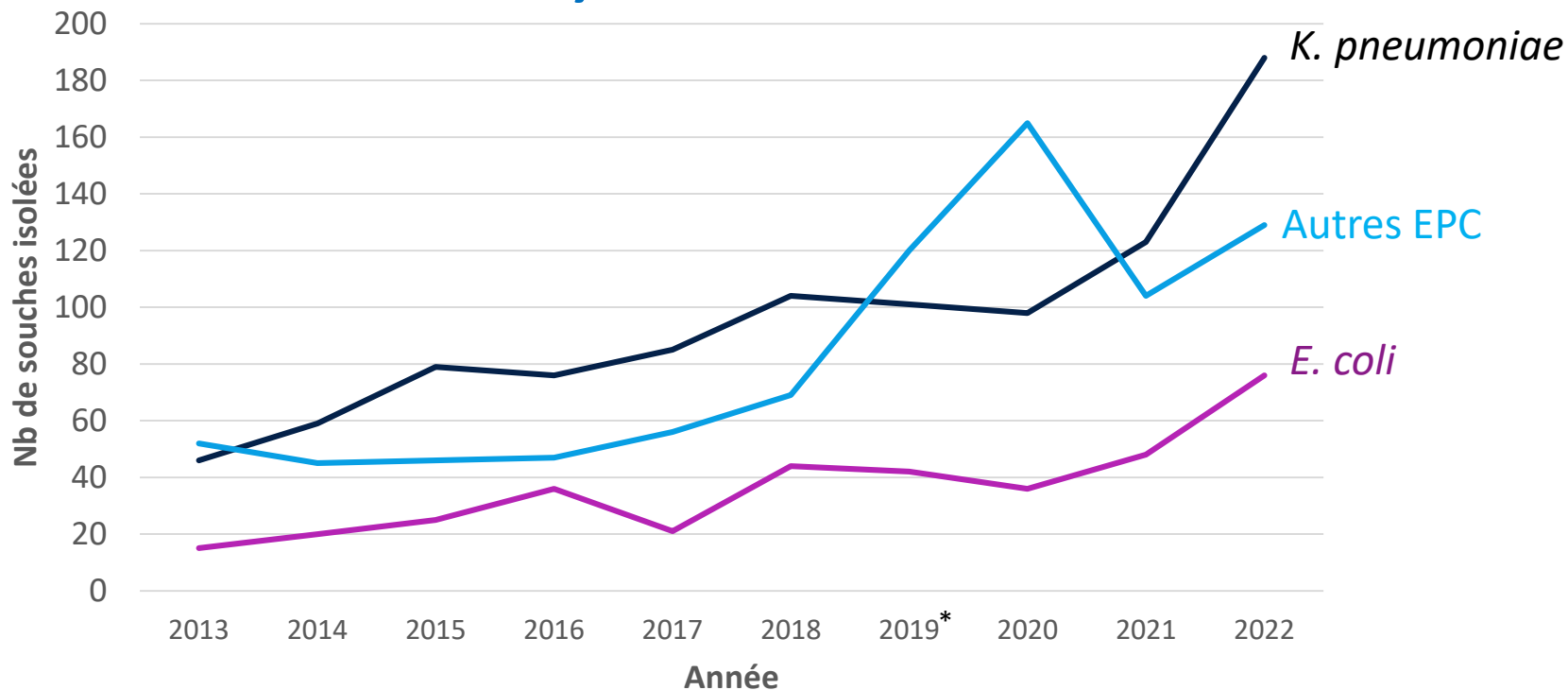
anresis.ch



Source : ANRESIS, rapport 2022

Nb de souches d'EPC identifiées : Suisse, 2013-2022

anresis.ch



* : changement de méthode de surveillance

d'après ANRESIS

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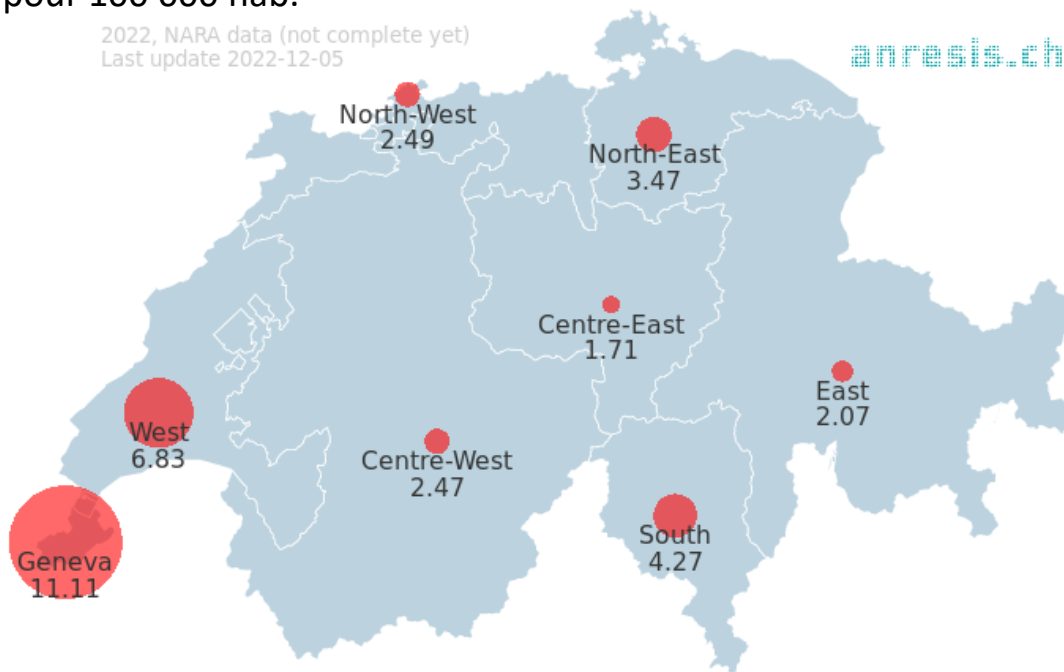


Epidémiologie des entérobactéries productrices de carbapénémases en 2022 en Suisse

Incidence pour 100 000 hab.

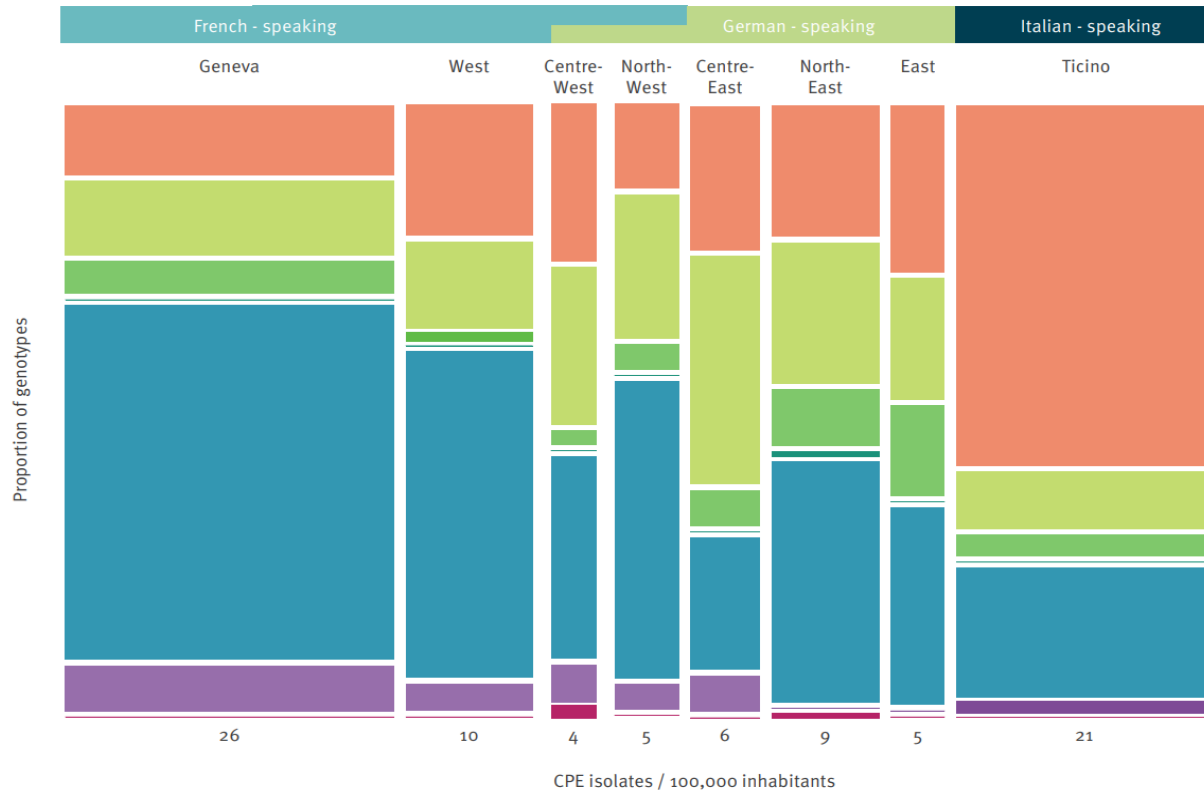
2022, NARA data (not complete yet)
Last update 2022-12-05

anresis.ch



<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

Répartition géographique des EPC (2013-2018)



- KPC
- NDM
- VIM
- IMP
- OXA-48-type
- OXA-181
- OXA-other

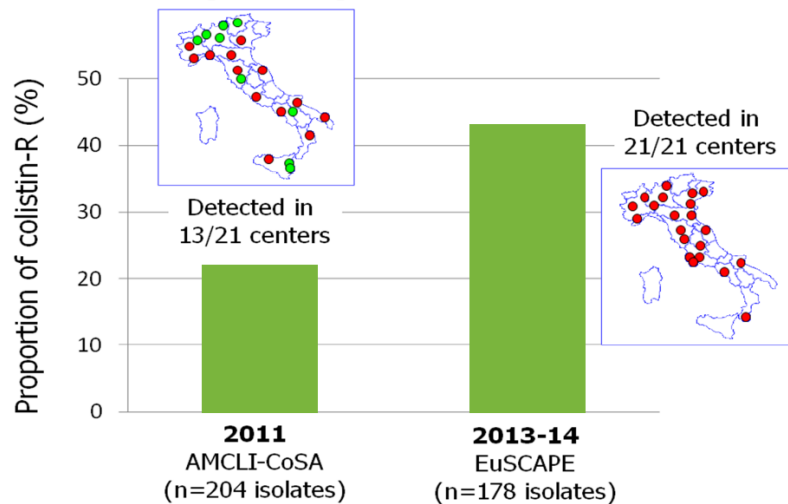
SURVEILLANCE

Temporal and regional incidence of carbapenemase-producing Enterobacterales, Switzerland, 2013 to 2018

Alban Ramette¹, Michael Gasser², Patrice Nordmann³, Reinhard Zbinden⁴, Jacques Schrenzel⁵, Damir Perisa⁶, Andreas Krossenberger¹
¹ Swiss Centre for Antibiotic Resistance (AMRESIS), Institute for Infectious Diseases, University of Bern, Bern, Switzerland
² These authors contributed equally to the manuscript
³ Molecular and Medical Microbiology, Department of Medicine, University of Fribourg, Fribourg, Switzerland
⁴ Institute for Medical Microbiology, University of Zurich, Zurich, Switzerland
⁵ Laboratory of Bacteriology, Geneva University Hospitals, Geneva, Switzerland
⁶ Federal Office of Public Health, Division of Communicable Diseases, Bern, Switzerland
 Correspondence: Alban Ramette (alban.ramette@ikik.unibe.ch)

Ramette A *et al.* Euro Surveill. 2021

Epidémiologie de *K. pneumoniae* EPC et COLI-R en Italie



Diapo empruntée à DL Monnet

Source : Giani T *et al.* Eurosurveill 2013
Monaco M *et al.* Eurosurveill 2014

Phénotypes de résistance des EPC

Antimicrobials	Carbapenemase-encoding genes (% of non-susceptible isolates)					MIC Range (mg/L)		MIC ₅₀ (mg/L)	MIC ₉₀ (mg/L)
	<i>bla</i> _{NDM} ^a (n = 50)	<i>bla</i> _{IMI} (n = 7)	<i>bla</i> _{IMP-10} (n = 3)	<i>bla</i> _{OXA-181} (n = 1)	Total (n = 61)	Min.	Max.		
Ertapenem	96	71.4	100	0	91.8	0.25	32	8	32
Imipenem	66 ^b	100	100	0	70.5 ^b	0.5	32	6	32
Meropenem	84	14.3	100	0	75.4	1	32	6	32
Tigecycline	34.7 ^c	14.3	100	0	33.3 ^c	0.032	24	0.38	6
Colistin	6.1 ^d	100	ND ^d	0	17.5 ^d	0.06	64	0.25	32
Fosfomycin	22	0	100	0	23	0.125	1024	12	128

RESEARCH

Open Access

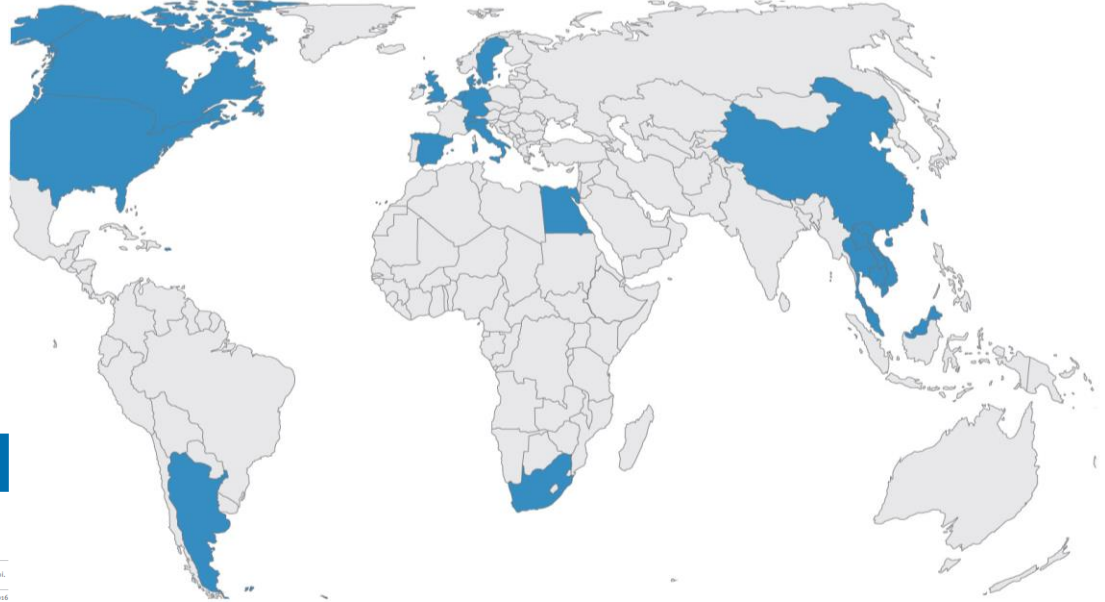
Carbapenemase-producing
Enterobacteriaceae circulating in the
Reunion Island, a French territory in the
Southwest Indian Ocean



Guillaume Miltgen^{1,2*}, Pascal Cholley^{3,4}, Daniel Martak^{3,4}, Michelle Thouverez¹, Paul Seraphin¹, Alexandre Leclaire¹,
Nicolas Traversier¹, Bénédicte Roquebert^{1,2}, Marie-Christine Jaffar-Bandjee^{1,2}, Nathalie Lugagne⁵,
Céline Ben Cimon⁶, Mahery Ramandrisoa⁷, Sandrine Picot⁸, Anne Lignereux⁹, Geoffrey Masson¹⁰, Jérôme Allin¹¹,
Nicolas Allou¹, Patrick Mavingui¹, Olivier Belmonte¹, Xavier Bertrand^{1,4} and Didier Hocquet^{1,4}

Miltgen G *et al.* ARIC 2020

Diffusion géographique du gène *mcr-1*



EDITORIAL

Plasmid-mediated colistin resistance (*mcr-1* gene): three months later, the story unfolds

RL Skov¹, DL Monnet²*

1. Department of Microbiology and Infection Control, Statens Serum Institut, Copenhagen, Denmark
2. Office of Chief Scientist, European Centre for Disease Prevention and Control, Stockholm, Sweden

Correspondence: Robert L. Skov (rsk@ssi.dk)

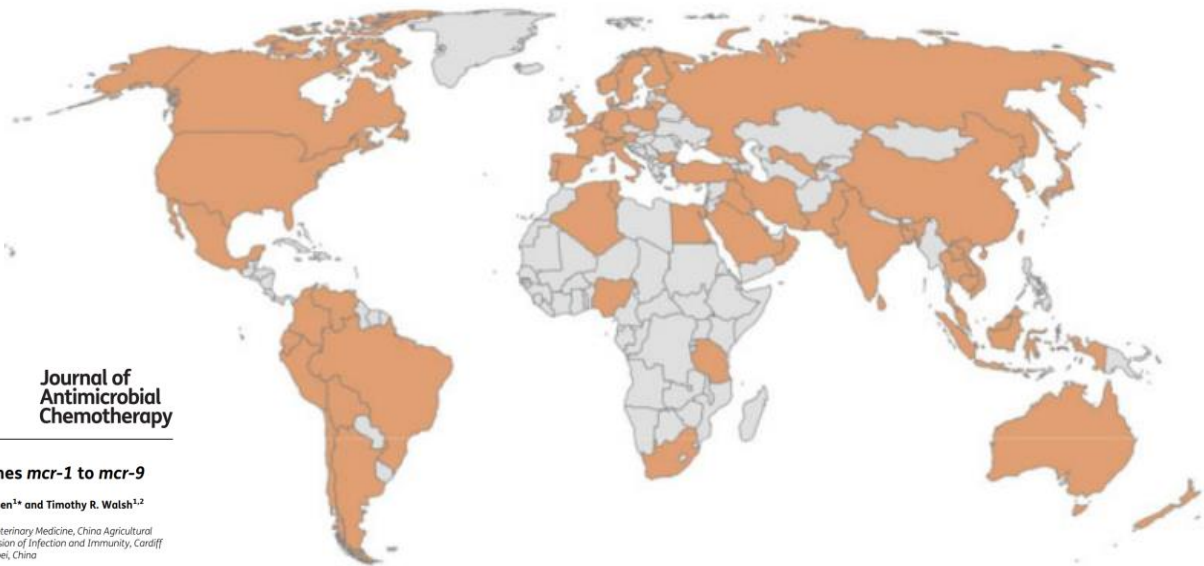
Citation style for this article:
Skov R, Monnet D. Plasmid-mediated colistin resistance (*mcr-1* gene): three months later, the story unfolds. *Euro Surveill.* 2016;21(9):pii=30055. DOI: <http://dx.doi.org/10.2807/1560-7917.ES.2016.21.9.30055>

Article submitted on 05 March 2016 / accepted on 03 March 2016 / published on 03 March 2016

Skov RL *et al.* EuroSurv 2016

Diffusion géographique du gène *mcr-1* : point en octobre 2019

The dissemination of *mcr-1*



J Antimicrob Chemother 2020; 75: 3087–3095
doi:10.1093/jac/dkaa205 Advance Access publication 8 June 2020

Journal of
Antimicrobial
Chemotherapy

Epidemiology of mobile colistin resistance genes *mcr-1* to *mcr-9*

Zhuoren Ling^{1,2}, Wenjuan Yin³, Zhangqi Shen¹, Yang Wang¹, Jianzhong Shen^{1*} and Timothy R. Walsh^{1,2}

¹Beijing Advanced Innovation Center for Food Nutrition and Human Health, College of Veterinary Medicine, China Agricultural University, Beijing, China; ²Department of Medical Microbiology and Infectious Disease, Division of Infection and Immunity, Cardiff University, Cardiff, UK; ³Medical College, Hebei University, Hebei, China

Ling Z *et al.* JAC 2020

Mesures de contrôle des EPC en Suisse

Bulletin

swissnosc

Centre national
de prévention des infections

Entérobactéries productrice de carbapénémases : stratégie de contrôle et prise en charge des patients porteurs

2017 / 05

Flaminia Olearo, Daniela Pires, Véronique Camus, Stephan Harbarth*

swissnosc

Nationales Zentrum für Infektionsprävention
Centre national de prévention des infections
Centro nazionale per la prevenzione delle infezioni
National Center for Infection Control

**Prévention et contrôle des bactéries multi-résistantes (BMR)
en dehors de flambées épidémiques**

Version 1.0, octobre 2021

swissnosc

Nationales Zentrum für Infektionsprävention
Centre national de prévention des infections
Centro nazionale per la prevenzione delle infezioni
National Center for Infection Control

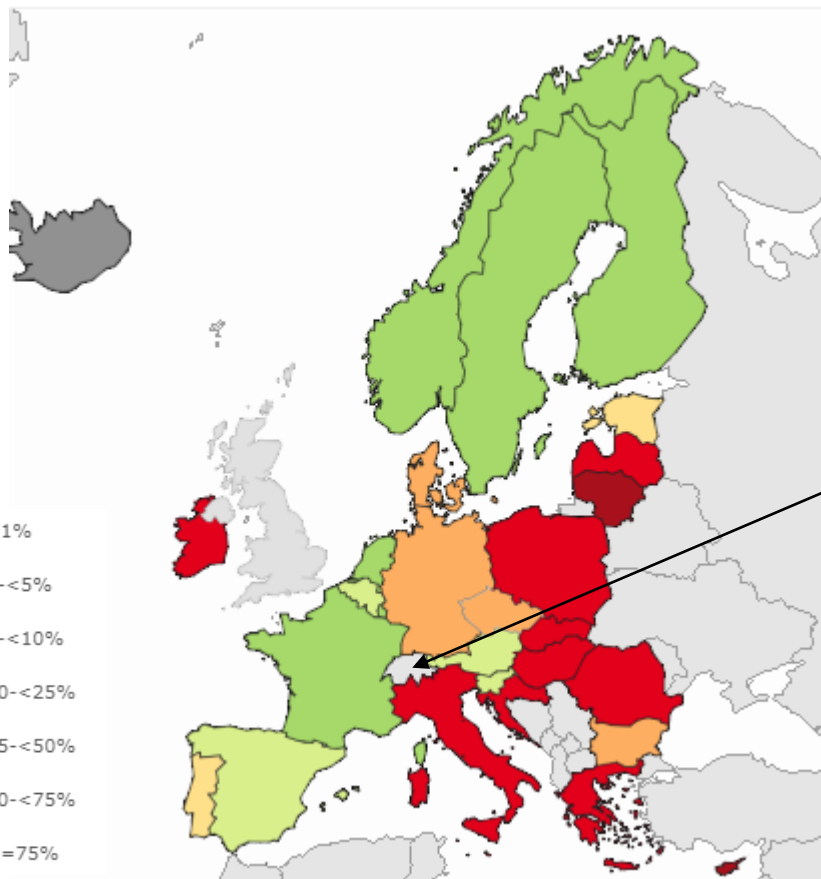
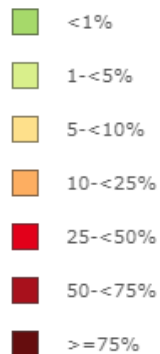
**Gestion des épidémies dues à des bactéries
multirésistantes (BMR)**

Version 1.0, octobre 2021

Entérocoques résistants aux glycopeptides / à la vancomycine (VRE)

Enterococcus faecium résistant à la vancomycine (VRE)

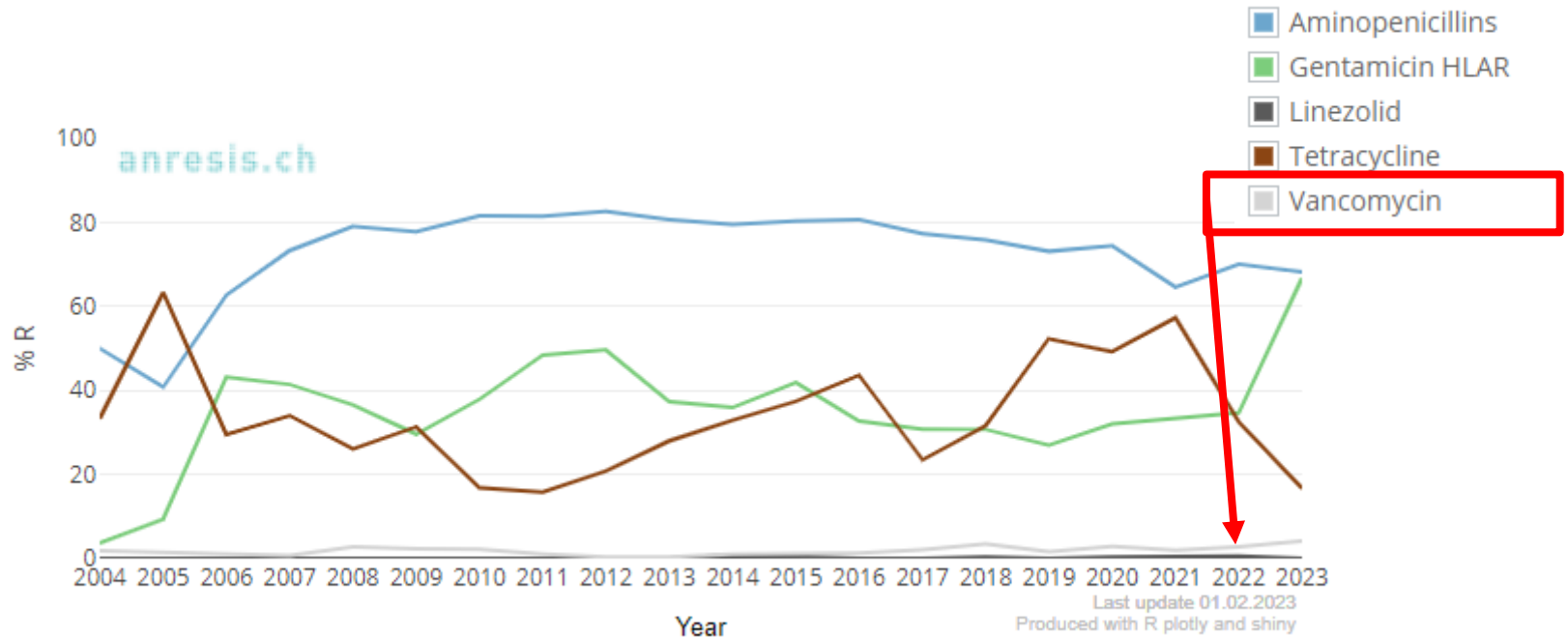
(donnée 2021)



Atlas 2023

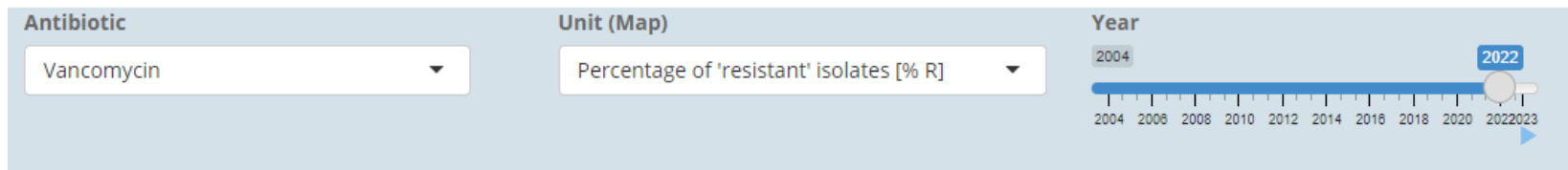
<https://atlas.ecdc.europa.eu/public/index.aspx?Dataset=27&HealthTopic=4>

VRE en 2022 en Suisse



<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

VRE en 2022 en Suisse



<https://www.anresis.ch/antibiotic-resistance/resistance-data-human-medicine/>

VRE en Suisse

OUTBREAKS

Nosocomial outbreak of vancomycin-resistant *Enterococcus faecium* (VRE) ST796, Switzerland, 2017 to 2020

Vanja Piezzi¹, Nasstasja Wassilew¹, Andrew Atkinson¹, Stéphanie D'Incau², Tanja Kaspar¹, Helena MB Seth-Smith^{3,4}, Carlo Casanova⁵, Pascal Bittel⁵, Philipp Jent¹, Rami Sommerstein^{1,6}, Niccolò Buetti^{7,8}, Jonas Marschall^{1,9}

1. Department of Infectious Diseases, University Hospital Bern, University of Bern, Bern, Switzerland
2. Department of Infectious Diseases, Lucerne Cantonal Hospital, Lucerne, Switzerland
3. Division of Clinical Bacteriology and Mycology, University Hospital Basel, Basel, Switzerland and Applied Microbiology Research, Department of Biomedicine, University of Basel, Basel, Switzerland
4. Institute of Medical Microbiology, University of Zurich, Zurich, Switzerland
5. Institute for Infectious Diseases, University of Bern, Bern, Switzerland
6. Department Health Sciences and Medicine, Clinic St. Anna, University of Lucerne, Lucerne, Switzerland
7. Infection Control Programme, University of Geneva Hospitals and Faculty of Medicine, Geneva, Switzerland
8. INSERM, IAME, Université Paris-Cité, Paris, France
9. Division of Infectious Diseases, Department of Internal Medicine, Washington University School of Medicine, St. Louis, MO, United States

Correspondence: Vanja Piezzi (vanja.piezzi@insel.ch)

Euro Surveill. 2022;27(48):2200285. doi: 10.2807/1560-7917.

Mesures de contrôle des VRE en Suisse



... observance de ces mesures



Second report of Swissnoso on the epidemiology of healthcare-associated infections in Switzerland

October 2020 – October 2021

Publié en juillet 2022

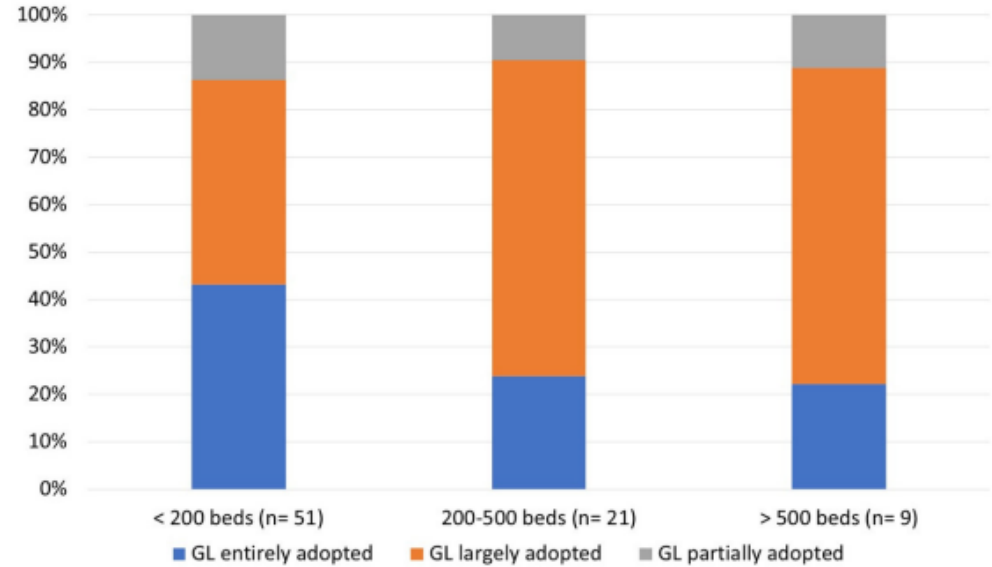


Figure 9: Self-reported compliance with Swissnoso guidelines (GL) by hospital size.

https://www.swissnoso.ch/fileadmin/swissnoso/Dokumente/5_Forschung_und_Entwicklung/8_Swissnoso_Publikationen/220917_2nd_report_epidemiological_HAI_situation_in_Switzerland_Oct_20_Oct_21_fin.pdf

Une réponse fédérale



Stratégie
NOSO

Au total

- Situation contrastée
 - selon la BMR
 - selon les pays (et les cantons)
- Globalement : augmentation du fardeau des BMR
- Contraste avec la relative pauvreté des découvertes de nouveaux antibiotiques
- Enjeu majeur des années à venir