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 **ESCMID** EUROPEAN SOCIETY OF CLINICAL
MICROBIOLOGY AND INFECTIOUS DISEASES

Significant changes in the epidemiology of Bloodstream Infections

Results of a prospective, longitudinal, region- wide survey conducted between 2007 and 2013

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on behalf of the

Bloodstream Infection Study Group of the Réseau des Hygiénistes du Centre

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BSI surveillance program in the Centre region of France (2.7 M inhabitants) and a microbiological study of *S. aureus* and ESBLE isolates since 2000

- Data collected 3 months of each year
- stable cohort : 33 hospitals and clinics
- 6330 short-stay beds
- 3,258,015 patient days
- variable studied :
 - patient age and sex,
 - recent history of catheterization (urinary, intravenous) and mechanical ventilation,
 - portal of entry

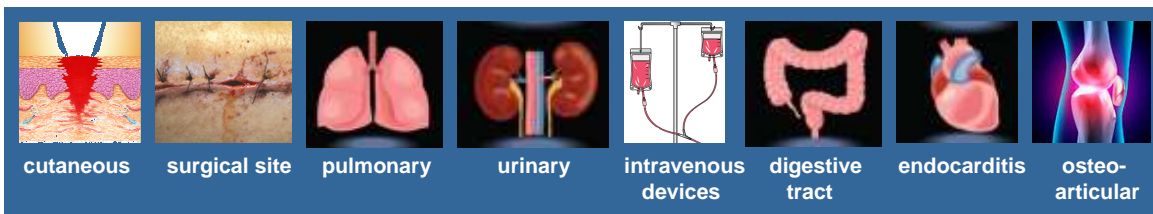


National
Standardized
Protocol



S. aureus and ESBLE isolates collected during the 7 survey periods

- one central lab
- tested for antimicrobial susceptibility
- genotyped (PFGE, MLST)



- acquisition
 - Into the community-setting
 - Healthcare-associated
- death within 7 days of diagnosis

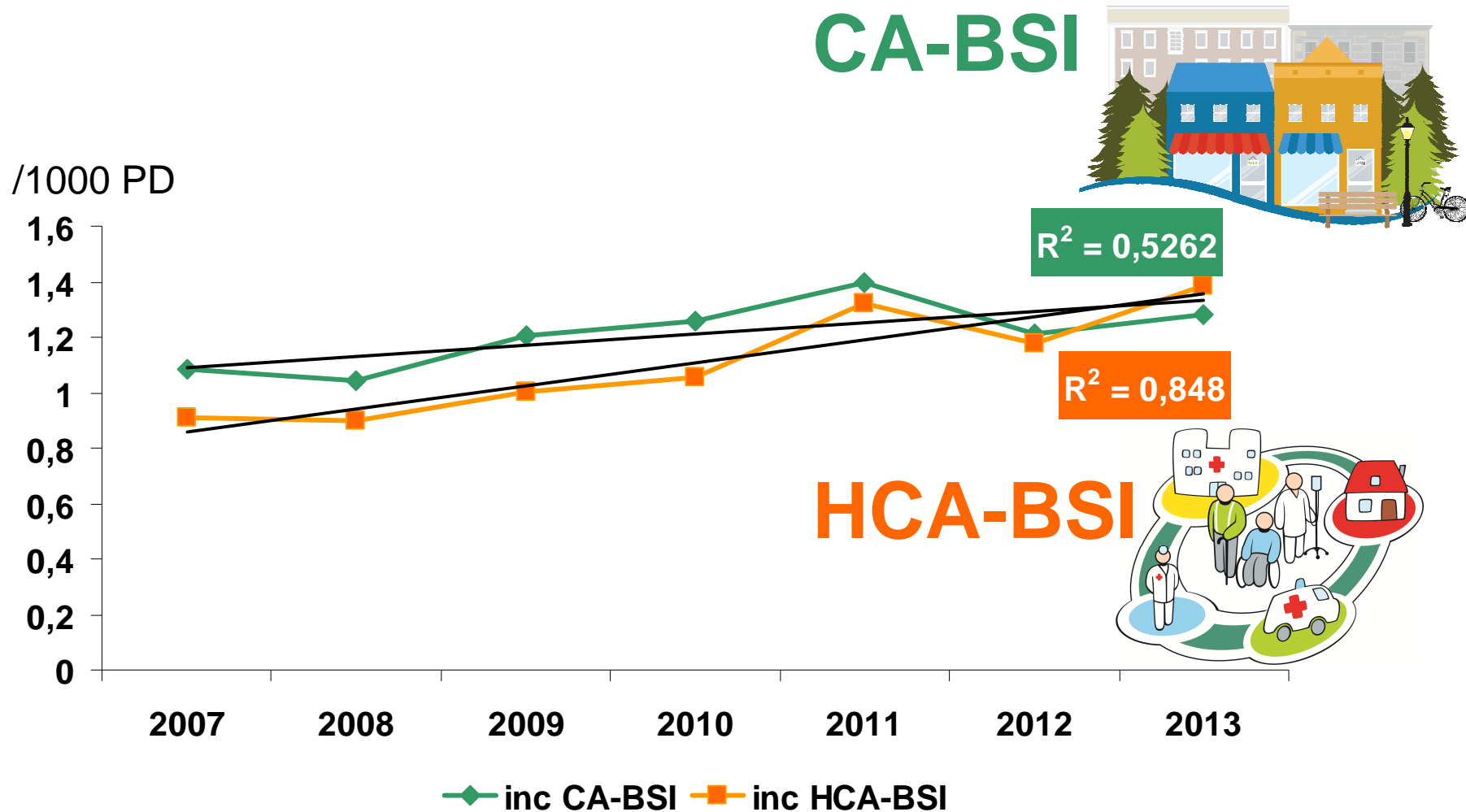


- BSI incidence determined with respect to the number of patient days (PDs)

- study period **2007-2013**

- 7274 BSI cases
 - 3801 CA-BSI
 - 3473 HA-BSI
 - 4157 males, 3117 females
- 1096 *S. aureus* (MRSA 24%)
- 2334 *E. coli* (ESBL+ 4 %)
- 126 ESBLE : 88 *E. coli*, 27 *K.pn*

BSI incidence rate (/1000 PD) (all BSI, all microorganisms)



R² coefficient of determination (linear regression)

de Kraker ME, Clin Microbiol Infect. 2013
Gagliotti C Euro Surveill. 2011

Incidence rate (/1000 PD)

R² coefficient of determination (linear regression)

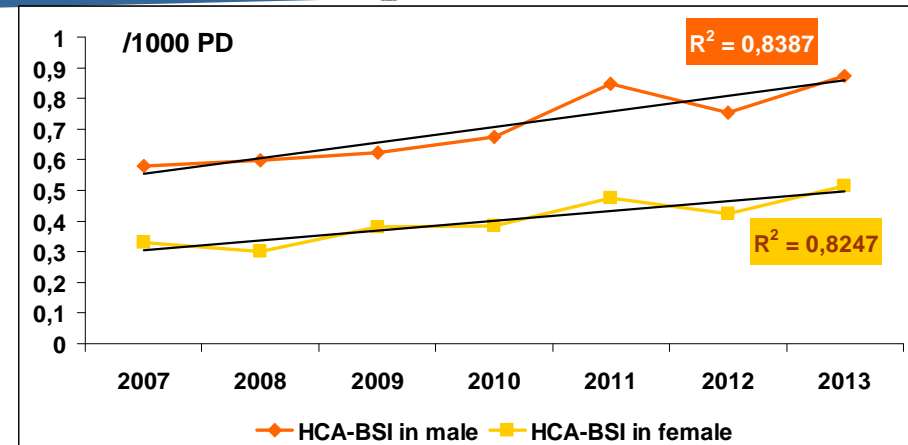
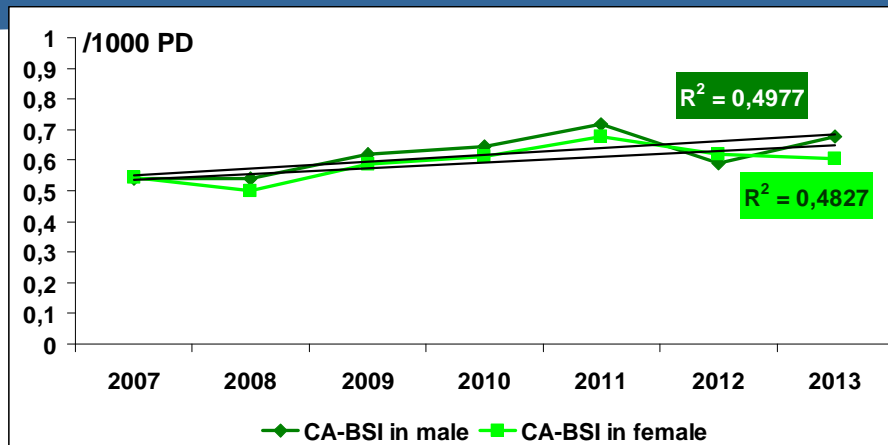


CA-BSI

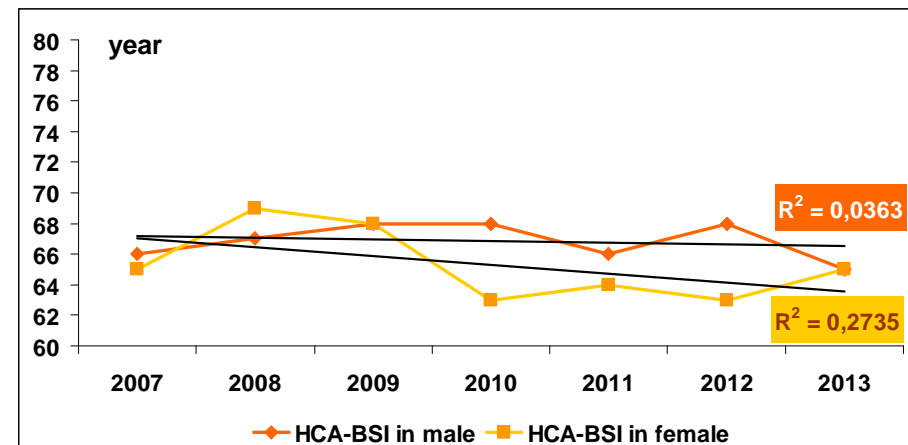
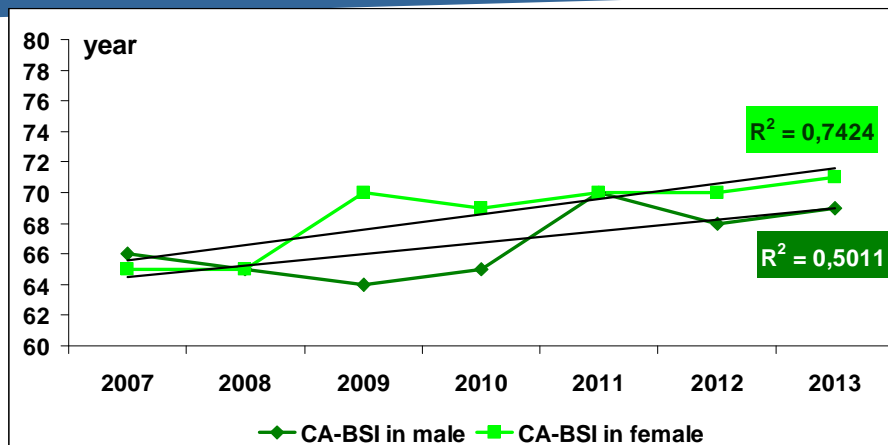


HCA-BSI

Patient sex



Patient age (year)



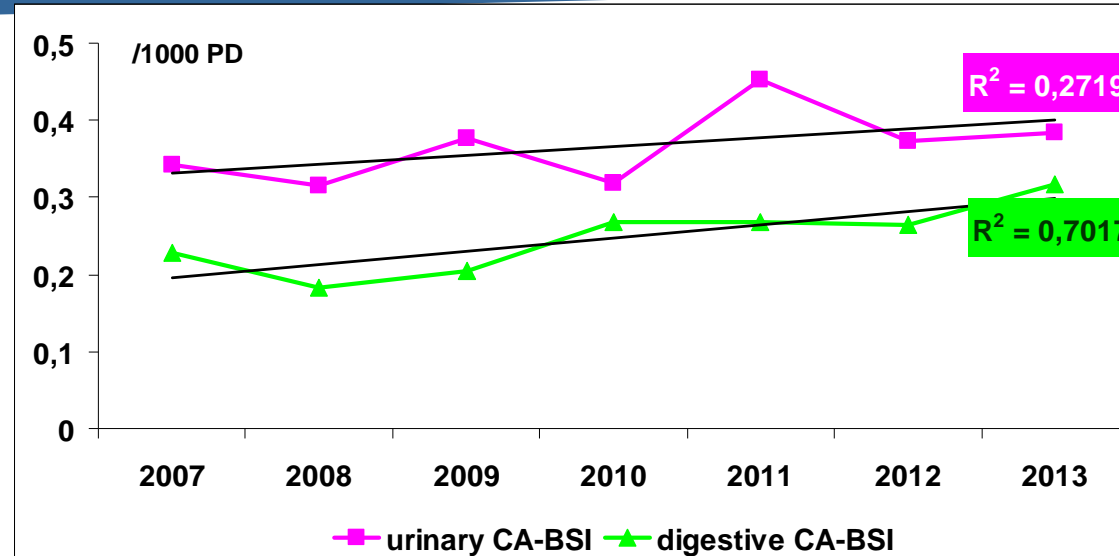
Incidence rate (/1000 PD)

R² coefficient of determination (linear regression)

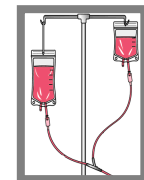
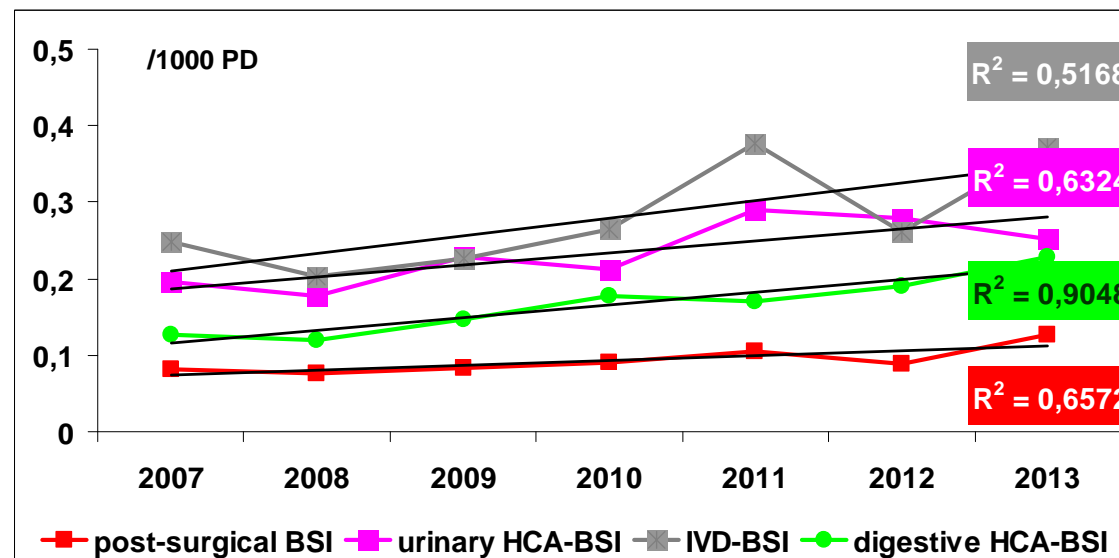
Major portal of entry



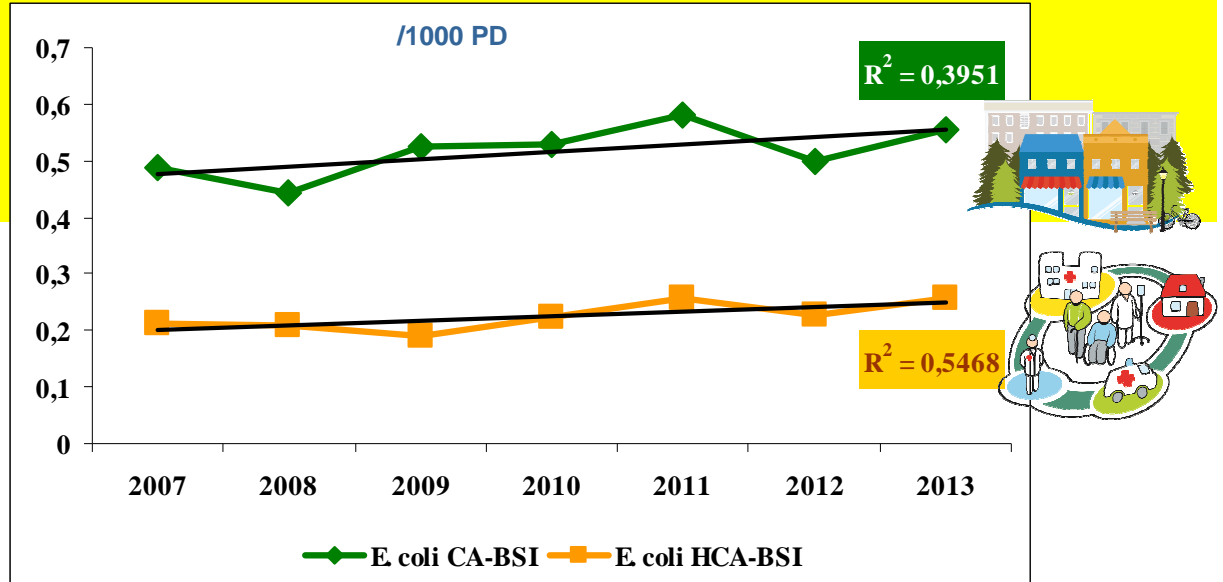
CA-BSI



HCA-BSI



E. coli BSI incidence rate (/1000 PD)

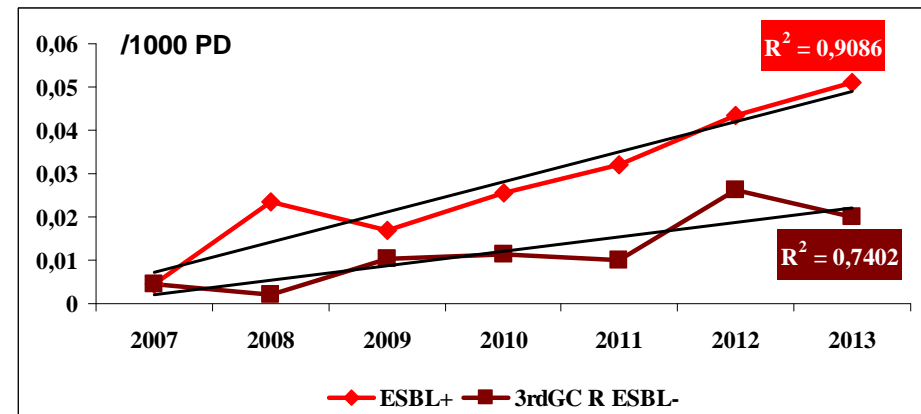
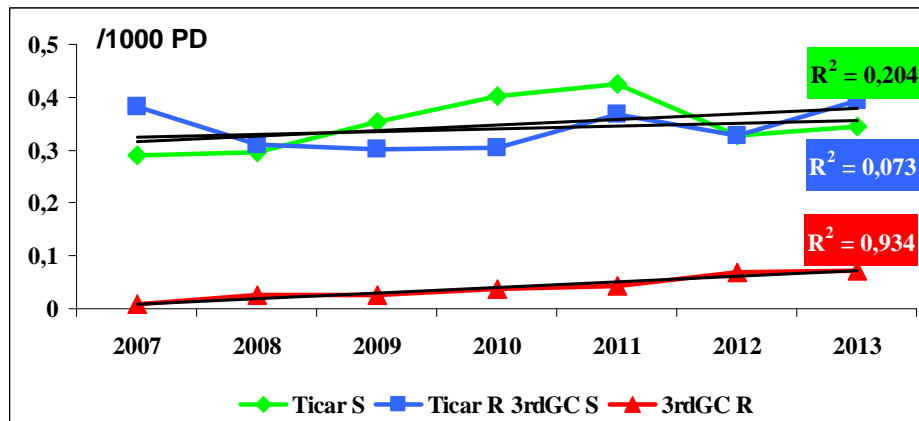
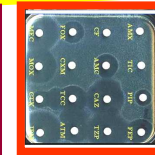
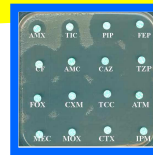


ATBtypes

WT ticar S

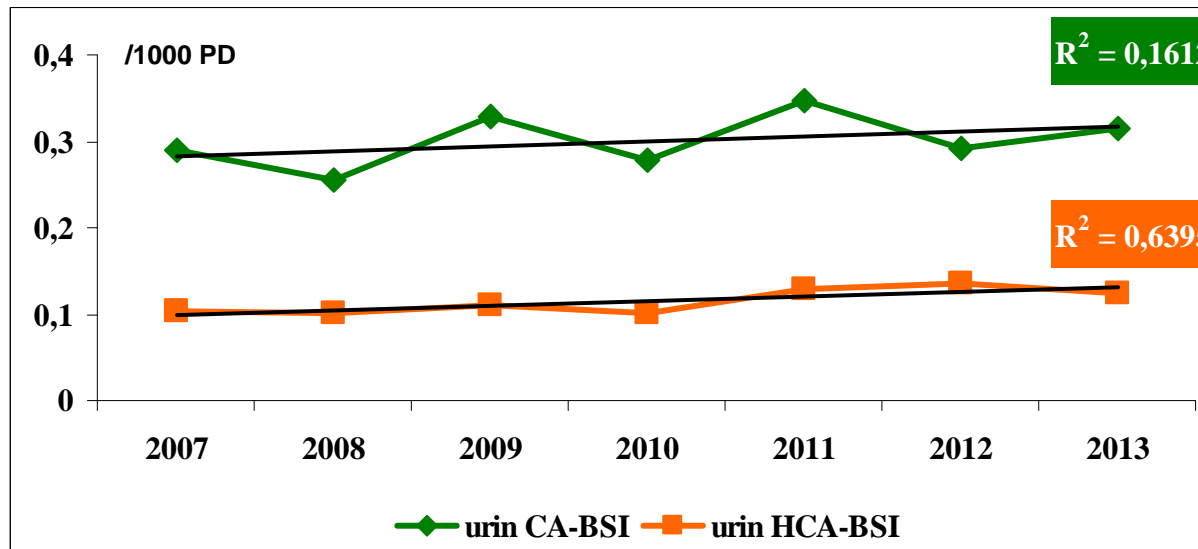
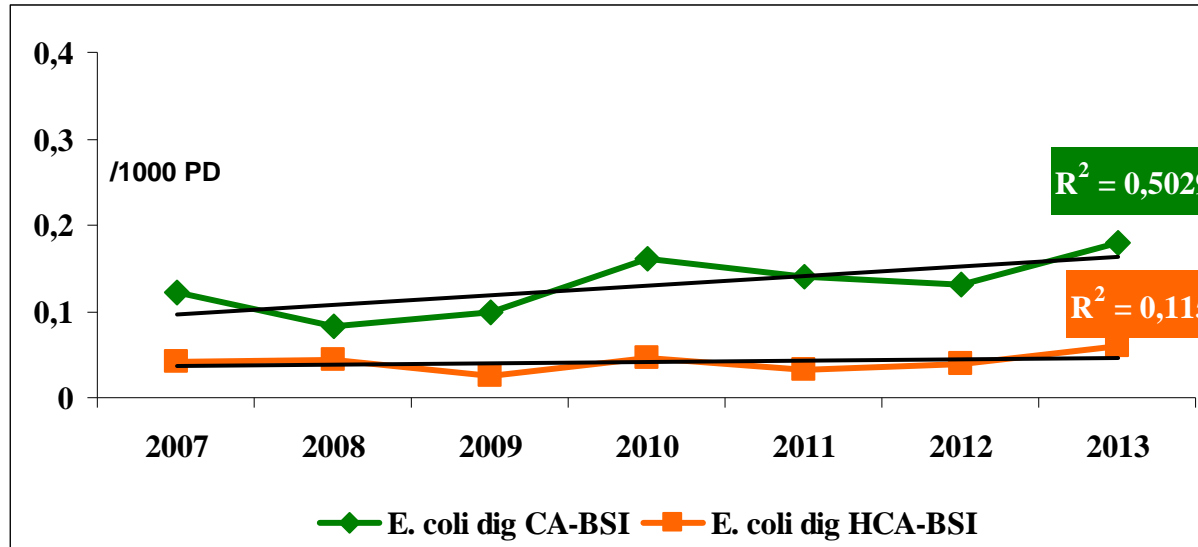
ticar R

3rd Gen. Cephalosp. R
AmpC ESBL



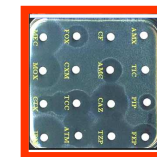
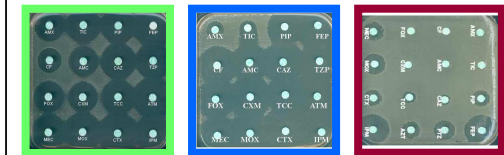
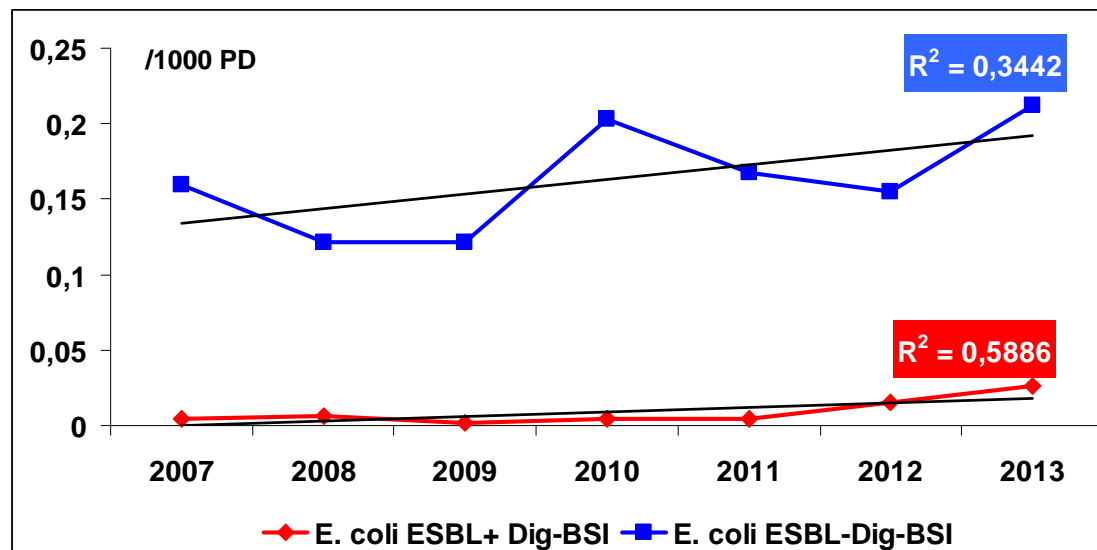
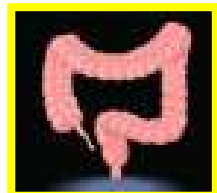
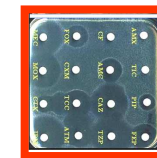
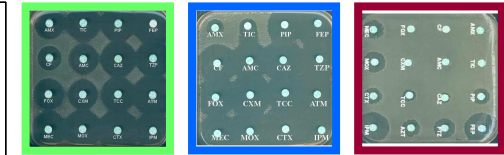
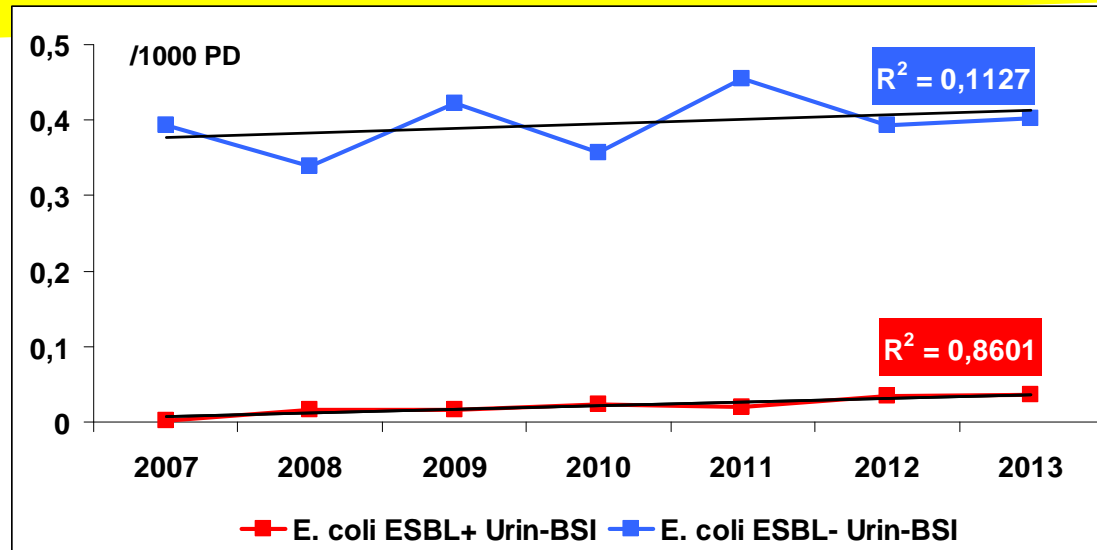
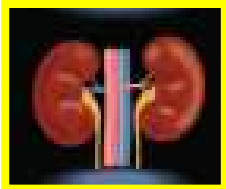
E. coli BSI incidence rate (/1000 PD)

Portal of entry

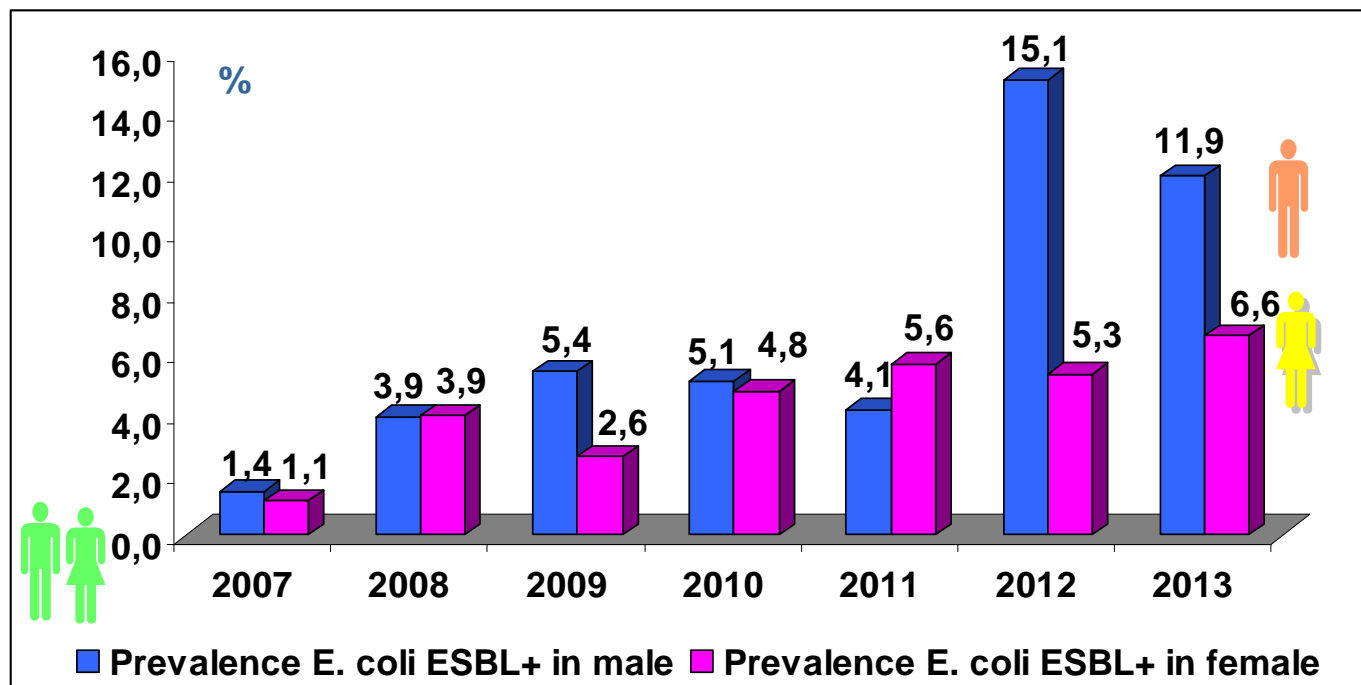


ESBL-producing *E. coli* BSI

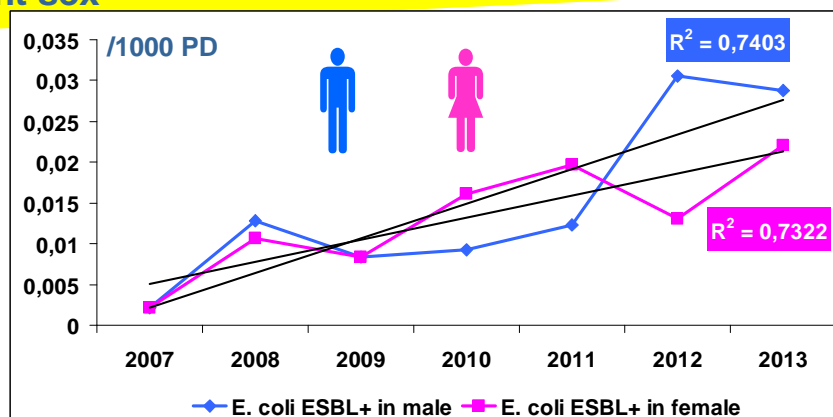
Major portal of entry



ESBL-producing *E. coli* BSI



Patient sex

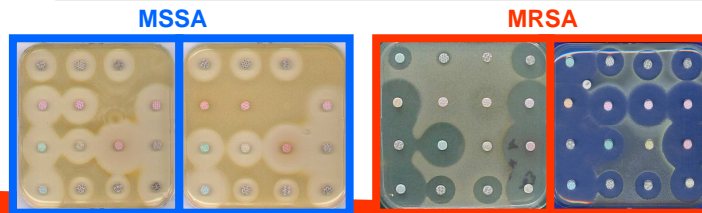
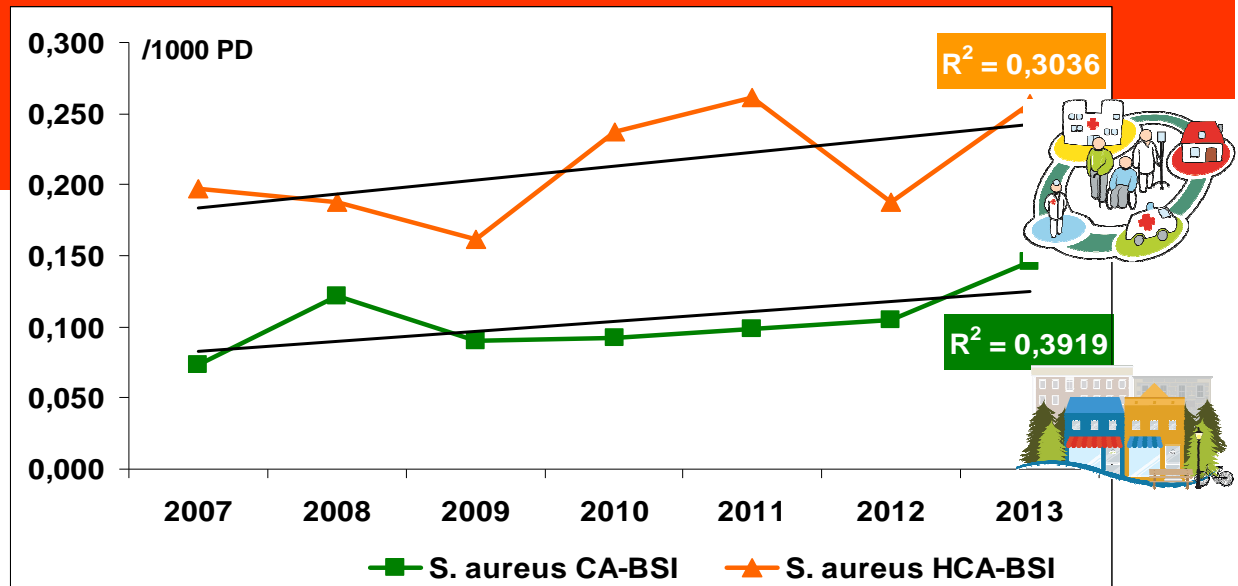


High genetic diversity

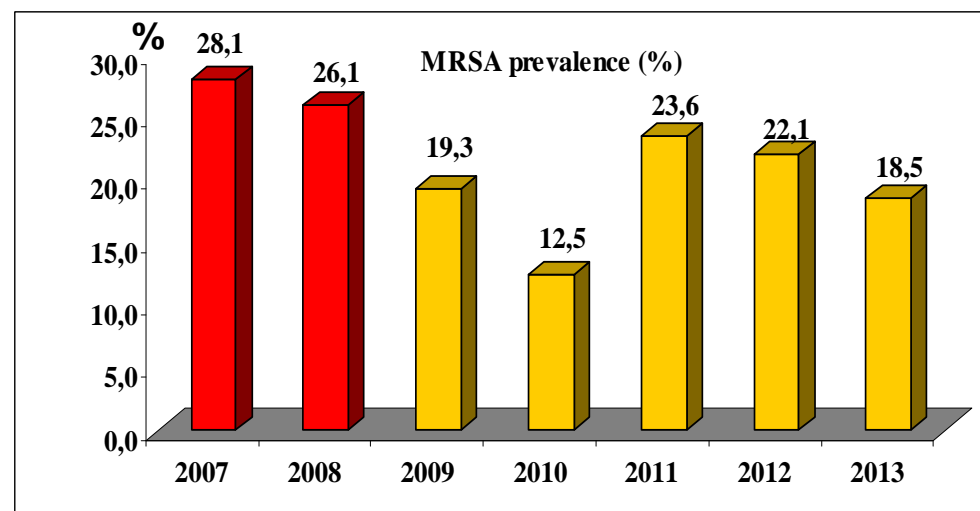
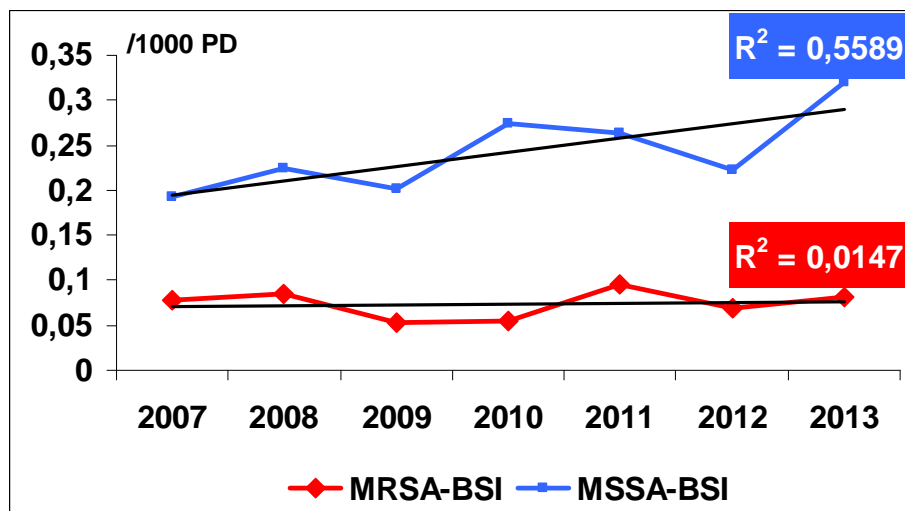


SSRAUT	81	07/07/1934	77	2	03/01/2012	09/03/2013	431
MEDGEN	57	08/01/1929	84	2	13/02/2013	13/02/2013	0

S. aureus BSI incidence rate (/1000 PD)



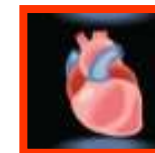
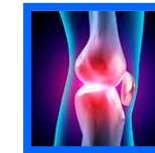
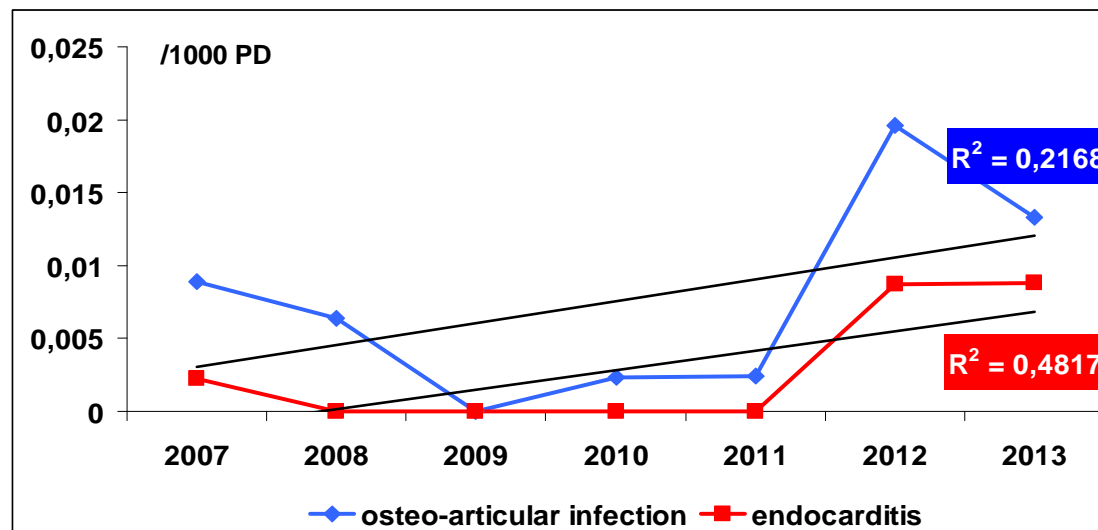
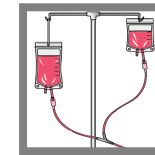
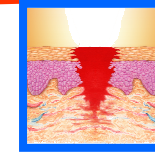
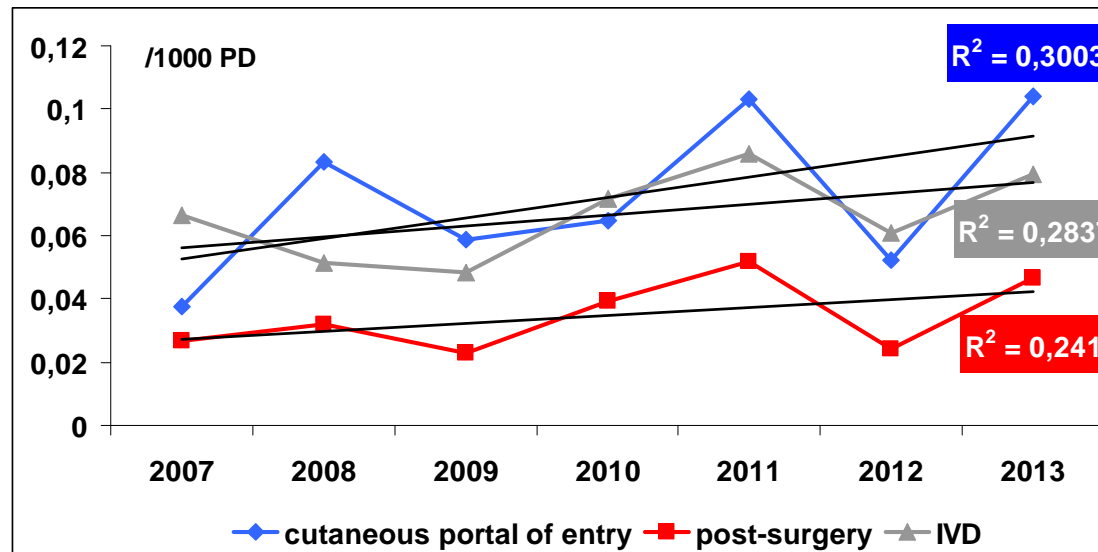
Methicillin resistance



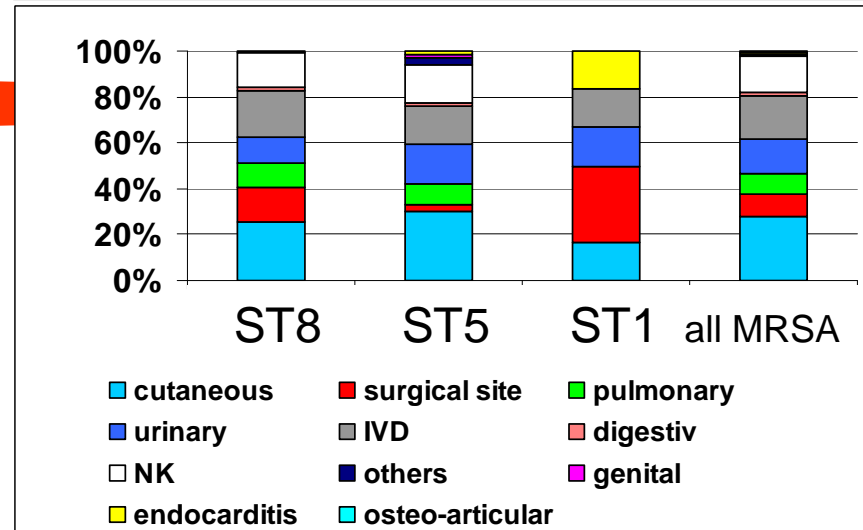
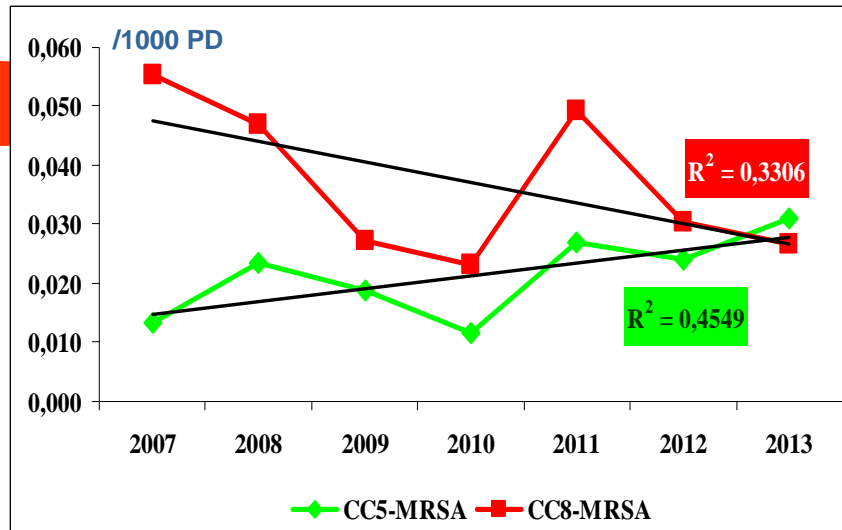
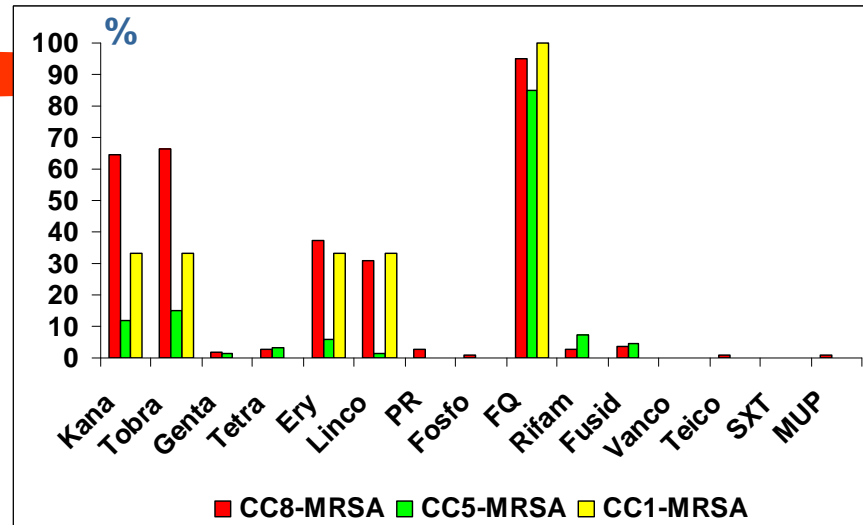
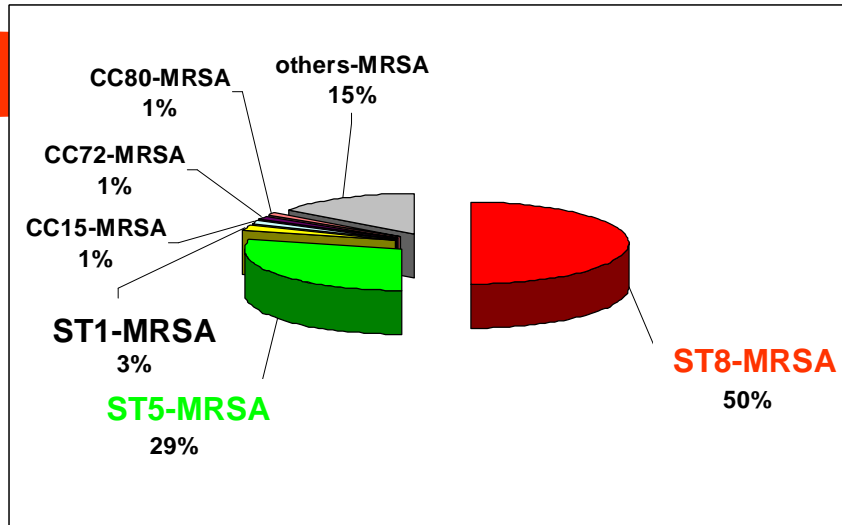
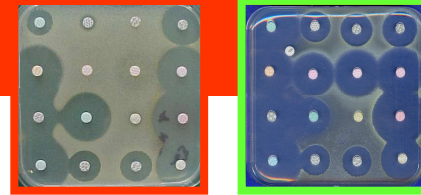
S. aureus BSI incidence rate (/1000 PD)

R² coefficient of determination (linear regression)

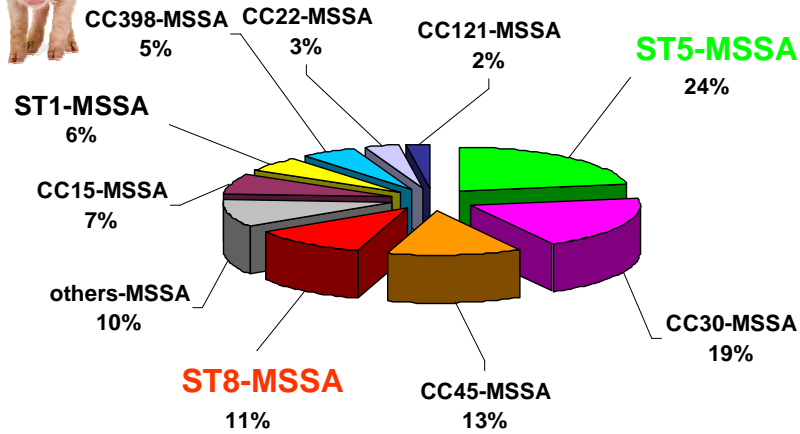
Portal of entry



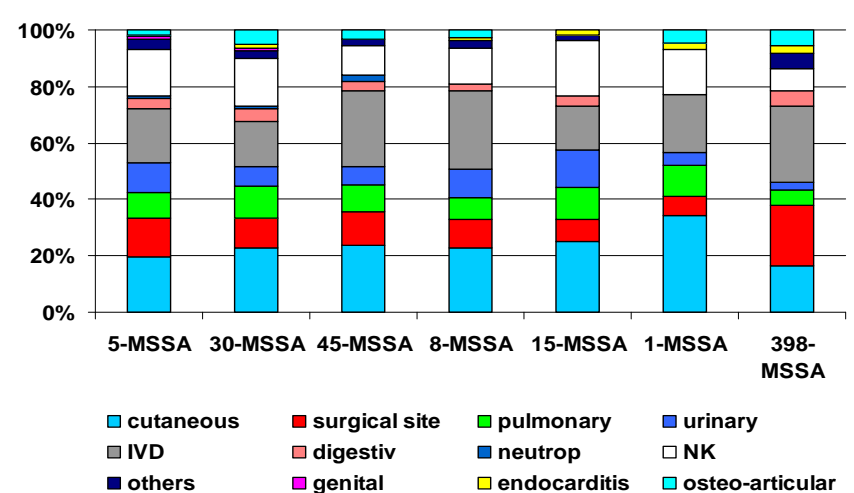
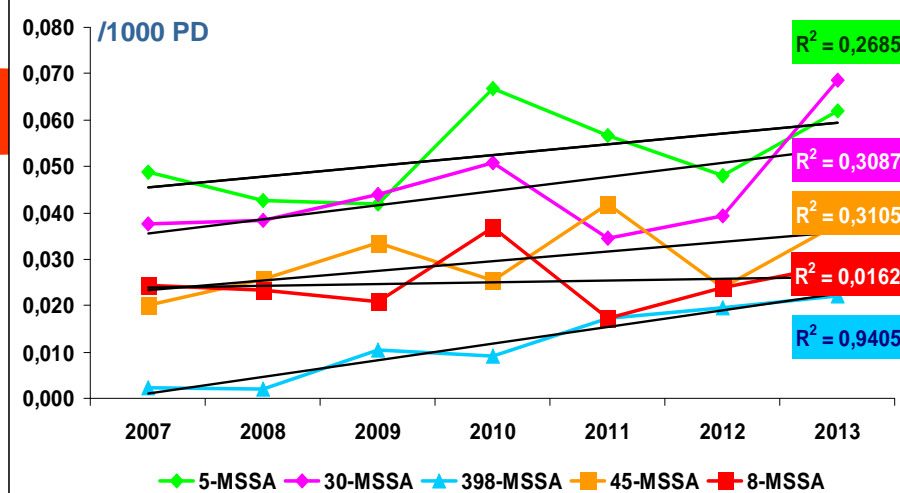
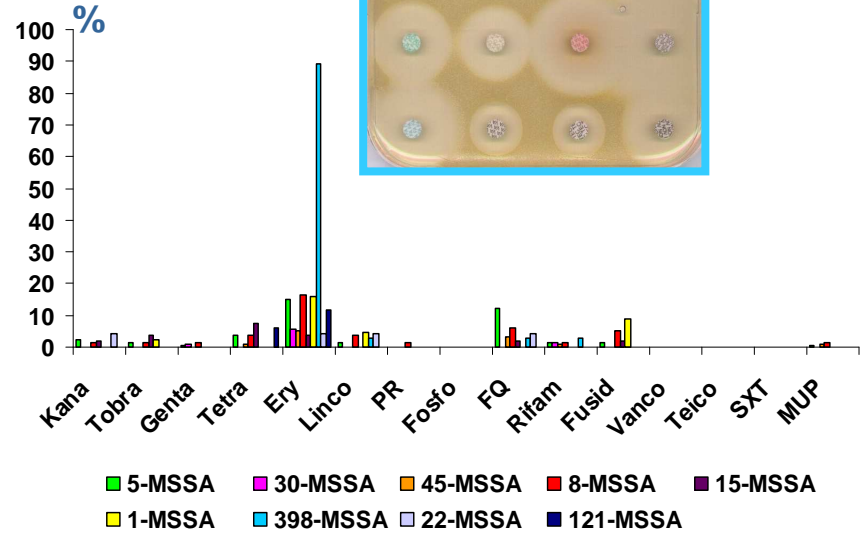
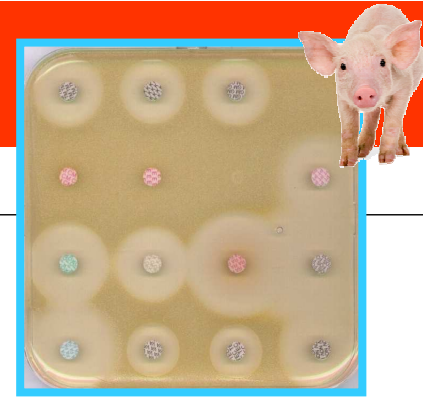
MRSA BSI



MSSA BSI



CC9, Lamamy CID 2013



rapid changes in the epidemiology of BSI

- involving the 2 major pathogens, *E. coli* and *S. aureus*
- increasing incidence of CA-BSI associated with a digestive portal of entry
 - *E. coli* of WT and ESBL-producing isolates
 - CC398 MSSAMRSA and ESBLE in food products
emergence of livestock associated *S. aureus* : CC398, CC9, CC97
Poultry consumption as a risk factor for CA-MRSA colonization

potential role of food?



- Increasing incidence of HCA-BSI associated with urinary, surgical site and IVD
 - increasing ability to colonize human flora
 - ability to escape human host (CC398)
 - increasing virulence ?
 - *E. coli* : increasing incidence for intestinal invasive infection
 - *S. aureus* CC398 : increasing incidence for endocarditis and osteo-articular infection

subpopulations of isolates with great ability to colonize and infect human

- host jumps in livestock environments ?
- horizontal transfer of genetic elements associated with human adaptation in livestock environment ?

=> alert about the need to consider these changes for the adaptation of infection control strategy especially before invasive procedure

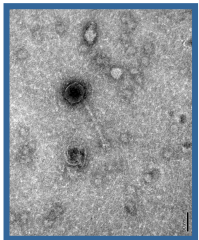


MRSA in pig: livestock, human contacts and food products (Armand-Lefevre, 2005; Witte, 2007; van Belkum, 2008)

a recent evolution

MSSA in human, BSI, in animal-free environment (Price, 2012; Valentin-Domelier, 2011; Jimenez, 2011; Stegger, 2010; Uhleman, 2012)

Enhanced adhesion to human keratinocytes and keratin, high transmissibility (Uhleman, 2012)



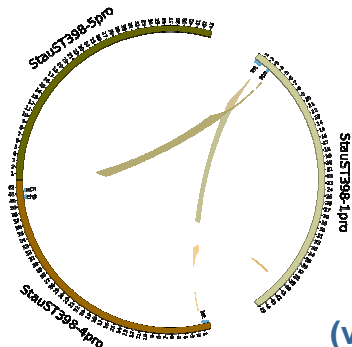
Acquisition of a MR11-like prophage (genome accession number [KC595279](#))

- » inserted into *smpB*
- » superantigen similar to enterotoxin B
- » putative RM system
- » helper phage

=> during stress and lysogeny, expression of prophage-encoded *chp* and *scn* virulence genes carried by the human specific $\phi 3$ -prophage

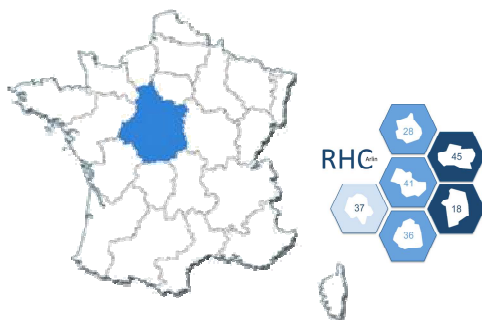
=> resistance against uptake of foreign DNA of the MR11-like-prophage

Enhanced pathogenicity in human



(van der Mee-Marquet et al., Inf Gen Evol 2013)

Abdelbary 2014
 Agnoletti 2014
 Tavakol 2012



Significant changes in the epidemiology of Bloodstream Infections Results of a prospective, longitudinal, region-wide survey conducted between 2007 and 2013

Pr R Quentin, Service Bactériologie et Hygiène, CHRU Tours France

The members of the Bloodstream infection study Group of the Réseau des Hygiénistes du Centre are AMIRAULT P (Vierzon), ARCHAMBAULT M (Pithiviers), BACHELIER MN (Bourges), BLOC D (Tours), BOUCHER M (Chateaudun), CATTIER B (Amboise), CHANDESRIS C (Amilly Montargis), CHEVEREAU V (La Chaussée St Victor), COUROUBLE G (Chateauroux), COURTIN M.-C (Amboise), DECREUX C (Chateauroux), DE GIALLULY C (Tours), DENIS C (Loches), DEPERROIS F (Chinon), FIEVRE C (Le Blanc), FOLOPPE P (Loches), FONGAUFFIER F (Chateaudun), FOURNIER-HOOCK R (Amilly Montargis), GIRARD N (Tours), GOURDET T (La Chaussée St Victor), GRAVERON JL (Fleury Les Aubrais), GROBOST F (La Ferté Bernard), GUILLON MF (Chateauroux), GUINARD F (Bourges), HARRIAU P (St Amand Montrond), HOMBROUCK-ALET C (Blois, Vendome, Romorantin), IMBAULT D (Vendome), JEHANNO D (Fleury Les Aubrais), KOURTA MJ (Chateaudun), LAURENT O (St Doulchard), LEHIANI O (Vierzon, Bourges, St Amand Montrond), LEPINEUX DA ROCHA A (St Amand Montrond), LESIMPLE AL (Vendome), LOUVIER X (Gien), MICHEL V (Le Blanc), MORANGE V (Tours), MOREL-DESJARDINS E (Bourges), MORIN E (Orléans), NAUDION C (Romorantin), NARBEY D (Blois), NEVEU C (Dreux), PABA O (Vendome), PERIGOIS F (Le Blanc), PETIT LE GOUAS G (Nogent Le Rotrou), POITVIN D (Chinon), PREVOST-OUSSAR M (Pithiviers), RATOVOHERY D (Chateauroux), ROUSSEAU B (Gien), ROUSSIN A (Orléans), SECHER A (Dreux). WATT S (Chinon).