

# MRSA: an introduction

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# Outline

- *Staphylococcus aureus* (humans, animals)
- MRSA
  - General characteristics of MRSA
  - CA-MRSA, HA-MRSA
  - Typing of MRSA
  - MRSA in farm animals
  - MRSA in companion animals
- Final remarks



# *Staphylococcus aureus*

Gram positive coc

Cause of several veterinary problems:

bovine mastitis

problems in equine

joints problems in chickens

systemic disease in pigs (rare)

pyoderma dog (more often *S. intermedius*)

Human: 33% of healthy people are carrier

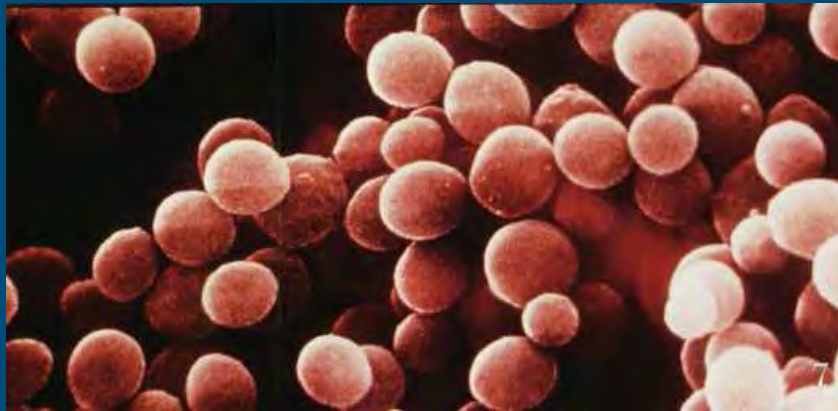
Veterinary carriers



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# *S. aureus* becomes MRSA.....

.....by acquiring *mecA* gen

- Methicillin Resistant *Staphylococcus aureus*
- Chromosome (Staphylococcal Chromosome Cassette - *SCCmec*)
- Penicillin binding protein PBP2a
- Resistant against all beta-lactam antimicrobials - penicillines, cephalosporines

(beta-lactamase inhibitors like clavulanic acid are not active)





# HA-MRSA and CA-MRSA (humans)

- HA-MRSA: Hospital acquired
  - emerged in the 60's (after introduction of methicillin in 1959)
  - multi-resistant but lame
  - antibiotic usage facilitates spread
  - most important control method is prevention of cross-infection
  
- CA-MRSA: Community associated
  - emerged in the 90's
  - in community – no relation health care settings
  - resistance moderate but often toxin (PVL+)
  - risk factors



# A clone of methicillin-resistant *Staphylococcus aureus* among professional football players.

(Kazakova et al, 2005)

BACKGROUND: Methicillin-resistant *Staphylococcus aureus* (MRSA) is an emerging cause of infections outside of health care settings. We investigated an outbreak of abscesses due to MRSA among members of a professional football team and examined the transmission and microbiologic characteristics of the outbreak strain. METHODS: We conducted a retrospective cohort study and nasal-swab survey of **84 St. Louis Rams football players** and staff members. *S. aureus* recovered from wound, nasal, and environmental cultures was analyzed by means of pulsed-field gel electrophoresis (PFGE) and typing for resistance and toxin genes. MRSA from the team was compared with other community isolates and hospital isolates. RESULTS: **During the 2003 football season, eight MRSA infections occurred among 5 of the 58 Rams players (9 percent);** all of the infections developed at turf-abrasion sites. **MRSA infection was significantly associated with the lineman or linebacker position and a higher body-mass index.** No MRSA was found in nasal or environmental samples; however, methicillin-susceptible *S. aureus* was **recovered from whirlpools and taping gel** and from 35 of the 84 nasal swabs from players and staff members (42 percent). MRSA from a competing football team and from other community clusters and sporadic cases had PFGE patterns that were indistinguishable from those of the Rams' MRSA; all carried the gene for Panton-Valentine leukocidin and the gene complex for staphylococcal-cassette-chromosome mec type IVa resistance (clone USA300-0114). CONCLUSIONS: We describe a highly conserved, community-associated MRSA clone that caused abscesses among professional football players and that was indistinguishable from isolates from various other regions of the United States.



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**FOX SPORTS** | MORE SCORES | SIGN IN | REGISTER

DAY 1 COMPLETE | **ROUND: 1 REVIEW** | 65. OAK (Q. MOSES, DE) | 66. DET (U. YOUNG, CB) | 67. DAL (J. MARTEN, OG) | 68. TB (Q. BLACK, O)

**St. Louis Rams**

Fan Poll Rank: #30 | FOXSports.com Rank: #18

Front | Roster | Depth Chart | Schedule | Stats | Injuries | Transactions | Team Report | Fantasy | Stadium | Salary

2006 SALARIES		
Rk	Player	Salary (US\$)
1	<a href="#">Orlando Pace</a>	\$18,000,000
2	<a href="#">Isaac Bruce</a>	\$7,400,000
3	<a href="#">Jeff Wilkins</a>	\$4,376,320
4	<a href="#">La'Roi Glover</a>	\$4,004,840
5	<a href="#">Dexter Coakley</a>	\$4,004,400
6	<a href="#">Marshall Faulk</a>	\$4,001,210
7	<a href="#">Leonard Little</a>	\$4,000,000
8	<a href="#">Drew Bennett</a>	\$2,751,050
9	<a href="#">Torry Holt</a>	\$2,735,000
10	<a href="#">Stephen Davis</a>	\$2,600,000
11	<a href="#">Steven Jackson</a>	\$2,287,500
12	<a href="#">James Hall</a>	\$2,256,160
13	<a href="#">Corey Chavous</a>	\$2,250,000
14	<a href="#">Randy McMichael</a>	\$2,000,000
15	<a href="#">Jason Fisk</a>	\$1,769,510
16	<a href="#">Ron Bartell</a>	\$1,724,000
17	<a href="#">Dante Hall</a>	\$1,550,000
18	<a href="#">Gus Frerotte</a>	\$1,500,000
19	<a href="#">Lenny Walls</a>	\$1,435,720
20	<a href="#">Will Witherspoon</a>	\$1,435,720
21	<a href="#">Alex Barron</a>	\$1,230,000

NFL TEAM PAYROLLS		
Rk	Team	Payroll (US\$)
1	<a href="#">Falcons</a>	\$121,715,529
2	<a href="#">Seahawks</a>	\$112,338,037
3	<a href="#">Raiders</a>	\$97,412,279
4	<b>Rams</b>	\$96,030,523
5	<a href="#">Panthers</a>	\$95,217,046
6	<a href="#">Buccaneers</a>	\$94,190,888
7	<a href="#">Broncos</a>	\$93,987,851
8	<a href="#">Redskins</a>	\$90,863,421
9	<a href="#">Patriots</a>	\$90,585,828
10	<a href="#">Jaquars</a>	\$89,377,281
11	<a href="#">Ravens</a>	\$89,377,281
12	<a href="#">Texans</a>	\$89,377,281
13	<a href="#">Giants</a>	\$86,905,392
14	<a href="#">Chiefs</a>	\$86,496,585
15	<a href="#">Jets</a>	\$84,879,756
16	<a href="#">Cowboys</a>	\$83,593,328
17	<a href="#">Steelers</a>	\$80,477,220
18	<a href="#">Cardinals</a>	\$80,412,272
19	<a href="#">Bears</a>	\$78,287,213
20	<a href="#">Eagles</a>	\$78,242,782
21	<a href="#">Saints</a>	\$74,321,745

**TEAM SALARIES**

Rams

**PLAYER SEARCH**  
Enter player's name



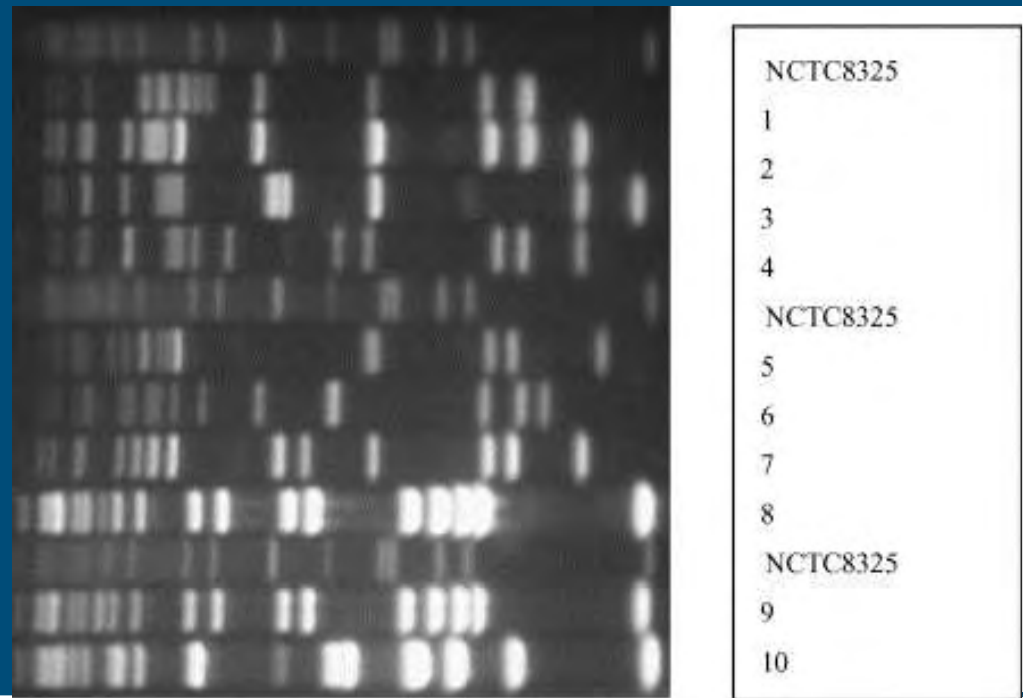
# MRSA: typing

- Staphylococcal Cassette Chromosome *mec* (SCC*mec*)
  - 5 identified SCC*mec* types I, II, III, IV, V, (VI)
- Typing:
  - PFGE
  - Spa-typing
  - MLST
- NT-MRSA



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# MRSA in hospitals: a problem?



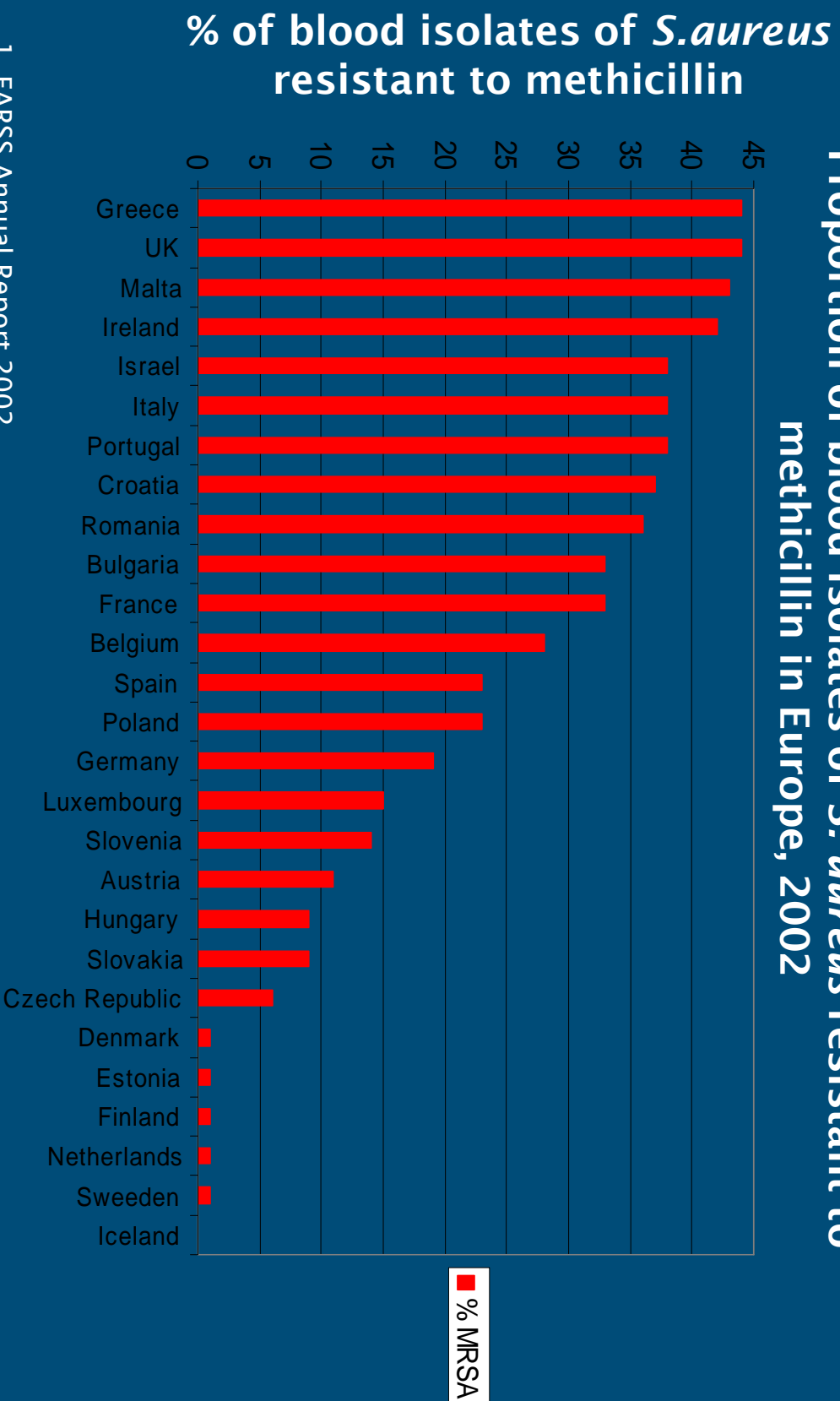
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# MRSA in Europe

Proportion of blood isolates of *S. aureus* resistant to methicillin in Europe, 2002



1 EARSS Annual Report 2002



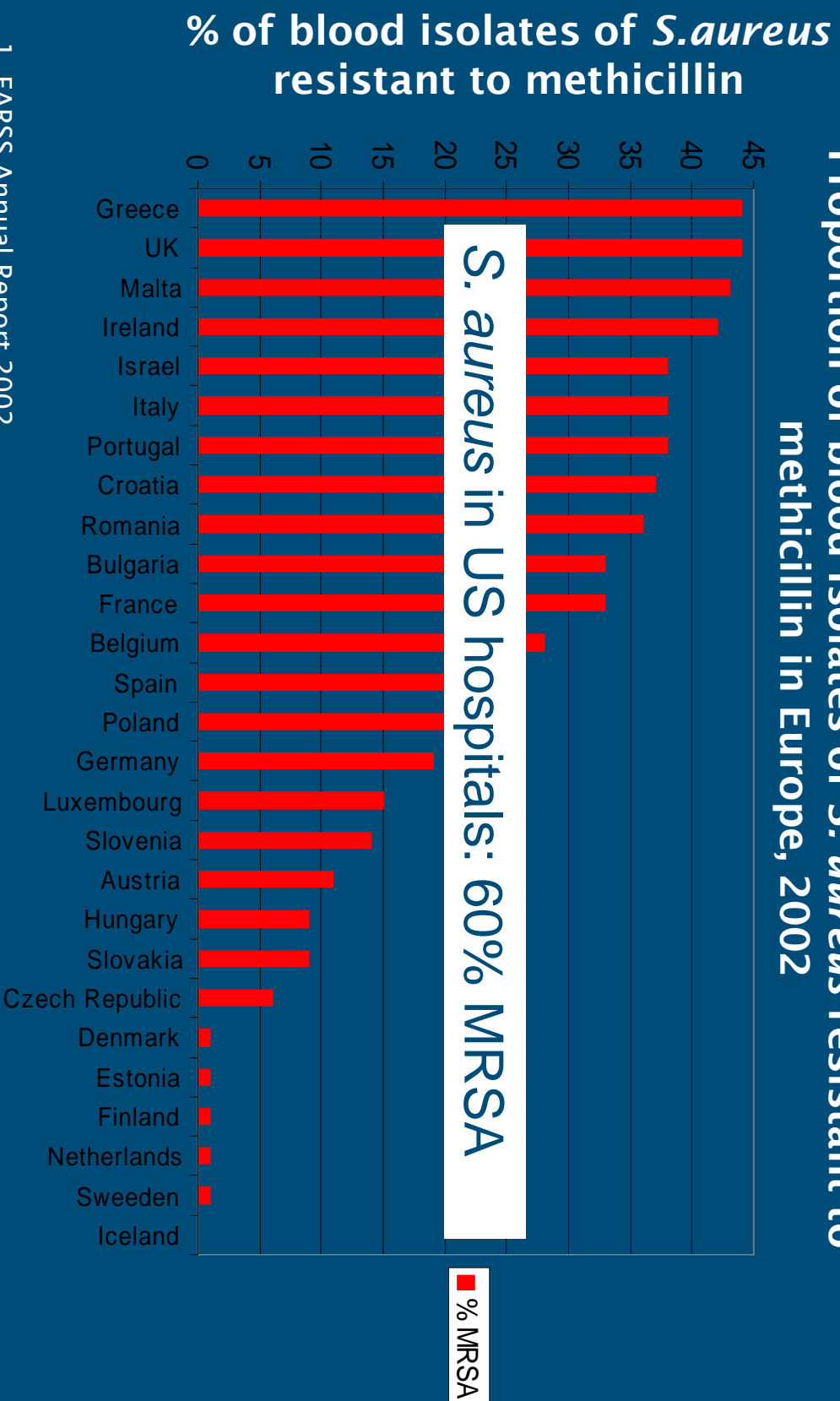
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# MRSA in Europe

Proportion of blood isolates of *S. aureus* resistant to methicillin in Europe, 2002



# MRSA in health care settings

- MRSA infections are more difficult to treat
  - less effective antibiotics available
  - no new drugs on the horizon
  - without an effective control strategy > 50-60%
  - high morbidity and mortality
  - increases costs (more expensive drugs, longer duration of hospitalization, more diagnostics)



# MRSA and animals (slide 2003....)

- MRSA in dogs, cats, rabbits, horse, chickens, cattle, pigs: sporadic cases
- MRSI in dogs with pyoderma from Spanje
- Methicillin resistant CoNS in sheep UK and horses from Japan



## 2004: 3 human cases NT-MRSA pig related (NL)

- Daughter of a pig farmer (+ pigs)
  - Son of pig veterinarian
  - Pig farmer (+ pigs)
  - Studygroup pig farmers (23% +)
- 
- Not identified as risk group!
  - Till 2002 no “pig-MRSA” (NT-MRSA)
  - Many pig farmers, many people in contact with pigs, nurses living on farms.....



# Pigs: preliminary screening

- 9 slaughterhouses with 6 herds each (10 swabs per herd):
  - 209/540 pig +
  - 44/54 herds +
- All isolates tetracyclin resistant
- All isolates TMPS sensitive
- No clinical signs in pigs

De Neeling et al., Vet. Microbiol. 2007

- Cross-sectional study: 40% pigs (RIVM/GD/WUR)



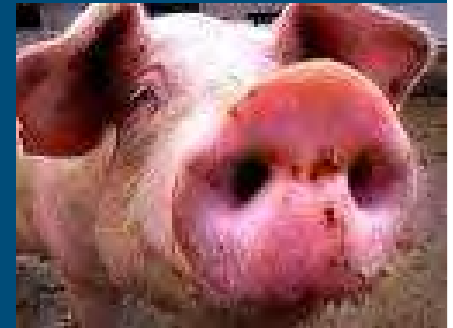
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# MRSA in different kinds of pig farms

- Screening of 31 pig farms (farrowing, rearing and finishing)
- 7/31 farms MRSA positive (23 %)
- 1 farm MRSA negative, farmer MRSA positive
  - Treatment with tetracycline
  - 8/10 pigs MRSA positive
- All MLST 398, NT-MRSA
- Use of antibiotics risk factor



Van Duijkeren et al., Vet Microbiol. 2007

- More about risk factors: study Els Broens RIVM/GD/WUR



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# Clinical disease in pigs?

- One case with exsudative dermatitis



EID 2007



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# Humans and NT-MRSA

- Many asymptomatic carriers (farmers etc)
- Few clinical cases are described
- Source: case control study => pig and cattle farmers
- Problem: risk for introduction into hospitals
- Spread within hospitals does not (yet) occur often (but what if.....)
- MRSA in food
- Risk for humans – specific groups – community



# What is the origin of MRSA in pigs?

- emerging and not only by improved detection
- coagulase negative Staphylococci contain resistance cassette - transfer of genetic material?
- non MRSA ST398 was already in pigs!
- NT-MRSA clonal but not the same: one recombination and subsequently development of this clone into diverse lines?
- Not restricted to the Netherlands



DISPATCHES

# MRSA Transmission between Cows and Humans

Éva Juhász-Kaszanyitzky,\* Szilárd Jánosi,\*  
Pál Somogyi,\* Ádám Dán,\*  
Linda van der Graaf-van Bloois,††  
Engeline van Duijkeren,‡  
and Jaap A. Wagenaar††

We isolated methicillin-resistant *Staphylococcus aureus* (MRSA) from cows with subclinical mastitis and

agar. They were tested (Slidex S France) to this farm. were tested tion of  $\beta$ - The first the next 1 lated from In De from 12 w with the o who gave

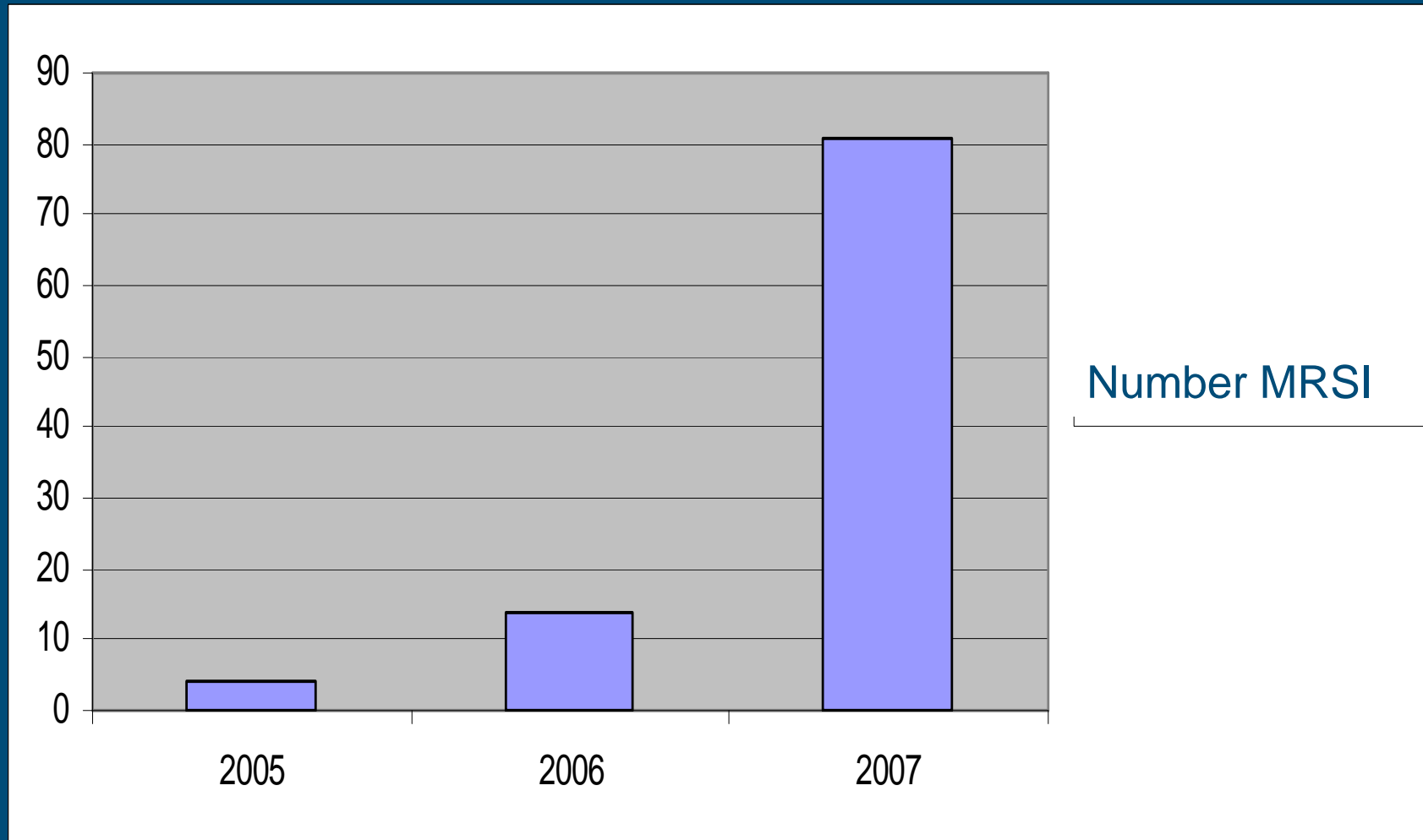


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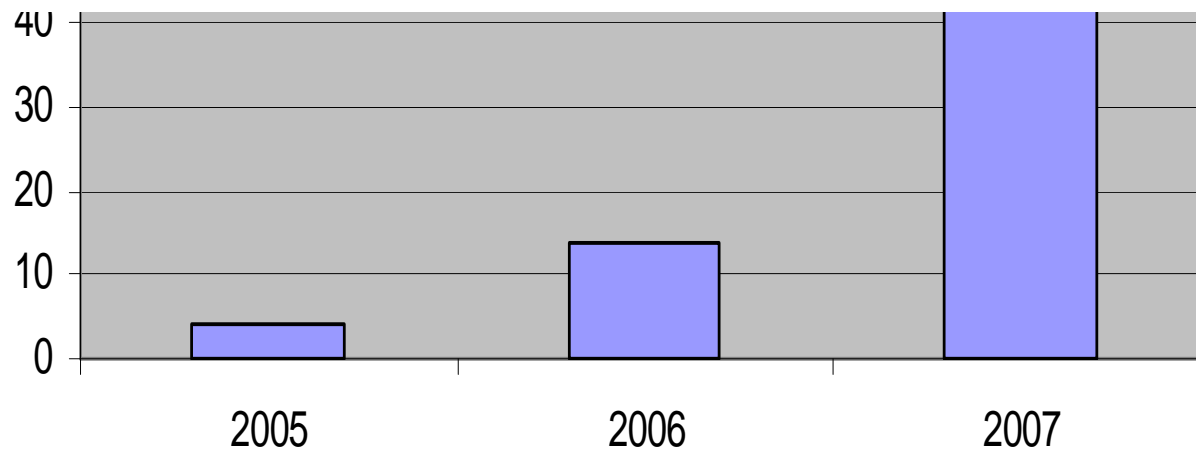
# Isolation of MRSI from companion animals



# Isolation of MRSI from companion animals

90  
Transmission of methicillin-resistant *Staphylococcus intermedius* between humans and animals.

Van Duijkeren et al, Vet Microbiol 2008.

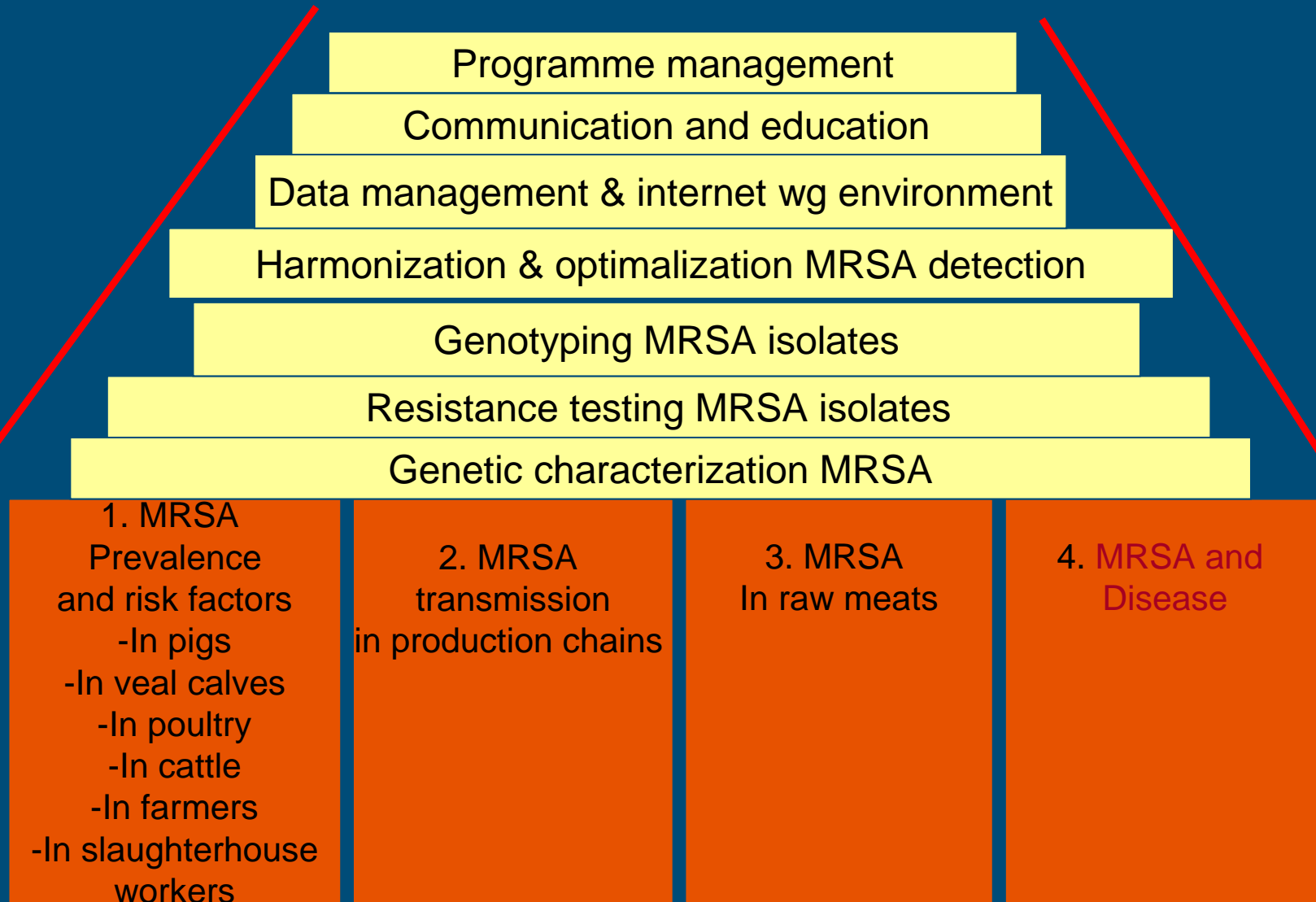


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# Dutch MRSA programme (Min Agriculture)



# Dutch MRSA programme (Min Agriculture)

RIVM

Faculty of Veterinary Medicine

Animal Health Service (GD)

Central Veterinary Institute

Erasmus University

University Medical Center Utrecht

Food Safety Authority (VWA)

VU-Medical Center

Amphia hospital Breda

1. MRSA  
Prevalence  
and risk factors  
-In pigs  
-In veal calves  
-In poultry  
-In cattle  
-In farmers  
-In slaughterhouse  
workers

MRSA and  
disease



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# Wat did we learn?

- To differentiate HA-MRSA, CA-MRSA and NT-MRSA
- Different typing methods available for MRSA
- NT-MRSA is emerging in production animals
- NT-MRSA is clonal
- MRSA may be emerging in companion animals



# Thanks to:

- Engeline van Duijkeren
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- Els Broens
- Enne de Boer

