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
  - MRSI in companion animals
- Final remarks

Staphylococcus aureus

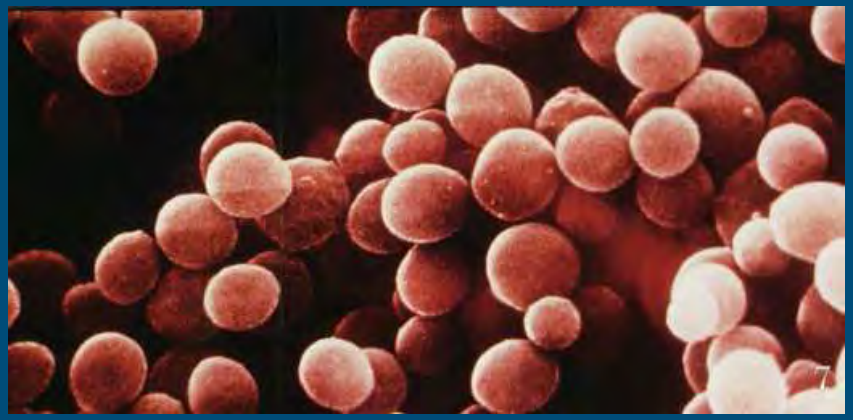
Gram positive coc

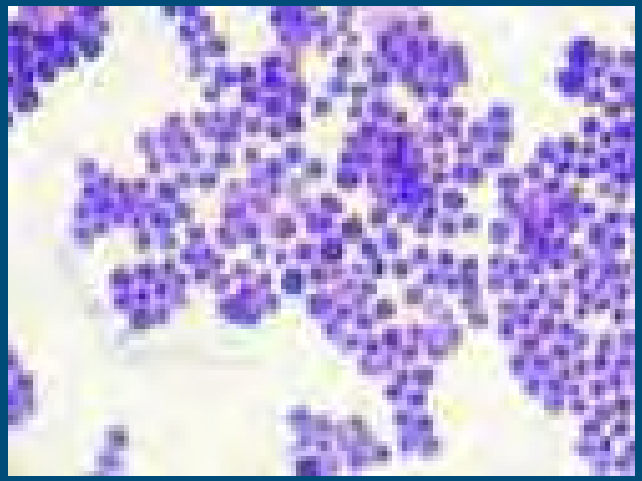
Cause of several veterinary problems:

- bovine mastitis
- problems in equine
- joints problems in chickens
- systemic disease in pigs (rare)
- pyodermia 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 (Staphyloccal Chromosome Cassette - SCC*mec*)
- Penicillin binding protein PBP2a
- Resistant against all beta-lactam antimicrobials - penicillines, cephalosporines

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


TR+SU
GEN40

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.

St. Louis Rams

Fan Poll Rank	FOXSports.com Rank
#30	#18

2006 SALARIES

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

NFL TEAM PAYROLLS

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

TEAM SALARIES

Rams

PLAYER SEARCH

Enter player's name

Go

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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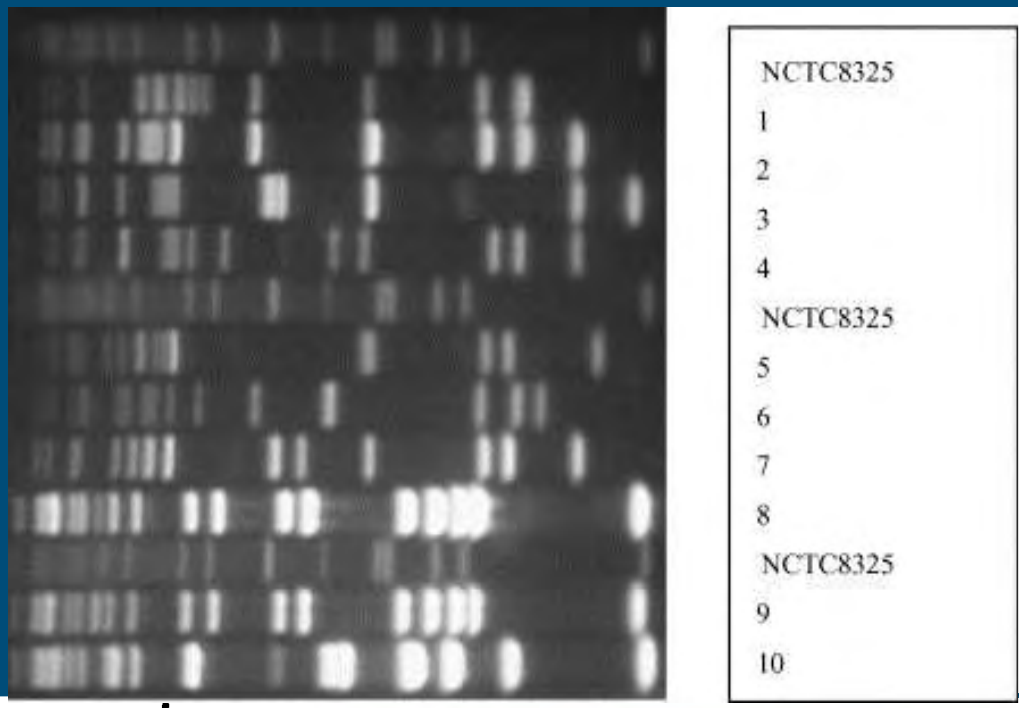
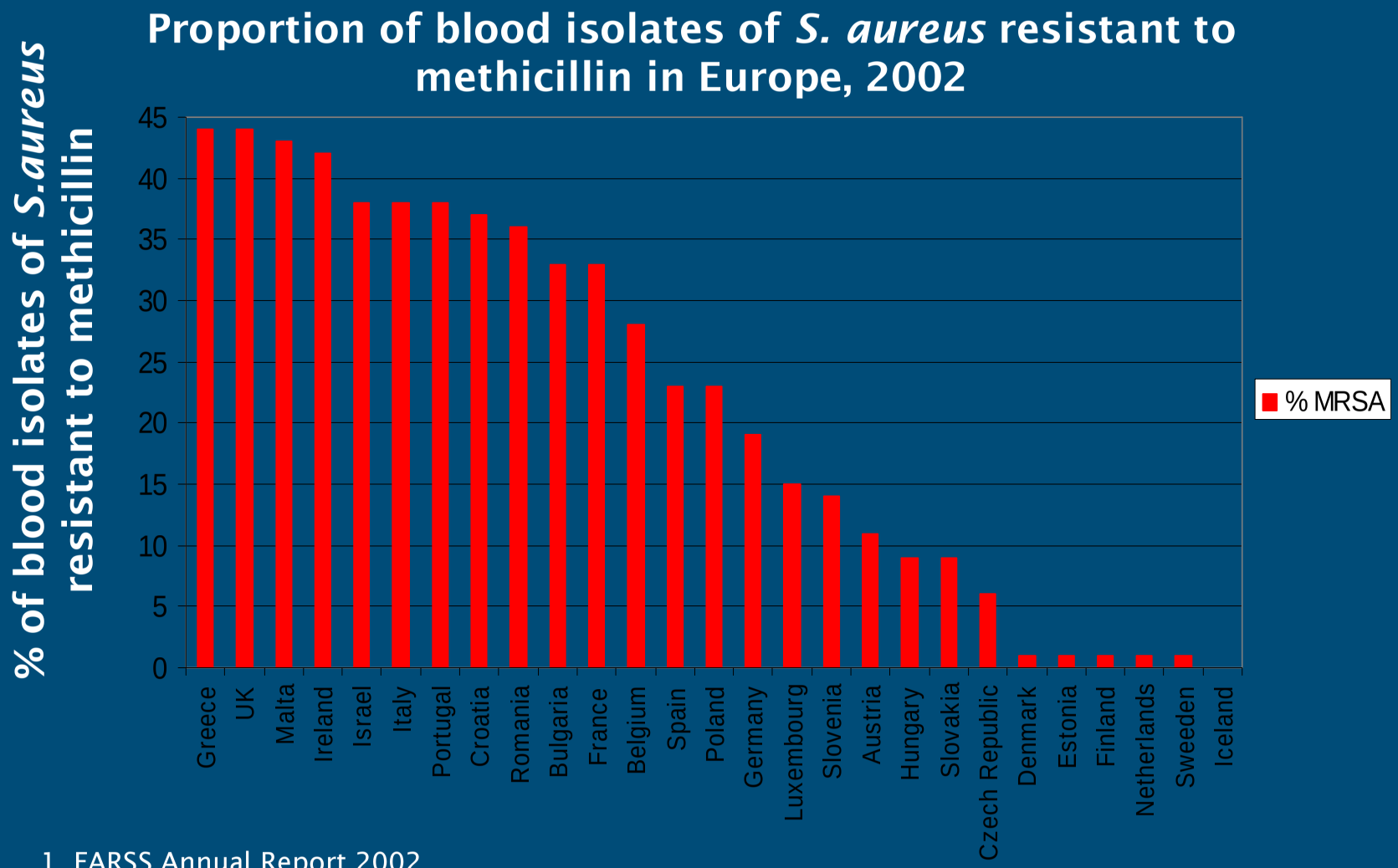


MRSA in hospitals: a problem?

MRSA in Europe



1 EARSS Annual Report 2002

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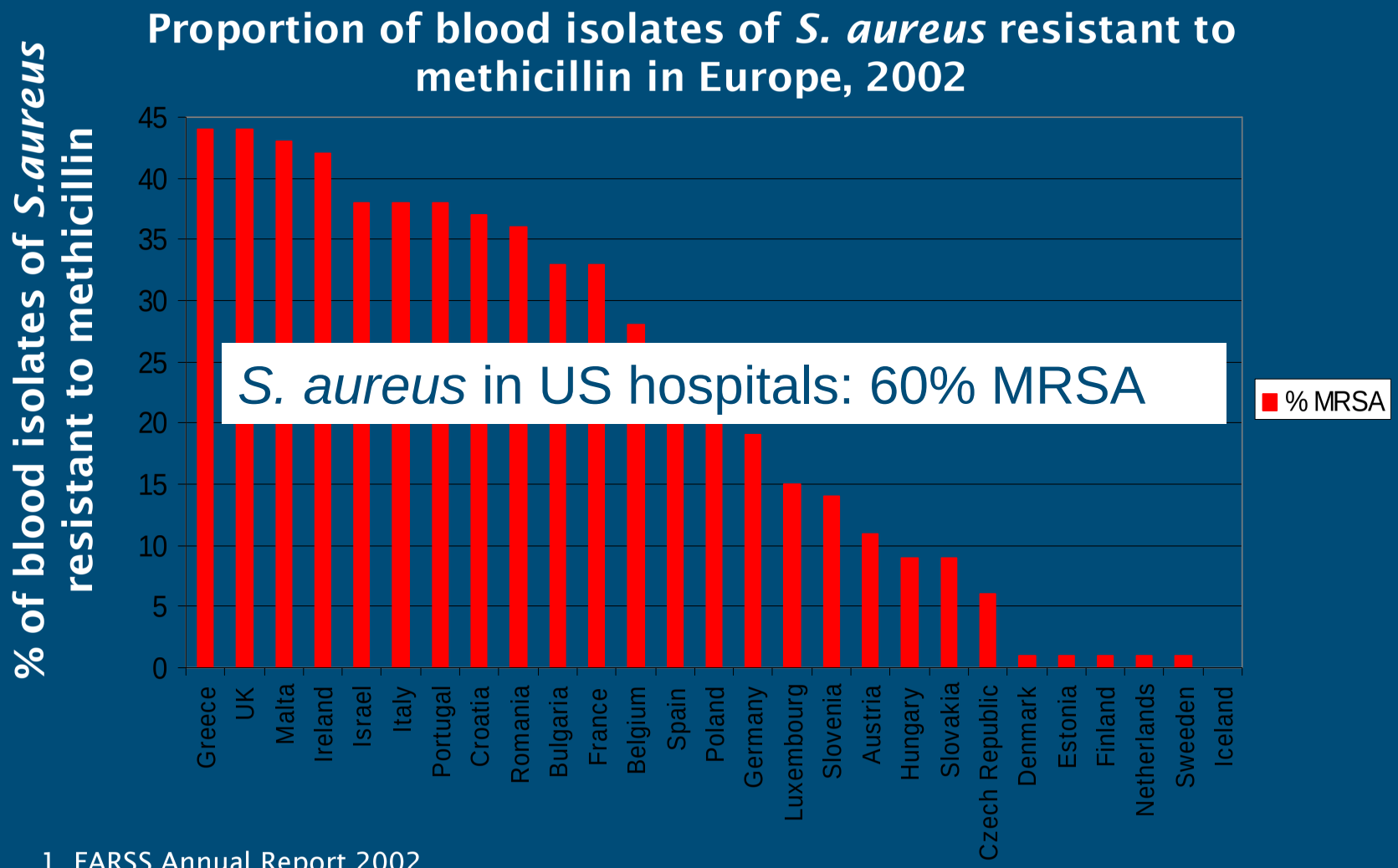
MRSA in Europe



S. aureus in US hospitals: 60% MRSA

1 EARSS Annual Report 2002

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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 pyodermia 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)

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 Micobiol. 2007

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

Clinical disease in pigs?

- One case with exsudative dermatitis

DISPATCHES

Methicillin-Resistant *Staphylococcus aureus* in Pigs with Exudative Epidermitis

Engeline van Duijkeren,* Marc D. Jansen,†
S. Carolien Flemming,* Han de Neeling,‡
Jaap A. Wagenaar,* Anky H.W. Schoormans,*
Arie van Nes,* and Ad C. Fluit†

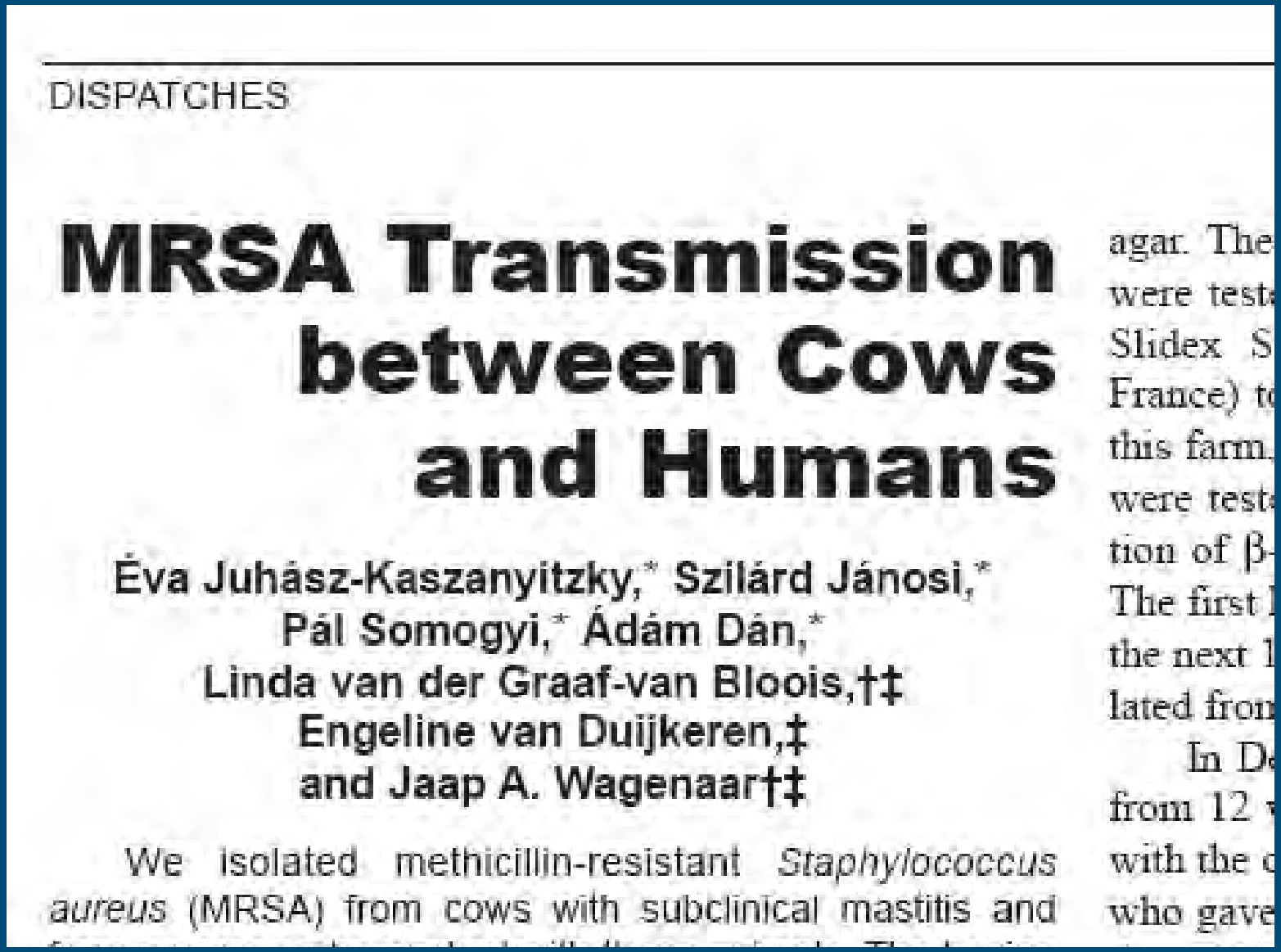
EID 2007

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 Staphylocci 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

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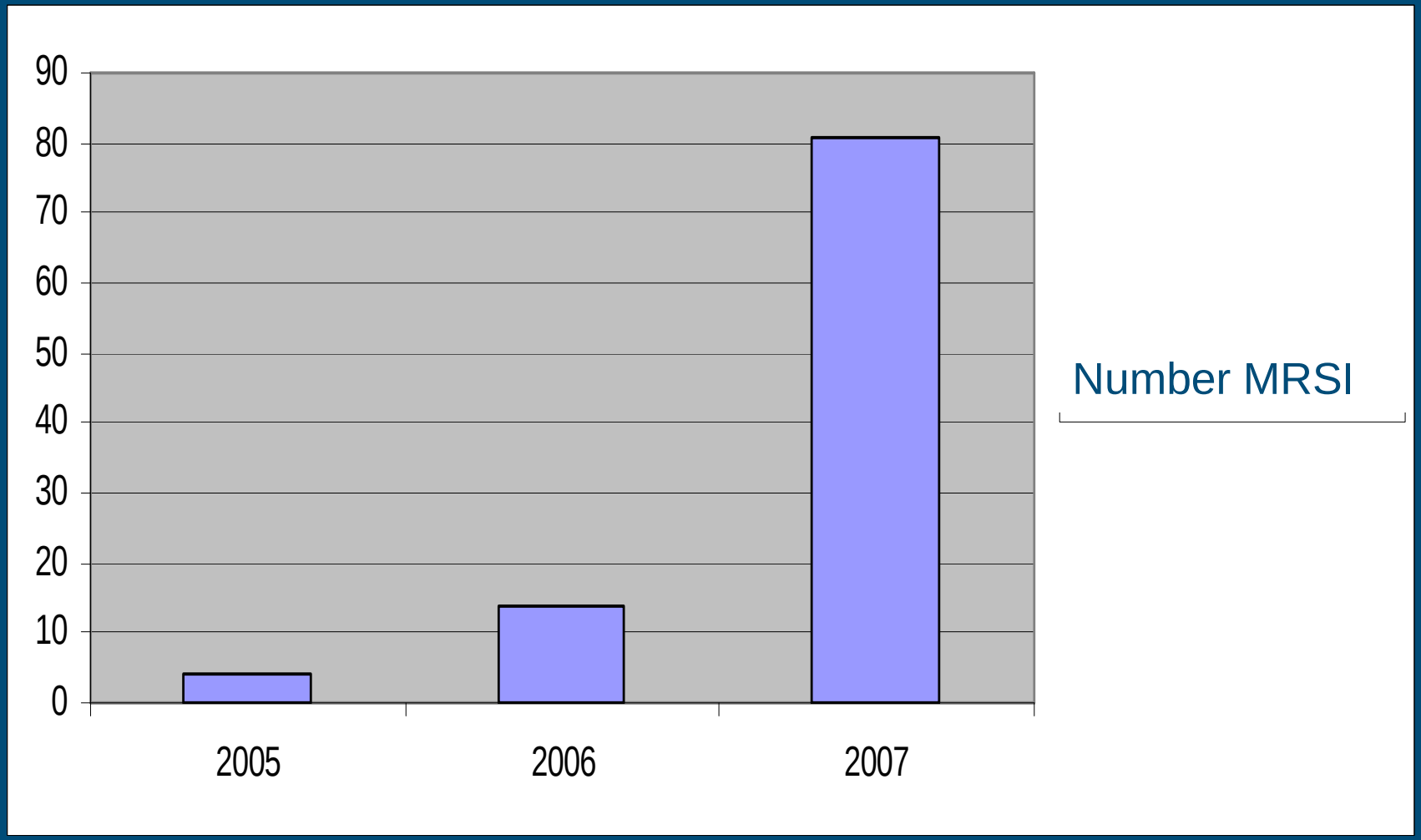
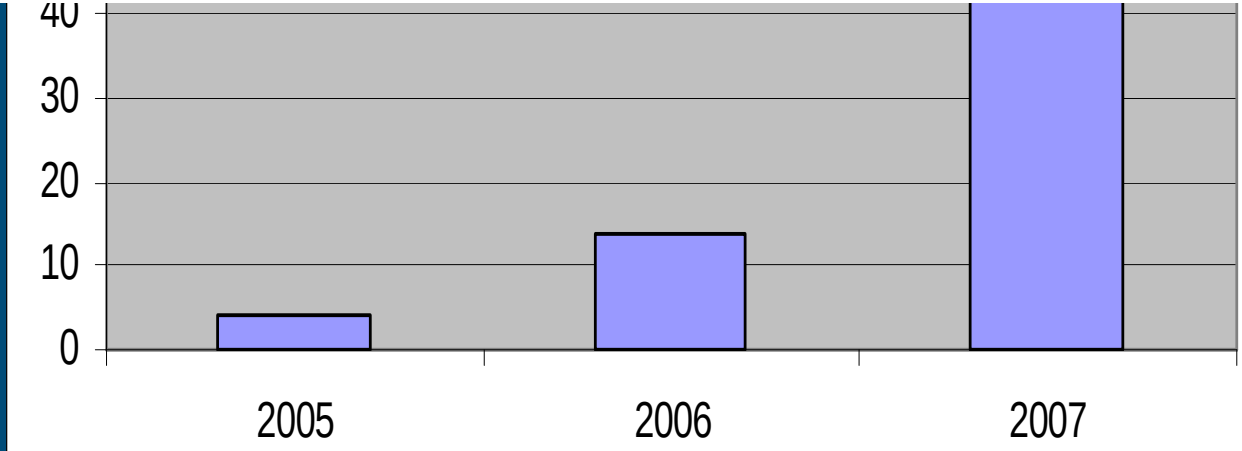
Isolation of MRSI from companion animals



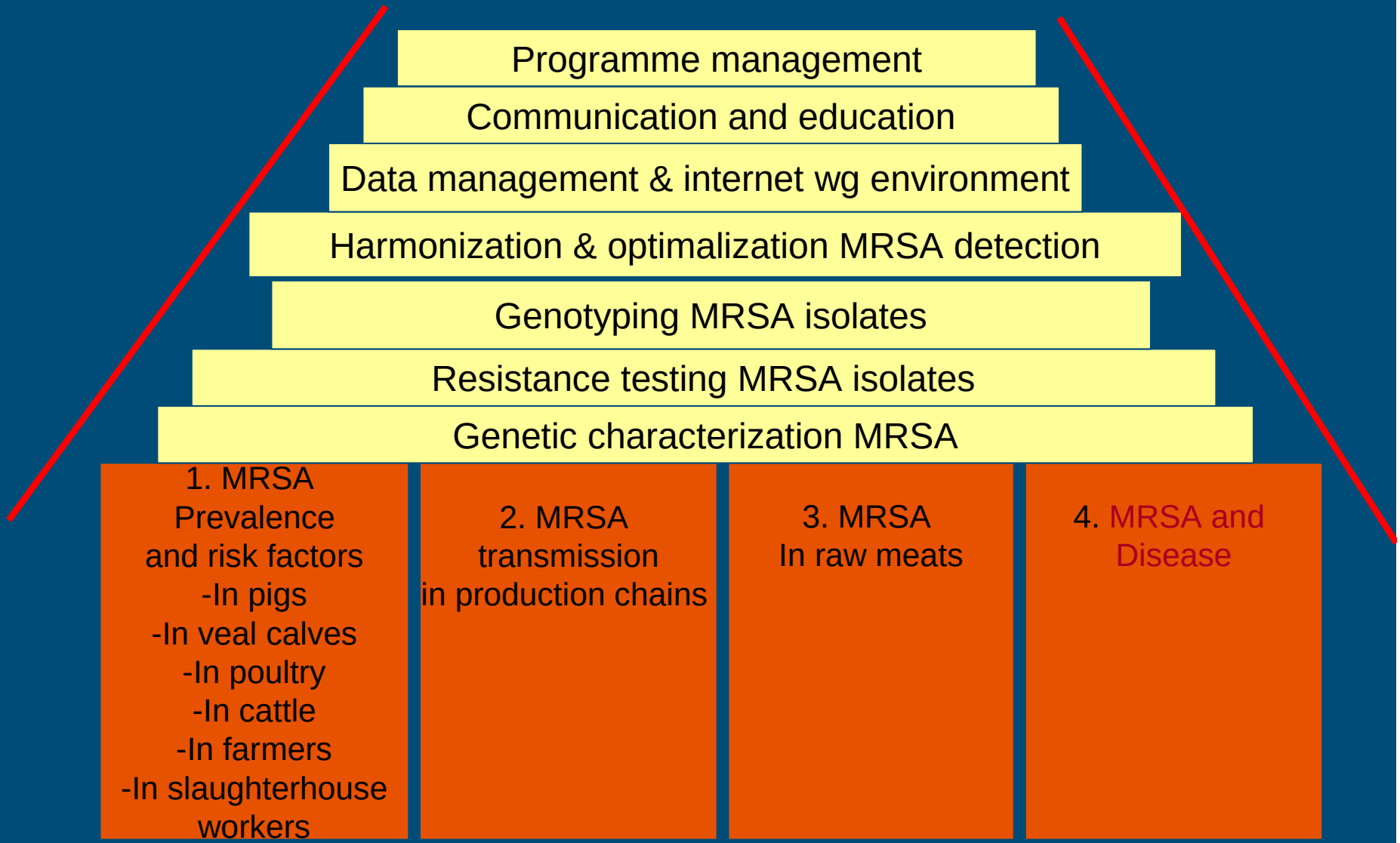
Isolation of MRSI from companion animals

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

Van Duijkeren et al, Vet Microbiol 2008.



Dutch MRSA programme (Min Agriculture)



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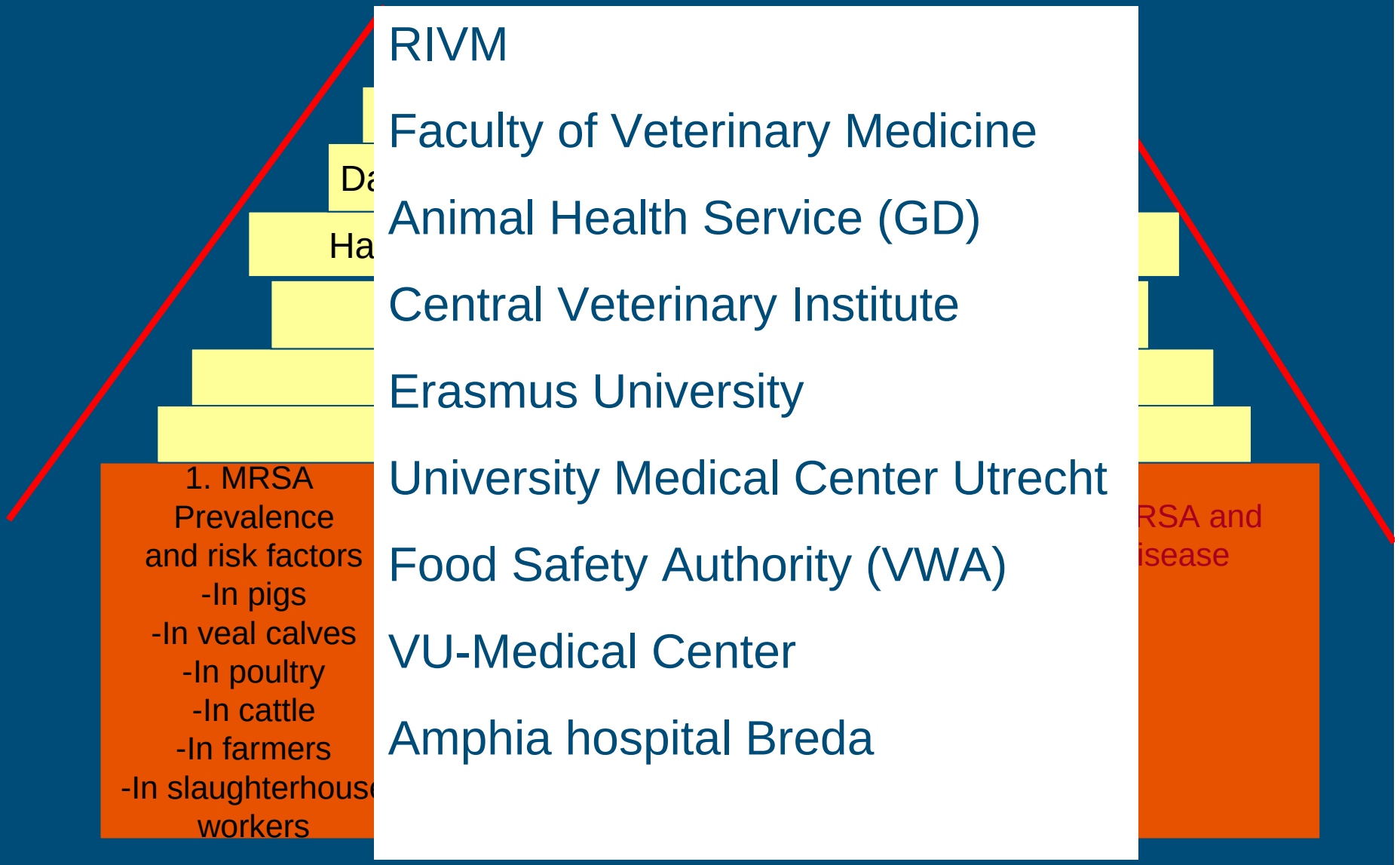

RIVM

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

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
- MRSI may be emerging in companion animals

Thanks to:

- Engeline van Duijkeren
- Dik Mevius
- Haitske Graveland
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- Isabella Oosting
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- Jan Kluytmans
- Mireille Wulf
- Arjen van de Giessen
- Han de Neeling
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