Antimicrobial Resistance and Molecular Epidemiology of *Staphylococcus aureus* in Ghana

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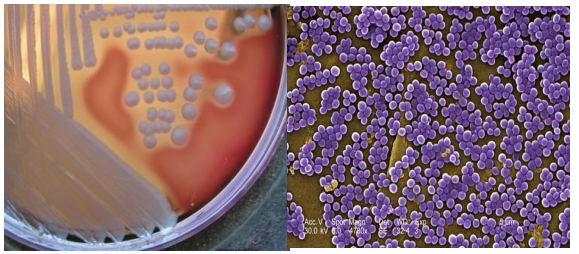
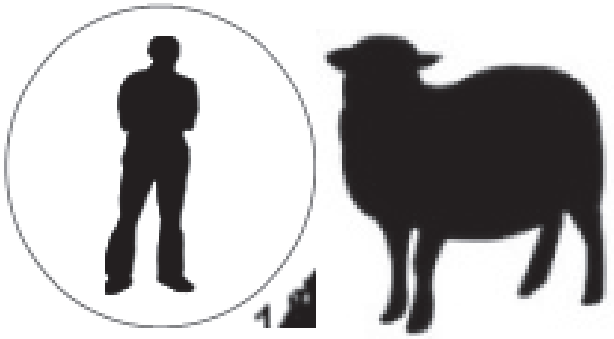
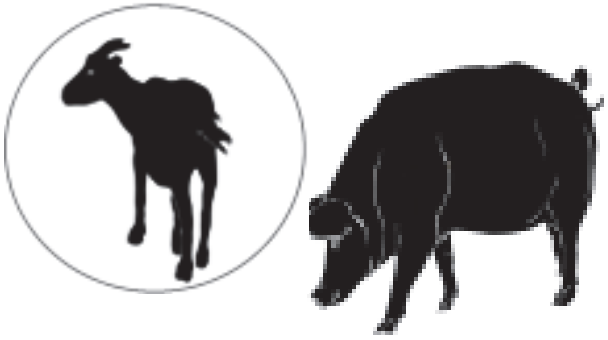
Background

- *S. aureus*- found mainly on skin and nasal cavities of humans/animals
- Nasal carriage of *S aureus* can lead to self-infection
- Persons/animals colonized with *S. aureus* may be sources for transmission to other individuals, animals or the environment
- Colonizing strains are therefore characterized to detect potentially invasive strains







Background

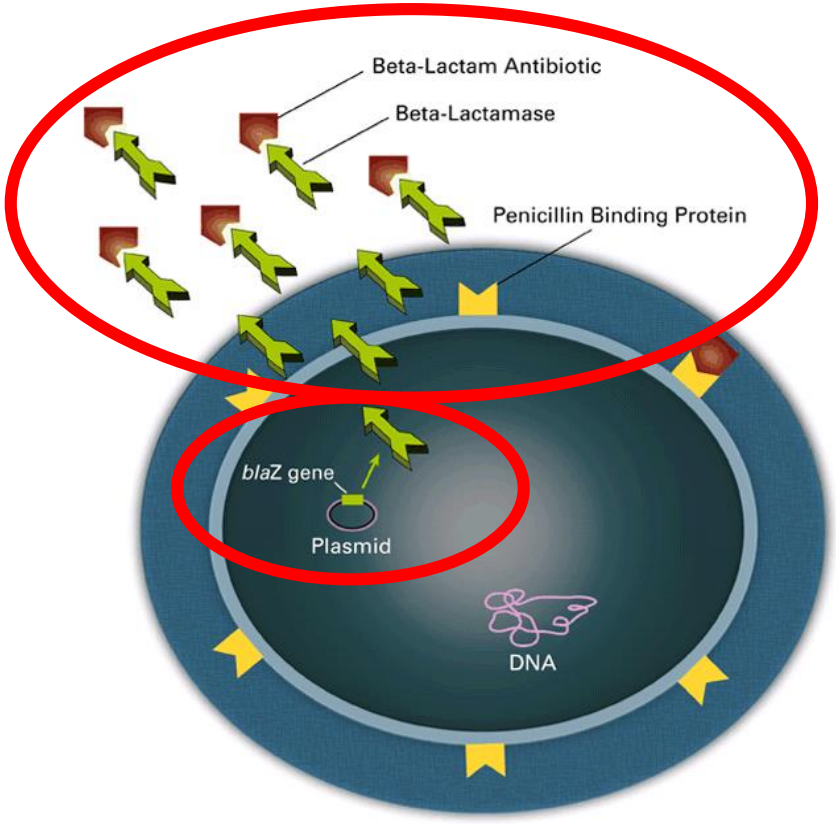
- Can cause wide range of infections in humans and animals:
- **Mild**: skin infection
- **Severe**: bacteremia, endocarditis, etc

Background

•Penicillin was the drug of choice for treatment of *S. aureus* infections until the 1950's

•*S. aureus* acquires *blaZ* gene (beta-lactamase)

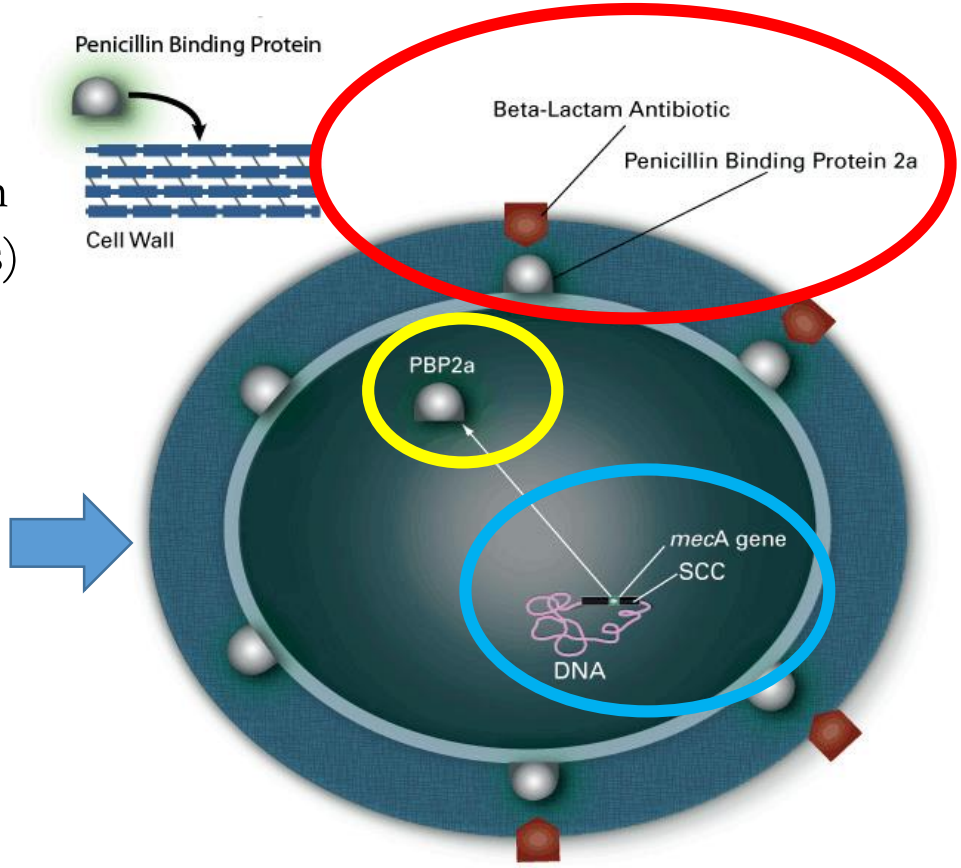
•Methicillin, was then introduced in 1959 for treatment of penicillin resistant *S. aureus* infections



Jevon MP (1961). "Celbenin"-resistant staphylococci BMJ 1:124-125

Background

- *S. aureus* acquired *mec A* (PBP2a)
- PBP2a : low affinity to all beta lactam antibiotics (limited therapeutic options)
- *mecA* located on the Staphylococcal Cassette Chromosome (SCC)
- Resistant to beta-lactams: **penicillin, cephalosporins** and **carbapenems**- which are widely used in humans and animals



Jevon MP (1961). "Celbenin"-resistant staphylococci BMJ 1:124-125

Background

- Methicillin resistant *S aureus* is a global health threat in humans and animals

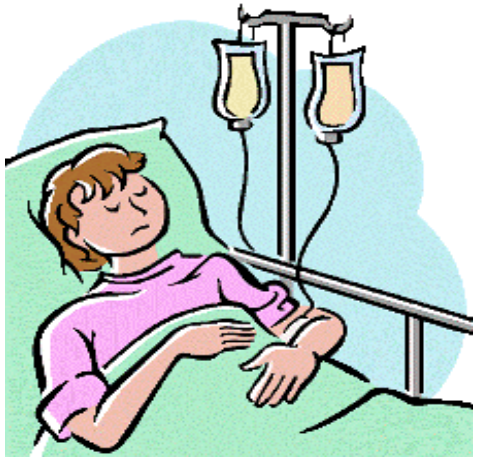
✓Long periods of hospitalization

✓High mortality and morbidity

✓High economic cost to patient

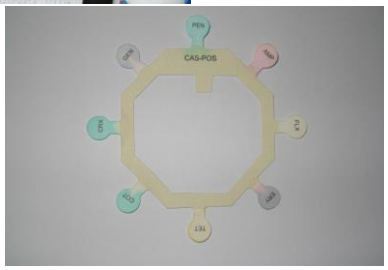
✓Treatment with expensive Vancomycin

- ALERT: emergence of VRSA



Background: Clinical Microbiology In Ghana

- ✓ Information on frequently isolated bacterial species (eg. *S. aureus (MSSA/MRSA)*) is limited
- ✓ Few clinical microbiology laboratories
- ✓ Culture and antimicrobial susceptibility testing (AST) of bacteria are not frequently performed



- Methods used in identification of bacteria are mainly phenotypic (eg. *S. aureus* : Tube/slide coagulase)
- Often, AST in most clinical microbiology laboratories are not standardized

i. Non usage of positive controls or standard inoculum

- Difficult to compare results locally, regionally and internationally

Background

- Odonkor et al. (2007) reported MRSA prevalence of **34%** among clinical isolates (PBP)

- Sampane-Donkor et al. (2012) indicated the occurrence of **15%** MRSA carriage among outpatients at KBTH (using cloxacillin)

General Objective

To generate epidemiological baseline data on *S. aureus* isolated from hospital and community settings in Ghana, using state-of-the-art methods for antimicrobial susceptibility testing and genotyping.

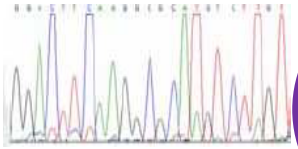
Specific Objectives

- To estimate the nasal carriage prevalence of *S. aureus* and MRSA in hospital and community settings.

- To determine the prevalence of antimicrobial resistance among carriage and clinical *S. aureus* isolates.

- To provide a snapshot of the molecular structure of *S. aureus*

Methods



spa typing (Protein A)

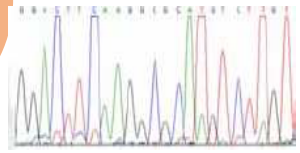
DNA microarray (MRSA)

Disk diffusion and Broth dilution

Antibiotic Susceptibility testing

S. aureus

Multilocus sequence typing



SCC*mec* *typing*

Study 1: Hospital Carriage

Journal of Global Antimicrobial Resistance 1 (2013) 189–193

Contents lists available at SciVerse ScienceDirect

Journal of Global Antimicrobial Resistance

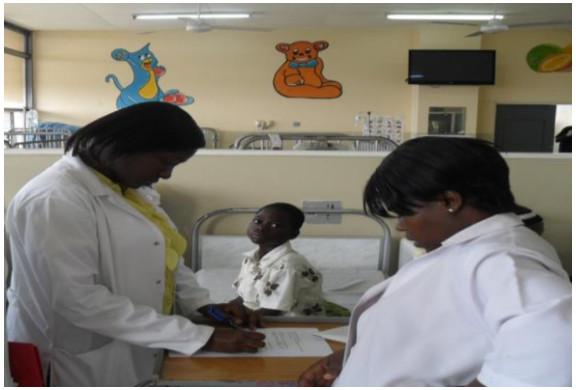
journal homepage: www.elsevier.com/locate/jgar

Prevalence of nasal carriage and diversity of *Staphylococcus aureus* among inpatients and hospital staff at Korle Bu Teaching Hospital, Ghana

Beverly Egyir [a,b,c,*], Luca Guardabassi [b], Søren Saxmose Nielsen [d], Jesper Larsen [a], Kennedy Kwasi Addo [c], Mercy Jemima Newman [e], Anders Rhod Larsen [a]

The aim:

To determine the nasal carriage prevalence, antimicrobial resistance and clonal diversity of *S. aureus* and MRSA among inpatients (IP) and hospital staff (HS) at KBTH.



Findings: Study 1-Hospital Carriage

The results indicated:

- ✓ **higher risk of carriage of MDR *S. aureus* among IP compared with HS.**

- **The finding of MRSA among surgical patients suggests that screening of IP before surgery, could be considered as an infection control measure in the hospital**

Study 2: Clinical Isolates

OPEN ACCESS Freely available online

PLOS ONE

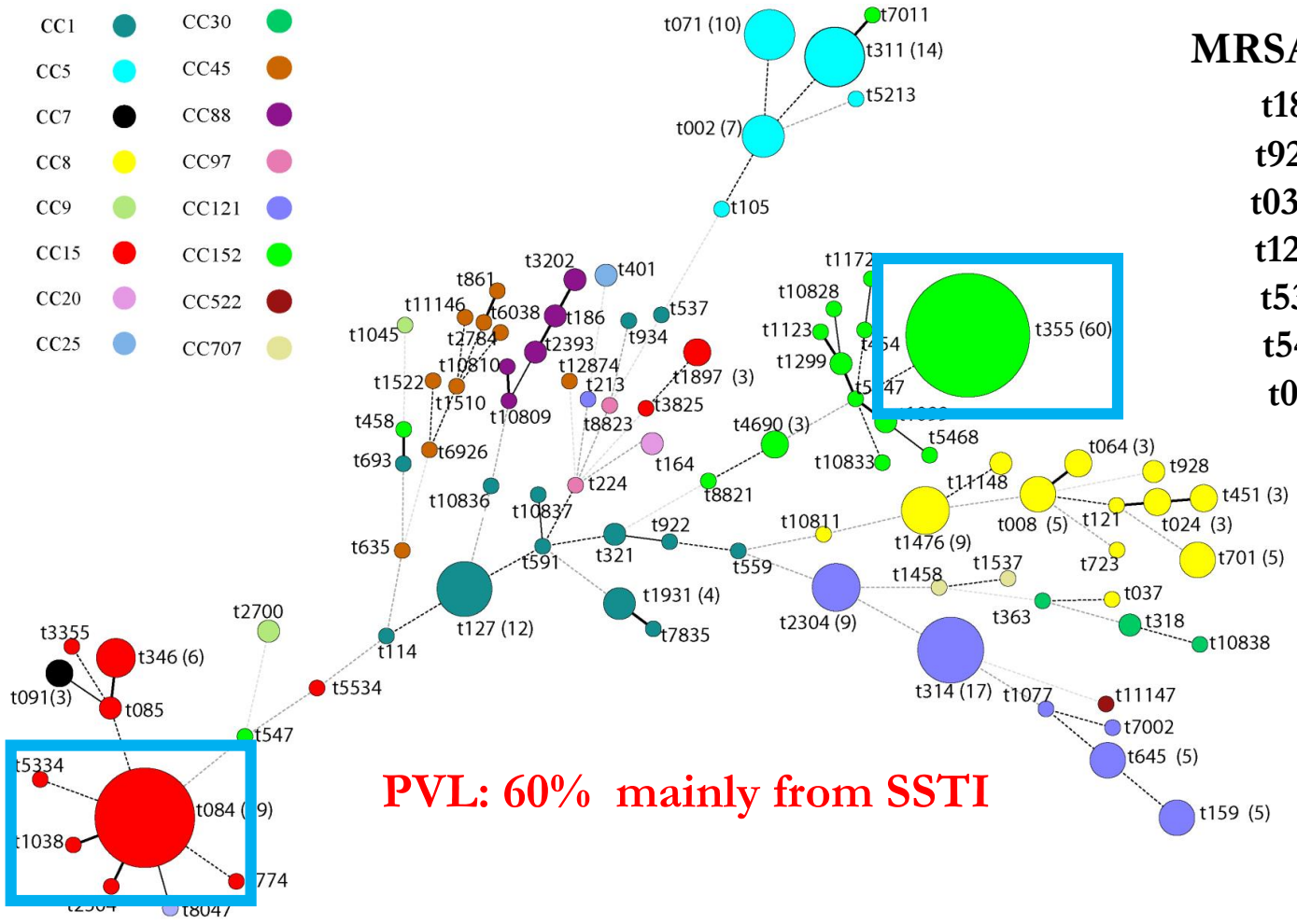
Molecular Epidemiology and Antimicrobial Susceptibility of Clinical *Staphylococcus aureus* from Healthcare Institutions in Ghana

Beverly Egyir[1,2,3]*, Luca Guardabassi[2], Marit Sørum[1], Søren Saxmose Nielsen[5], Augusta Kolekang[6], Enoch Frimpong[6], Kennedy Kwasi Addo[3], Mercy Jemima Newman[4], Anders Rhod Larsen[1]

The aim:

To determine the antimicrobial susceptibility patterns and clonal diversity of *S. aureus* isolates from clinical samples

Findings: Study 2- Clinical Isolates



MRSA clones detected :

t186- ST88-IV (n=2)
t928- ST250-I (n=2)
t037- ST239-III (n=1)
t121- ST8-IV (n=1)
t537 - ST72-V (n=1)
t547- ST789-IV (n=1)
t024-ST2021-V (n=1)

PVL: 60% mainly from SSTI

Minimum spanning tree of 308 clinical *S. aureus* isolates

Study 3: Community Carriage

OPEN ACCESS Freely available online

PLOS ONE

Insights into Nasal Carriage of *Staphylococcus aureus* in an Urban and a Rural Community in Ghana

Beverly Egyir[1,2,3]*, Luca Guardabassi[2], Joseph Esson[4], Søren Saxmose Nielsen[5], Mercy Jemima Newman[4], Kennedy Kwasi Addo[3], Anders Rhod Larsen[1]

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The aims of the study were:

i) to assess the nasal carriage prevalence of *S. aureus* in urban and a rural residents

i) to identify phenotypic and genotypic traits of strains isolated from the two communities.

Study 4: MRSAs

Journal of Global Antimicrobial Resistance 3 (2015) 26–30

Contents lists available at ScienceDirect

Journal of Global Antimicrobial Resistance

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Short Communication

Methicillin-resistant *Staphylococcus aureus* strains from Ghana include USA300

Beverly Egyir [a,b,c,*], Luca Guardabassi [b], Stefan Monecke [d,e], Kennedy Kwasi Addo [c], Mercy Jemima Newman [f], Anders Rhod Larsen [a]

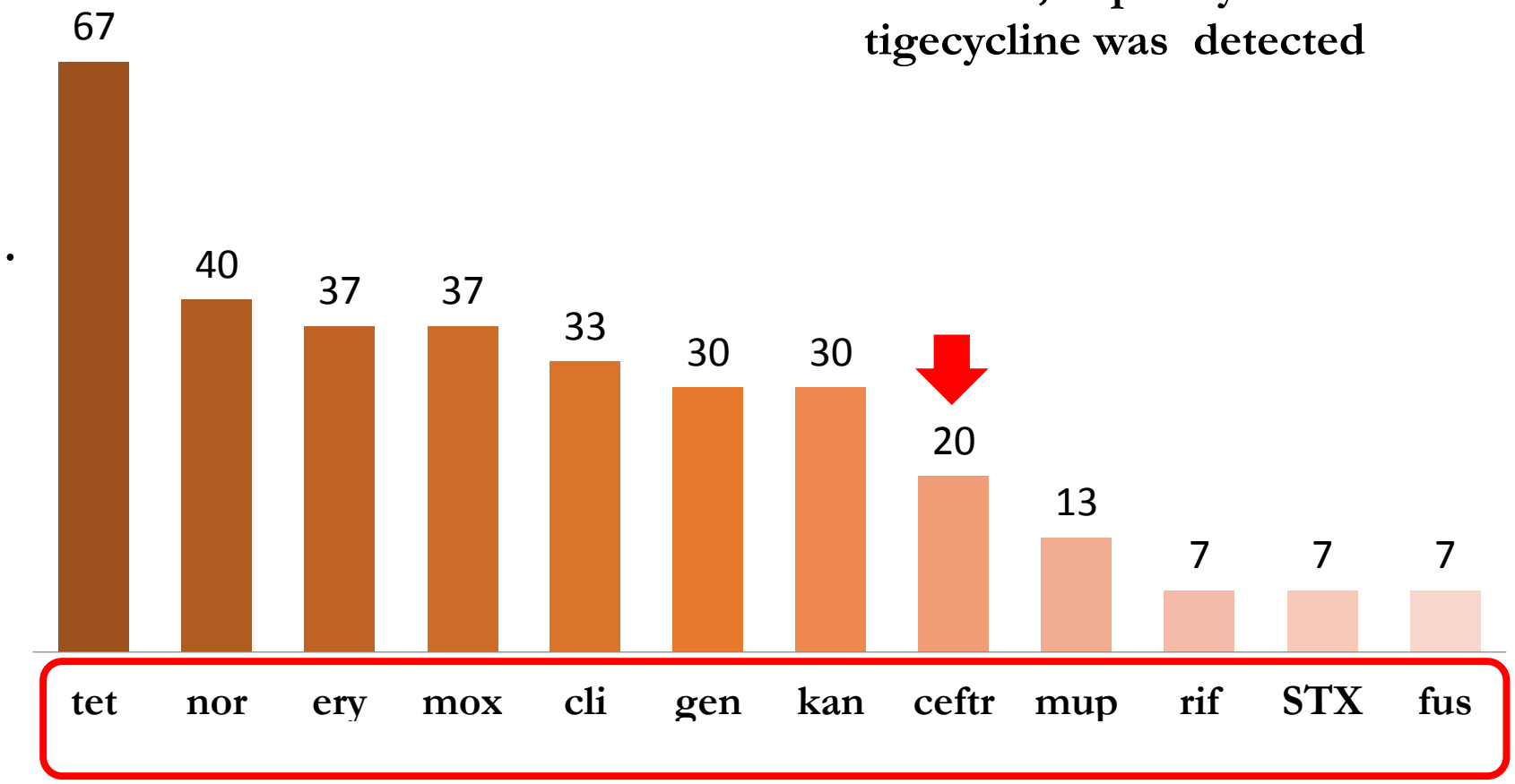
Objective:

To provide baseline information on the antimicrobial resistant and virulence gene content of MRSA isolates

- The study reports for the first time the occurrence of USA300 (17%) MRSA clone in Ghana

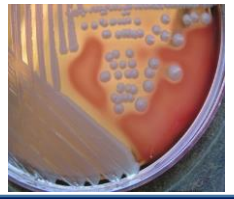
Findings: MRSAs

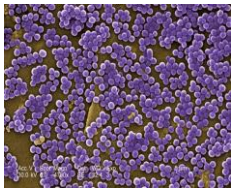
No resistance to glycopeptides linezolid, daptomycin and tigecycline was detected



Summary

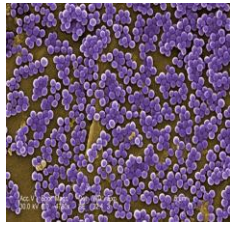
- A total of 550 *S. aureus* were isolated from 2,135 samples
- Carriage prevalence of *S. aureus* was lower among **IP** inpatients compared to **HS** staff
- **IP**(surgical patients) were frequent carriers of MDR *S. aureus* compared to **HS**
- Fewer MRSA carriers were found in the community than in the hospital
- Isolates were commonly resistant to penicillin and tetracycline





Summary

- Isolates were genetically diverse: *spa* types t355 (ST152) and t084 (ST15) as prevalent *S. aureus* lineages
- Prevalence of PVL was remarkably high among the isolates
- Overall, MRSA prevalence in this study was lower (6%) compared to previous (15-36%) studies in Ghana that used only phenotypic detection methods
- MRSA isolates detected were multidrug resistant and belonged to known global epidemic clones



Acknowledgements

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- Dr. Anders Rhod Larsen
- Prof. Kennedy Kwasi Addo
- Prof. Mercy Jemima Newman

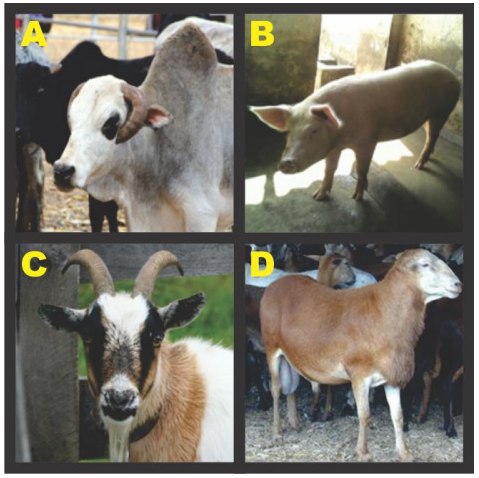
University of Copenhagen, Faculty of Health and Medical Denmark

Staten's Serum Institut, Denmark

UG/NMIMR

Ongoing Study

Livestock associated MRSA

- 

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