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

Beverly Egyir, PhD
Noguchi Memorial Institute for Medical Research
Bacteriology Department, University of Ghana
**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

• *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

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
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 \textit{S. aureus} and MRSA in hospital and community settings.

• To determine the prevalence of antimicrobial resistance among carriage and clinical \textit{S. aureus} isolates.

• To provide a snapshot of the molecular structure of \textit{S. aureus}
Methods

Methods

- Multilocus sequence typing
- Antibiotic Susceptibility testing
- SCCmec typing
- DNA microarray (MRSA)

S. aureus

Disk diffusion and Broth dilution
The aim:

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

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

Beverly Egyir¹,²,³*, Luca Guardabassi², Joseph Esson⁴, Søren Saxmose Nielsen⁵, Mercy Jemima Newman⁴, Kennedy Kwasi Addo³, Anders Rhod Larsen¹

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

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.
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

• Prof. Luca Guardabassi
• Dr. Anders Rhod Larsen
• Prof. Kennedy Kwasi Addo
• Prof. Mercy Jemima Newman

• DANIDA-ADMER project

University of Copenhagen,
Faculty of Health and Medical
Denmark

Staten's Serum Institut,
Denmark

UG/NMIMR
Livestock associated MRSA

Funders:

CAMBRIDGE AFRICA

The ALBORADA Trust
Thank You