

# CIRAR

Molecular Epidemiology of  
Community- Acquired vs. Hospital-  
Acquired Methicillin Resistant  
*Staphylococcus aureus* (MRSA) in a  
Level III Neonatal Intensive Care Unit  
(NICU)

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# Why is MRSA important?

- Neonates are particularly susceptible to severe disease caused by MRSA.
- Outbreaks of MRSA can be prolonged and difficult to control.
- Routine infection control measures may not control transmission.
- Additional cost associated with a MRSA infection versus no infection or infection with methicillin susceptible *S. aureus* (MSSA) = \$9,275 and \$27,000.

# MRSA Infection Control Strategies in NICU

1. Screen all transfers for MRSA (anterior nares, axilla, umbilical stump, groin)
2. If clinical case occurs, targeted surveillance of adjacent infants
3. Patients with MRSA infection remain on contact precautions for the duration of hospitalization.
4. To attempt eradication of MRSA in colonized infants, mupirocin is applied to the nares.
5. Infants  $\geq$  1500 grams are bathed with hexachlorophene.

# Community-acquired MRSA

- MRSA infection in patients lacking traditional risk factors.
- Unique when compared with hospital-acquired strains.
  - Phenotype
    - Antimicrobial susceptibilities
    - Predominance of skin and soft tissue infections
  - Genotype – *mec A*
  - Virulence factors

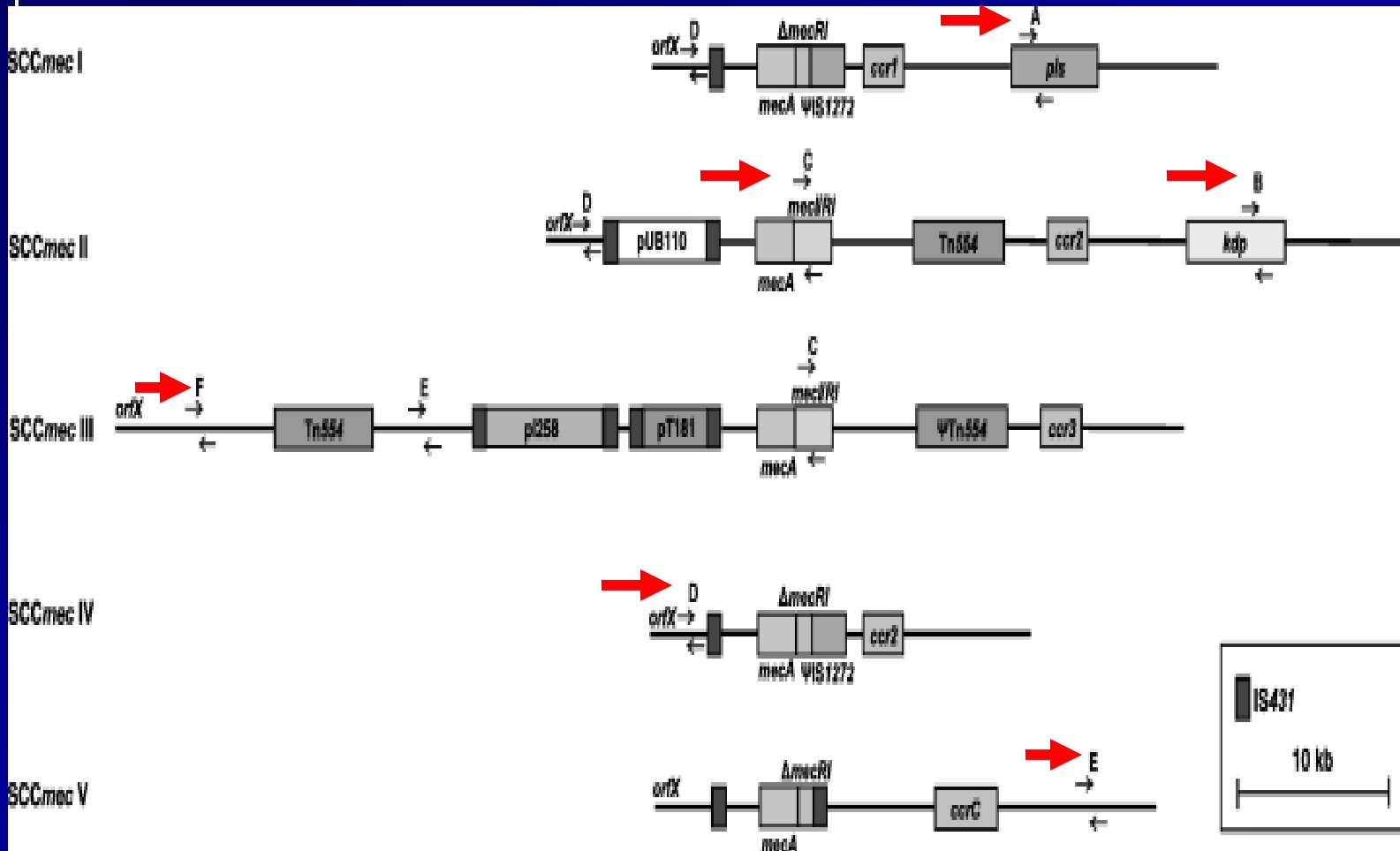
# Resistance Mechanism: *Mec A*

- Resistance to methicillin and other  $\beta$ -lactam antibiotics is encoded by *mec A*, which is situated on a mobile genetic element, the Staphylococcal Cassette Chromosome *mec* (SCC *mec*).
- *Mec A* encodes for penicillin binding protein (PBP) 2a, to which  $\beta$ -lactam antibiotics cannot bind.

# *Mec A* typing

- Hospital- vs. community-acquired MRSA associated with different *mec A* types:
  - HA-MRSA (I-III)
  - CA-MRSA (type IV-V).

# Mec A typing



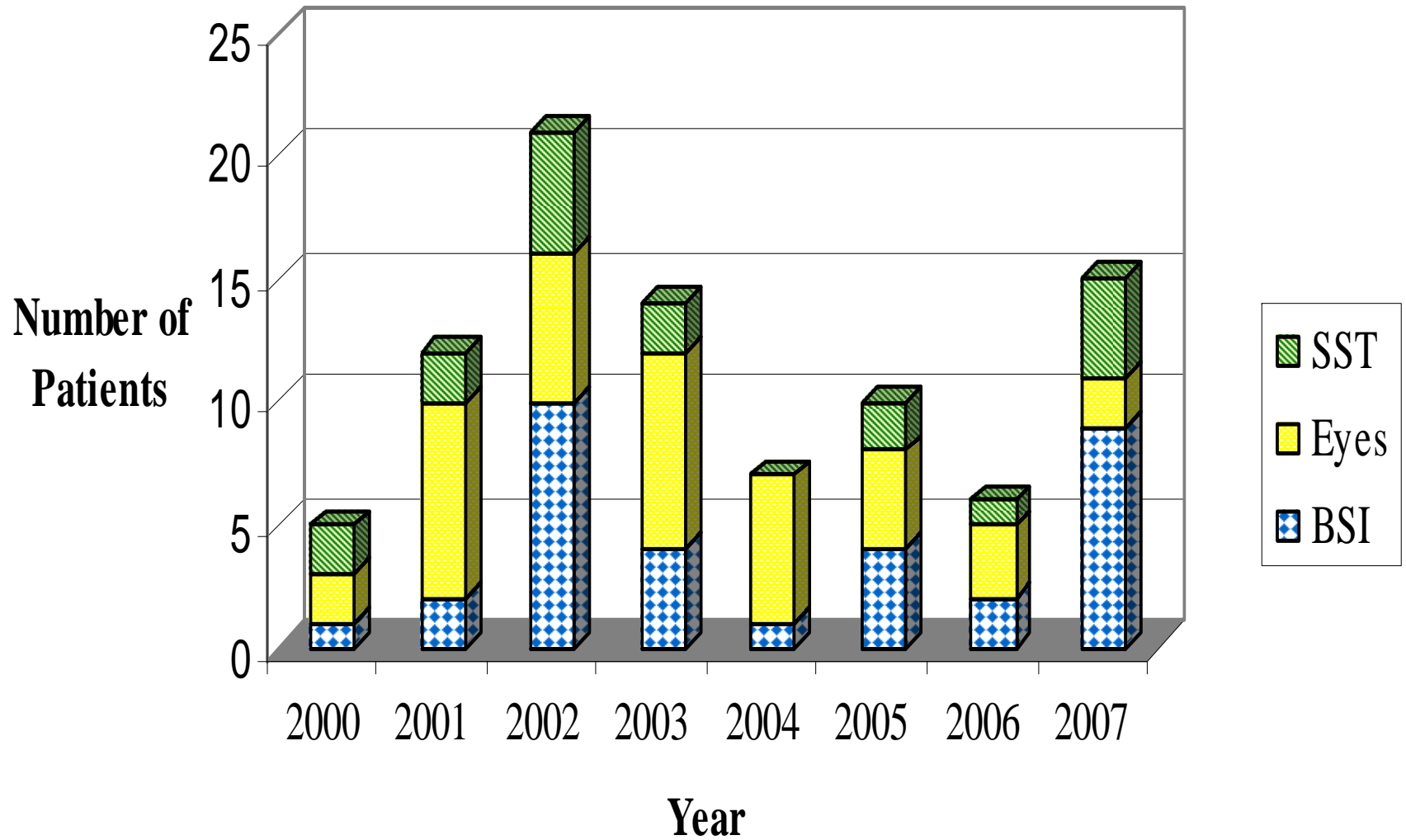
# Panton-Valentine Leukocidin

- CA-MRSA carry the genes for Panton-Valentine leukocidin (PVL) at a higher frequency.
- PVL is a *S. aureus*-specific exotoxin often associated with severe skin infections and necrotizing pneumonia.

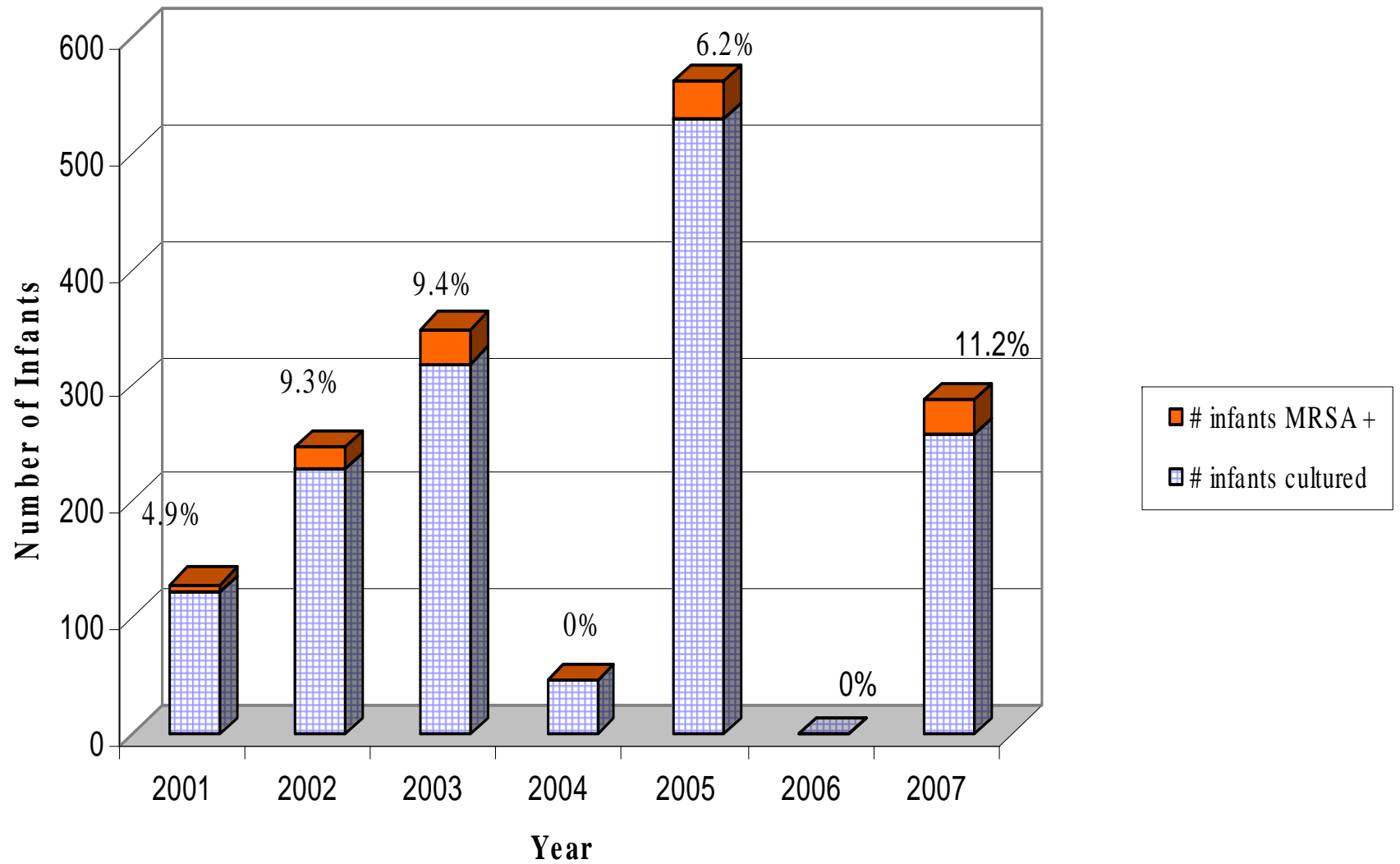
# Methods: Molecular typing

1. MRSA isolates were genotyped by pulsed field gel electrophoresis (PFGE) using *Sma*I.
2. SCC *mecA* typing using the PCR methods of Oliveira and determination of the presence of PVL performed by Clinical Microbiology Laboratory.

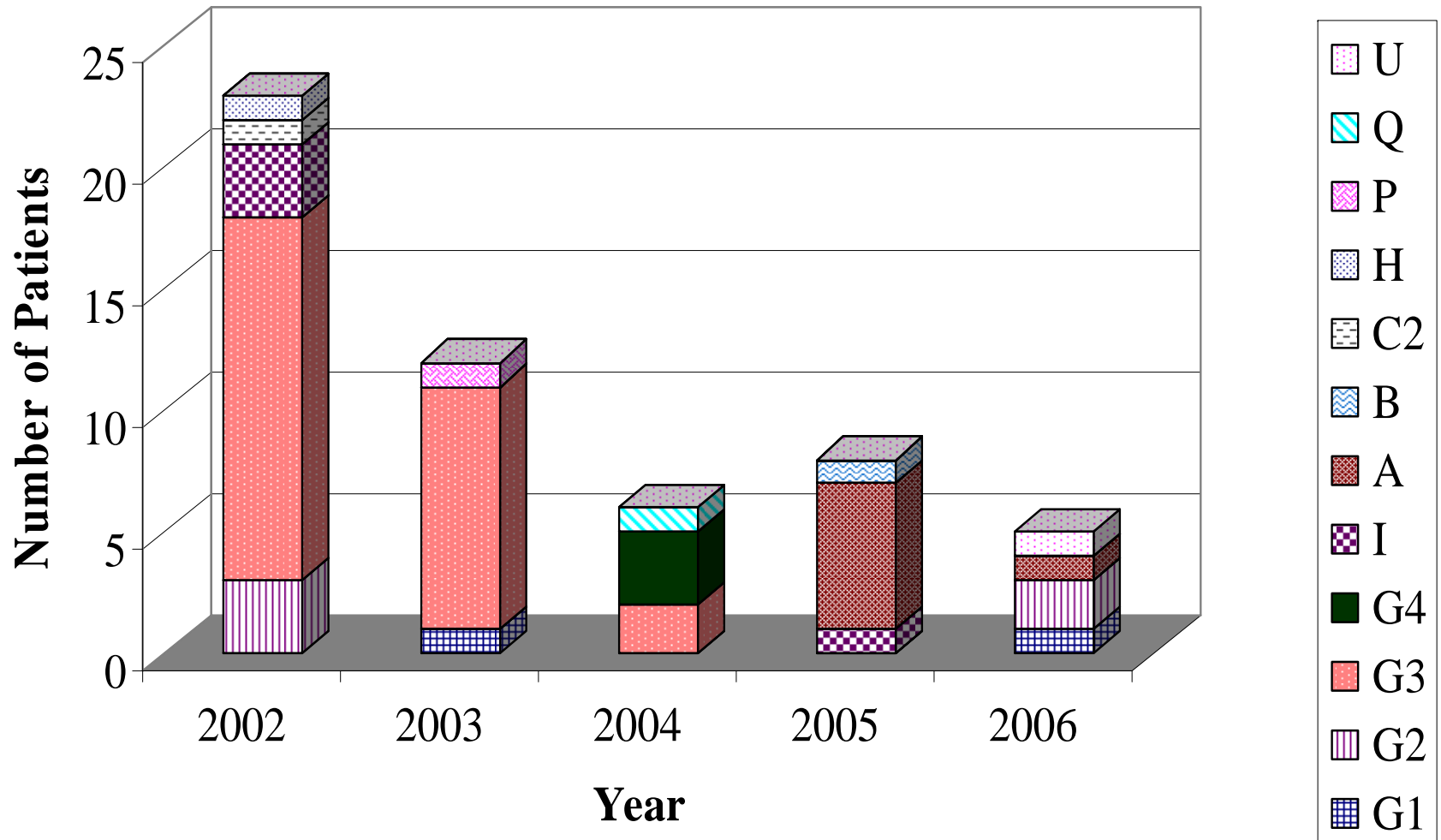
**Figure 1: All MRSA Infections 2000-2007**



**Figure 2: MRSA positive Surveillance Cultures**



**Figure 3: PFGE Clones for MRSA Positive Clinical Cultures for 2002-2006**





# Table 1: Characteristics of patients with unique clones

| <u>Clone</u> | <u>Year</u> | <u>Transfer</u> | <u>DOL</u> | <u>Pertinent history</u>                                     |
|--------------|-------------|-----------------|------------|--|
| C2           | 2002        | <b>DOL 1</b>    | 3          | Cardiac surgery  |
| H            | 2002        | No              | 35         | Infant <b>HIV</b> infected<br>Mother IV drug use             |
| P            | 2003        | <b>DOL 1</b>    | 2          | Cardiac surgery  |
| Q            | 2004        | <b>DOL 0</b>    | 12         | Mother hospitalized 3 weeks pre-partum                       |
| B            | 2005        | No              | 28         | <b>Small bowel resection</b>                                 |
| U2           | 2005        | No              | 7          | <i>Cardiac surgery after 1<sup>st</sup> positive culture</i> |
| C            | 2005        | <b>DOL 0</b>    | 4          | Repair of congenital diaphragmatic hernia                    |
| D            | 2005        | <b>DOL 6</b>    | 6          | Cardiac surgery  |

# Mec A typing and Presence of PVL in NICU

| PFGE pattern | SCC <i>mec</i> type | PVL      |
|--------------|---------------------|----------|
| <b>G3</b>    | <b>II</b>           | -        |
| G2           | II                  | -        |
| G4           | IV                  | +        |
| <b>A</b>     | <b>IV</b>           | <b>+</b> |
| I            | IV                  | +        |
| Q            | IV                  | -        |
| U            | IV                  | +        |

# Antibiotic Susceptibility

| Mec Type | Clinda | Gent | Rifampin | LVX | Erythro | Tetra |
|----------|--------|------|----------|-----|---------|-------|
| II       | S      | S    | S        | S   | I       | S     |
| II       | S      | S    | S        | R   | R       | S     |
| IV       | S      | S    | S        | S   | R       | S     |
| IV       | R      | S    | S        | S   | R       | S     |
| IV       | S      | S    | S        | R   | R       | S     |
| IV       | S      | S    | S        | R   | R       | S     |

# Results

- From 2001-2007, 1503 patients had surveillance cultures performed, of which 119 (7.9 %) were positive for MRSA.
- ***Take home point:*** Of these 119 infants, 40 (34%) were diagnosed with an infection.

# Results

Over time, the predominant clone changed.

- From 2001-2003, the predominant Clone G3 caused infections in 22 patients and colonization in 35 patients.
- In 2005, a new predominant Clone A emerged and caused infections in 6 patients and colonization in 24 patients.
- In 2006, there were infections in 6 patients with a heterogeneous clonality, and persistence of the G and A clones.

# Summary and Conclusions

- Molecular typing, including *mec A* typing, has increased our understanding of the changing epidemiology of MRSA in our NICU as CA-MRSA strains have replaced HA-MRSA.
- There is a continual influx of different clones of MRSA as shown by the PFGE typing, from outside hospitals and potentially from vertical transmission from the mothers.

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