

# Methicillin-Resistant *Staphylococcus aureus* Recovered from Wounds in Iraq



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# Bacteria at Time of Injury

## Etiology

Gram-positive		Gram-negative	
CNS	32	<i>Pseudomonas stutzeri</i>	1
<i>S. aureus</i>	4 *	<i>C. meningosepticum</i>	1
<i>Micrococcus sp.</i>	1	<i>E. coli</i>	1

\*2 cases were MRSA

Murray 2006



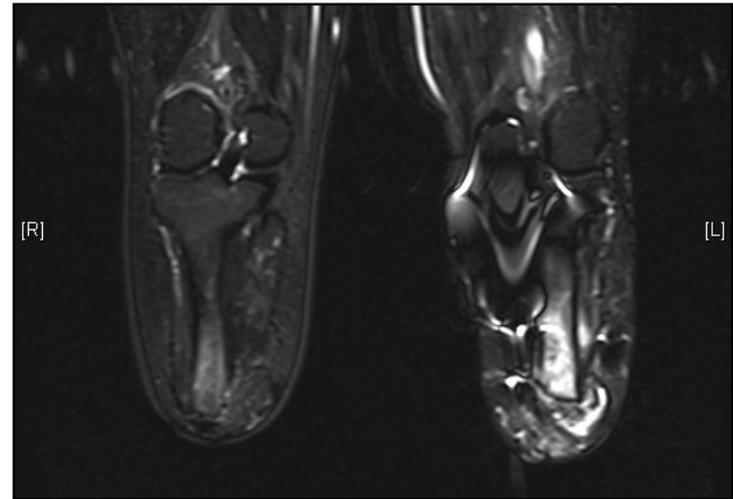
# *Staphylococcus aureus* Orthopedic Injuries

- Original versus recurrent/relapse
  - *S. aureus*- 15% vs 50%
  - MSSA- 6% vs 22%
  - MRSA- 10% vs 28%



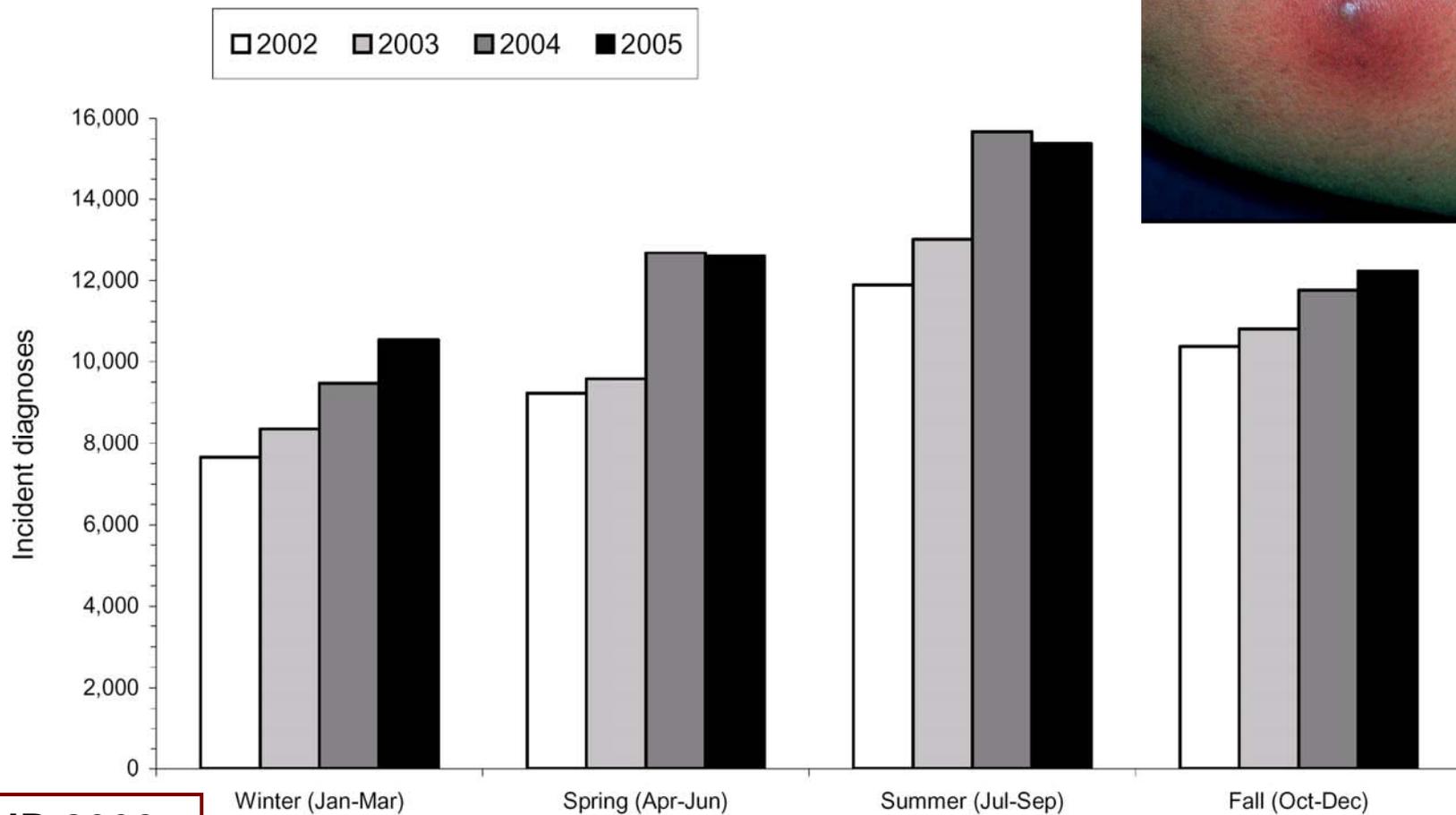
Yun 2008

April 2006



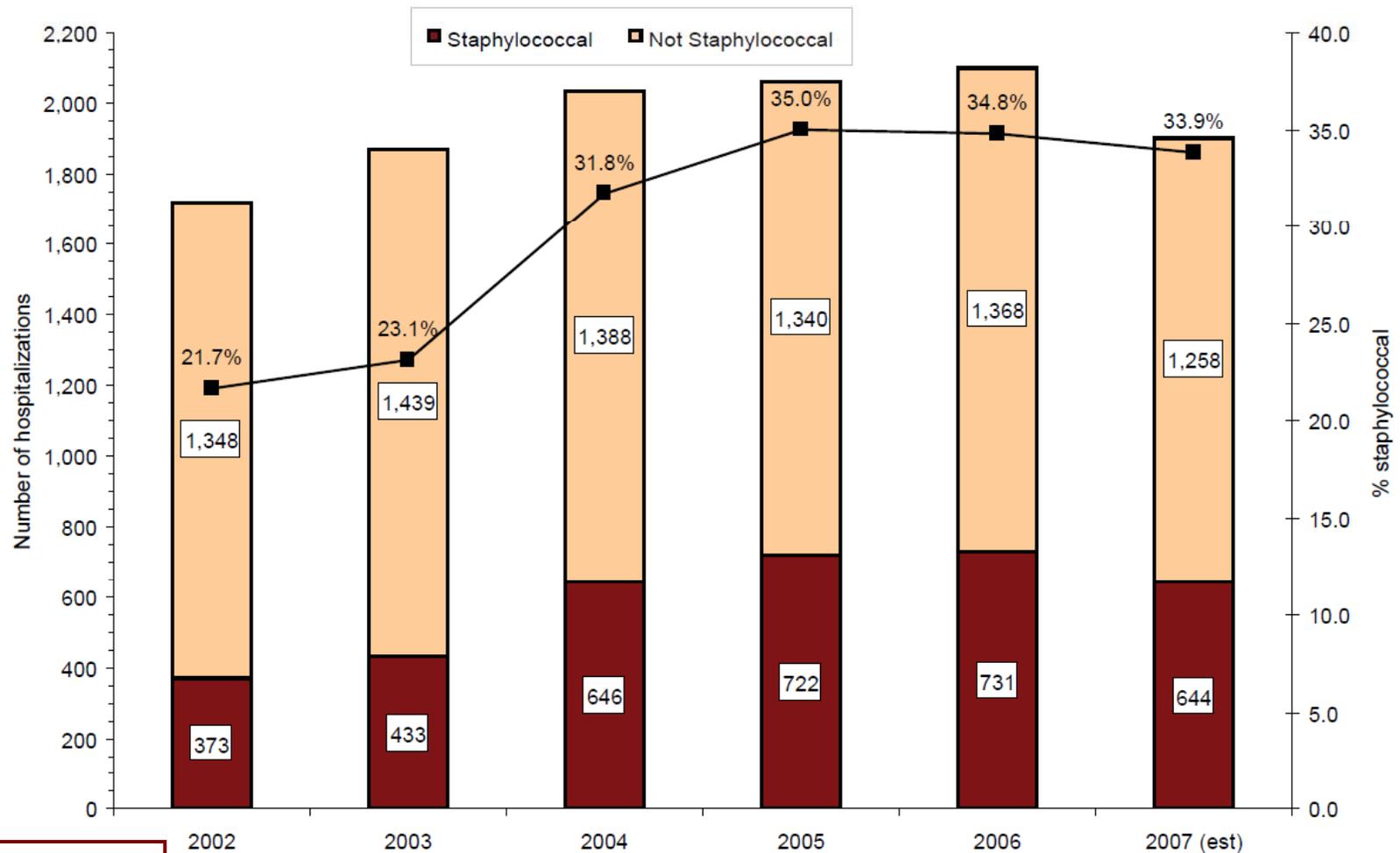
April 2009- *S. aureus*

# Skin and Soft Tissue Infection Incidence



MSMR 2006

# Hospitalizations SSTI *S. aureus*



MSMR 2007

# Community-associated MRSA SSTI in Iraq

- 26 of 66 SSTI cultured with 22 CA-MRSA
- Incidence SSTI- 800 cases per 100,000 persons per year
- Incidence CA-MRSA SSTI- 600 cases per 100,000 persons per year

# Community-associated MRSA Combat Medic Trainees

- 812 trainees at Fort Sam Houston
- 3% colonized with MRSA
  - 9% developed soft tissue infection
- 28% colonized with MSSA
  - 3% developed clinical infection

# CA- vs HA-MRSA

## What is different?

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PFT	Location	SCCmec
USA100	Hospital	Type II
USA200	Hospital	Type II
<b>USA300</b>	<b>Community</b>	<b>Type IV</b>
USA400	Community	Type IV
USA800	Community	Type IV

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# MRSA

## Virulence Factors

Virulence gene	CA-MRSA	HA-MRSA
PVL	77%	4%
<i>sea</i>	58%	4%
<i>sec</i>	50%	--
<i>seh</i>	65%	4%
<i>sek</i>	62%	--
<i>agr3</i>	65%	4%

# Community-associated MRSA

## Antibiotic Resistance

Antibiotic	% Susceptible
Vancomycin	100
Rifampin	100
TMP-SMZ	100
Tetracycline	100
Ciprofloxacin	64
Clindamycin	96

# Research Question

## Objective

- Characterize the genotypic and phenotypic patterns of MRSA wound cultures including SSTI from the clinical microbiology section at a CSH to provide enhanced epidemiology of the pathogens in theater

# Methods

## Study Location

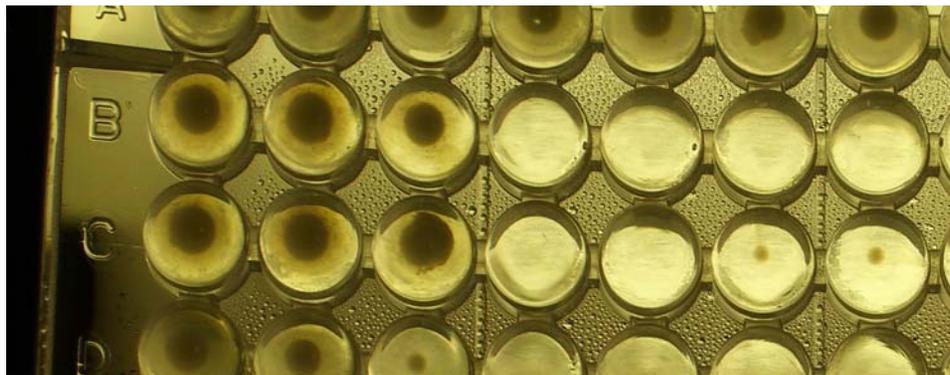
- Iraq/BAMC IRB approved protocol
- CSH in Baghdad, Iraq
- Between December 2007 and March 2009 MRSA wound isolates were collected, frozen and shipped to the USAISR/BAMC

# Methods

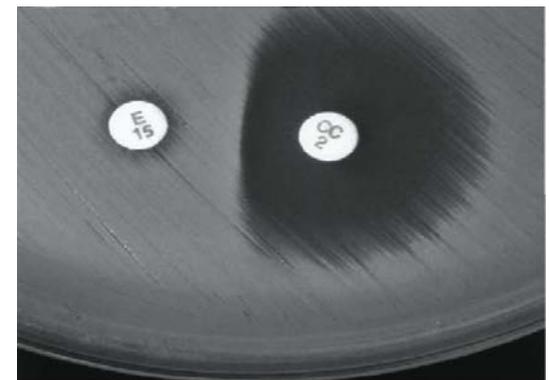
## Antimicrobial Susceptibility Testing

- Broth microdilution
- BD Phoenix™ Automated Microbiology System
- D-zone testing for inducible clindamycin resistance

Broth Microdilution



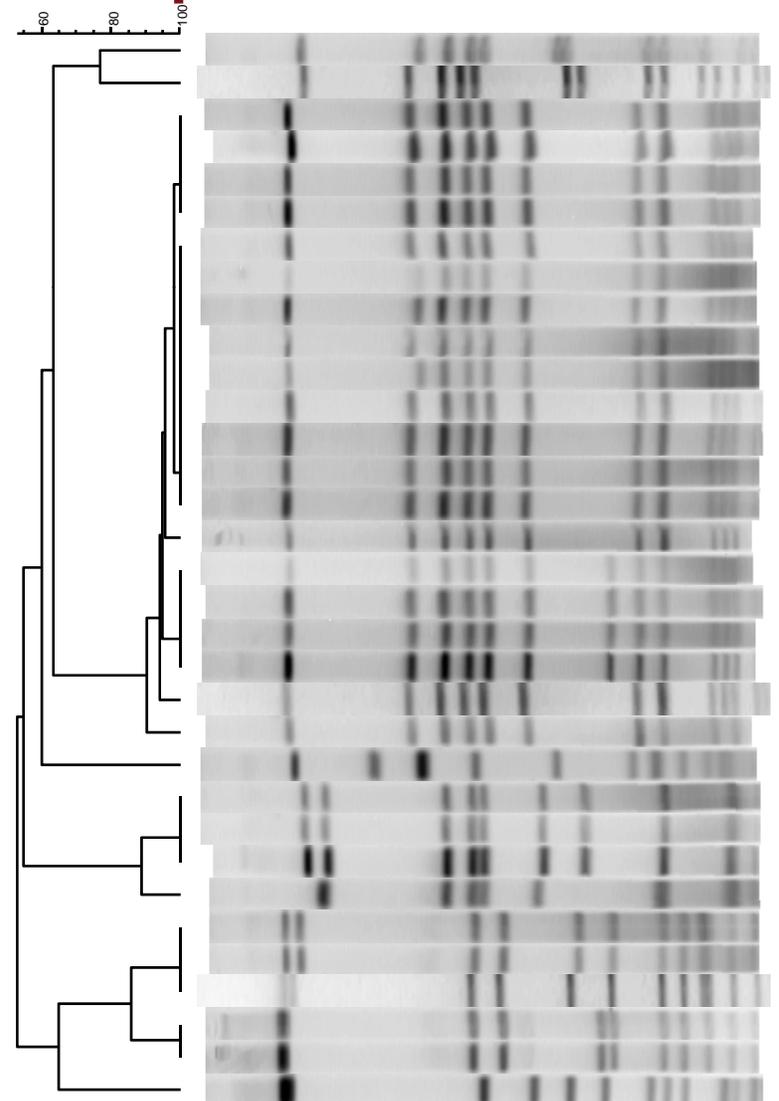
D-Zone



# Methods

## Pulsed-field Gel Electrophoresis

- *Sma*I restriction enzyme



# Methods

## Virulence Genes

- Panton-Valentine leukocidin (PVL)- cytotoxic to monocytes, macrophages and neutrophils
- arcA gene for arginine catabolic mobile element (ACME)- inhibits neutrophil production

# Results

## Isolates

- 84 bacteria
  - USA300- 66
  - USA1100- 4
  - Type 2- 5
  - Type A- 2
  - Type B, C, D, E, F, G- 1 each

# Results

## Antibiotic Susceptibility

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Pulsed-field Type	Vancomycin	Daptomycin
<b>Total (84)</b>	<b>100</b>	<b>96</b>
USA300 (66)	100	99
USA1100 (4)	100	100
Type 2 (5)	100	100

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# Results

## Antibiotic Susceptibility

Pulsed-field Type	TCN	Trim-Sulf	Clinda	Clinda + inducible resistance
<b>Total (84)</b>	<b>95</b>	<b>94</b>	<b>94</b>	<b>87</b>
USA300 (66)	99	97	97	97
USA1100 (4)	100	100	100	100
Type 2 (5)	100	100	100	0

# Results

## Antibiotic Susceptibility

Pulsed-field Type	TCN	Trim-Sulf	Clinda	Clinda + inducible resistance
<b>Total (84)</b>	<b>95</b>	<b>94</b>	<b>94</b>	<b>87</b>
USA300 (66)	99	97	97	97
USA1100 (4)	100	100	100	100
Type 2 (5)	100	100	100	0

# Results

## Antibiotic Susceptibility

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Pulsed-field Type	Levo	Moxi	Rifampin	Linezolid
<b>Total (84)</b>	<b>60</b>	<b>91</b>	<b>98</b>	<b>98</b>
USA300 (66)	59	96	100	97
USA1100 (4)	100	100	100	100
Type 2 (5)	0	0	100	100

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# Results

## Antibiotic Susceptibility

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Pulsed-field Type	Levo	Moxi	Rifampin	Linezolid
<b>Total (84)</b>	<b>60</b>	<b>91</b>	<b>98</b>	<b>98</b>
USA300 (66)	No monotherapy			97
USA1100 (4)	No monotherapy			100
Type 2 (5)	0	0	100	100

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# Results

## Antibiotic Susceptibility

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Pulsed-field Type	Levo	Moxi	Rifampin	Linezolid
<b>Total (84)</b>	60	91	98	99
USA300 (66)	No monotherapy			\$
USA1100 (4)	No monotherapy			\$
Type 2 (5)	0	0	100	100

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# Results

## Resistance Genes

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Pulsed-field Types	SCC <i>mec</i> %
USA300 (66)	IV (100)
USA1100 (4)	IV (50), NA (50)
Type 2 (5)	II (100)

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# Results

## Virulence Genes

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Pulsed-field Types	ACME %	PVL %
USA300 (66)	94	100
USA1100 (4)	0	100
Type 2 (5)	0	0

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# Results

## Subpopulation

- 17 patients with limited clinical data
  - 12 outpatients of which 5 from outlying bases
  - 15 isolates USA300

# Summary

## Findings

- MRSA isolates from Iraq are consistent genotypically and phenotypically with CA-MRSA isolates in the US
- Best oral therapy includes bactrim, tetracyclines or clindamycin
- Best intravenous therapy is vancomycin

# Summary

## Limitations

- Limited clinical data including nationality, anatomical source of isolate, mechanism of injury
- No follow up available for patients

# Conclusion

## Future Progress

- Better clinical correlation of isolates and injuries
  - Being addressed by the Multidrug-resistant Organisms Repository and Surveillance Network (MRSN)
- Need systematic collection of isolates throughout a patient's treatment course to determine timing of MRSA inoculation into wounds

# Conclusion

## Future Progress

- Improved preventive strategies needed
  - Nasal mupirocin of limited utility
  - Chlorhexidine towel decolonization of limited utility
  - Vaccine being evaluated

# Acknowledgment

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- Michael Ellis

# Questions?



The opinions or assertions made are the private views of the speaker and are not to be construed as official or reflecting the views of the Department of the Army or the Department of Defense

Department of Clinical Investigation / Operational Security / Public Affairs Office- Reviewed and Approved

No conflicts of interest