



A comparison of mortality rates of MRSA and MSSA in an Intensive Care Unit

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Definitions:

- MRSA - "Super Bug"

Methecillin Resistant *Staphylococcus Aureus*

- MSSA

Methecillin Susceptible *Staphylococcus Aureus*

Outline:

- Background
 - What is *Staphylococcus aureus*?
 - Antibiotic resistance: A history
 - MRSA: Some Statistics
 - What can be done?
- The Study
 - Motivation for study and Data
 - Patient populations
 - Initial Univariate Analyses
 - Case-Matching
 - Logistic regression analysis
- Conclusions
 - Summary

What is *Staphylococcus aureus*?

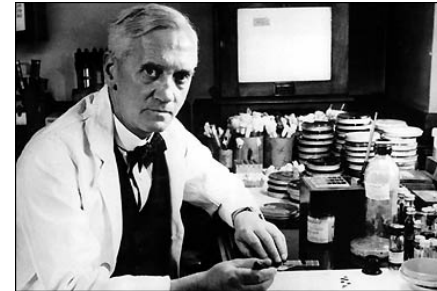
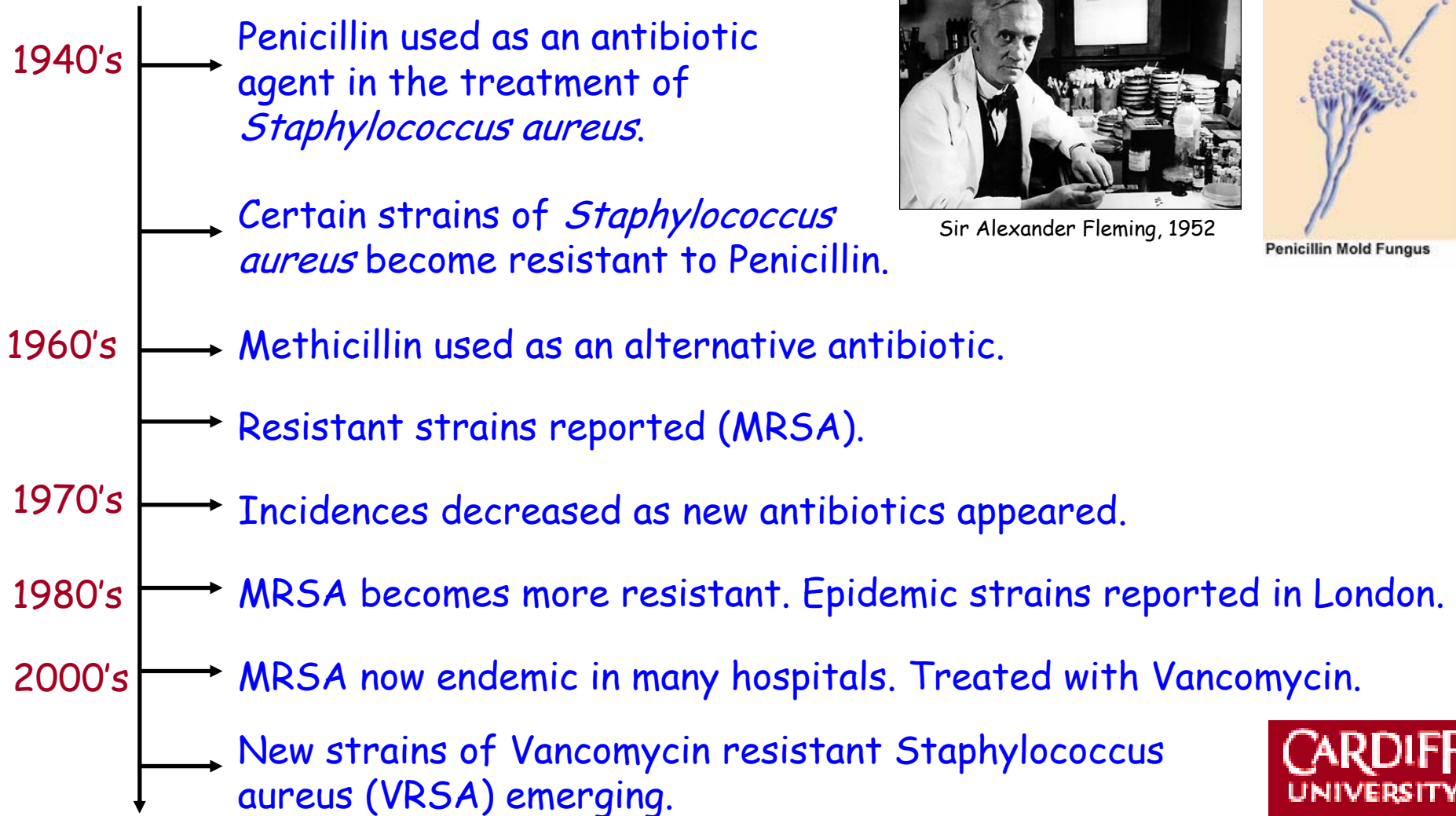
- **Bacterium** that lives harmlessly on the skin and in the nose of approximately 1/3 of healthy people.



Staphylococcus aureus. Electron micrograph.

- **Can cause disease** if it enters the body, via cuts, surgical incisions, drips/catheters etc.
- **Symptoms:** Skin/wound infections, pneumonia, blood poisoning.

Antibiotic Resistance: A History



Sir Alexander Fleming, 1952

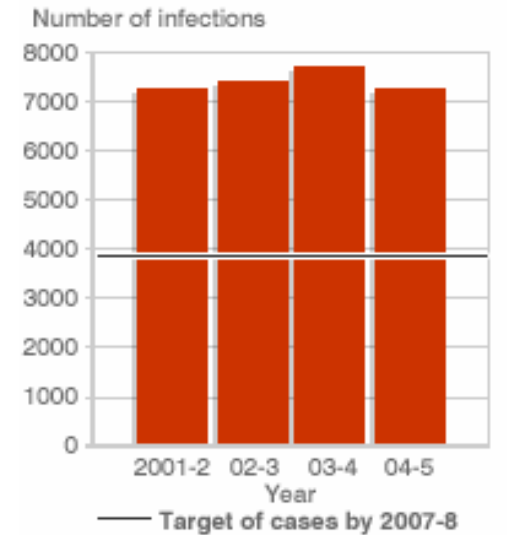


Penicillin Mold Fungus

MRSA: The Stats

- UK has one of the highest rates of MRSA in Europe.
- MRSA infection in hospitals increased by 5.5% between 2001 - 2004.
- Reduced rate of infection in 2005.
- Government target of 50% reduction rate by 2008.

MRSA BLOODSTREAM INFECTION IN HOSPITALS IN ENGLAND



SOURCE: Department of Health

- MRSA is linked to approximately 1000 deaths per year in England.
- It costs the NHS approximately £1 billion per year.

What can be done?

1) Infection control

- Handwashing between patients
- Improve overall standards of hygiene (ward matron)
- Treat MRSA patients in isolation



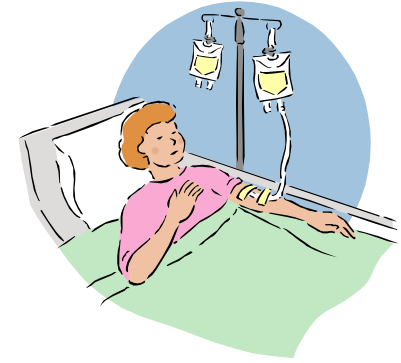
2) Reduce bacterial resistance

- Stop over-prescription of antibiotics
- Always finish course of antibiotics



Aim:

- To compare the hospital mortality of patients with MRSA against those with MSSA in an intensive care unit (ICU).



Data:

- All patients with MRSA or MSSA bacteraemia, admitted to the ICU of the University Hospital of Wales between January 1996 and April 2003.
- Excludes patients in the Cardiac ICU.
- A total of 197 patients: 130 with MRSA, 67 with MSSA.
- Total number of ICU admissions = 6925
 - ⇒ 2.9% of ICU admissions had MRSA or MSSA bacteraemia.
- Lists of infected patients from Department of Microbiology database, matched to comprehensive ICU database.

Patient Populations:



- The groups are well matched for age and gender.

Severity of illness:

- Measured using the APACHE II score.
- No significant difference on admission to the ICU.
- Greater in the group who had MSSA on the day of bacteraemia.
- Similar chronic disease histories.

Length of stay:

- Patients with MRSA were in hospital longer before bacteraemia and stayed in the ICU longer.

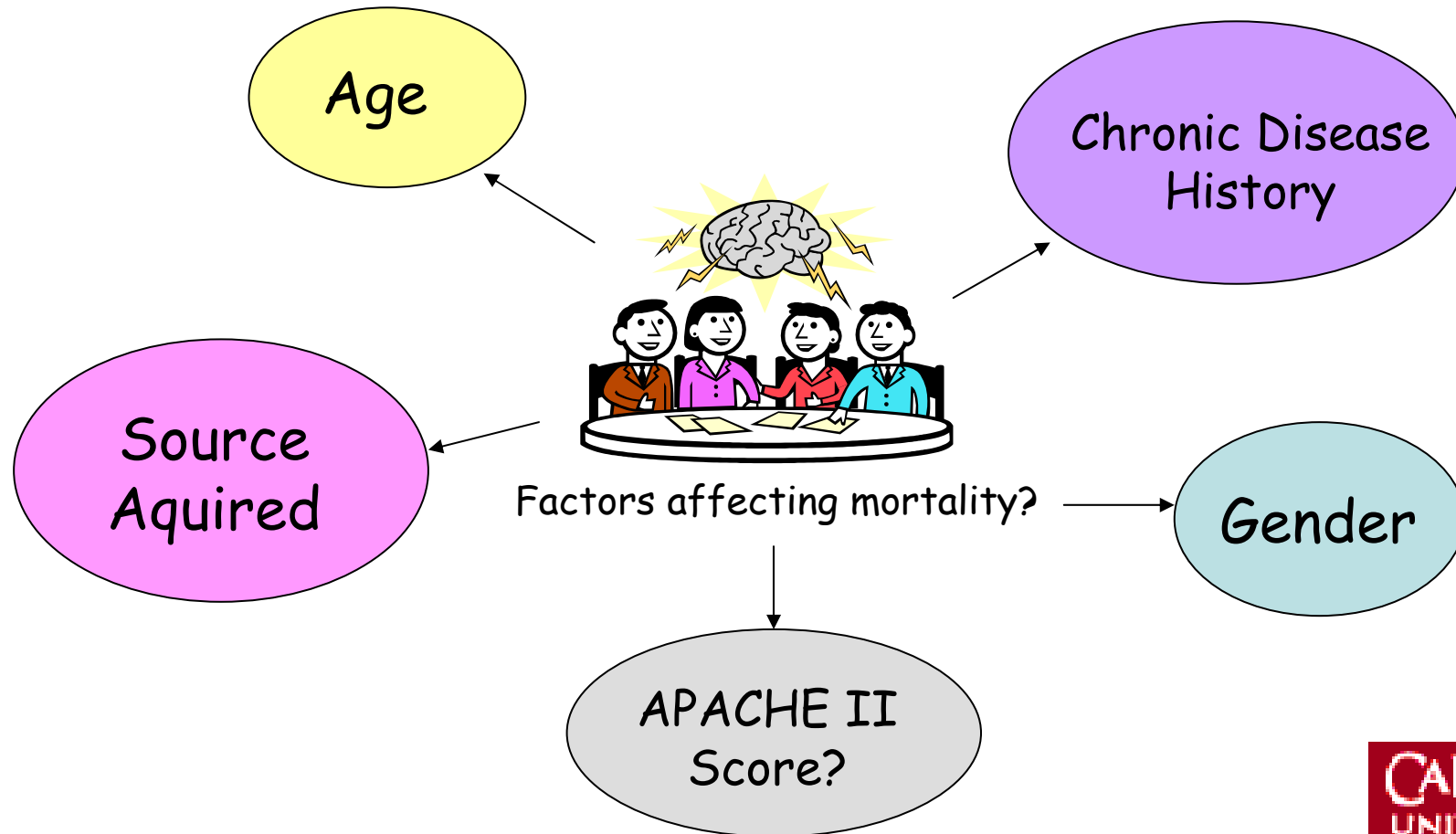
Initial Univariate Analysis:

Mortality $\left\{ \begin{array}{l} \text{Survive} \\ \text{Do not Survive} \end{array} \right.$

	<i>MRSA</i>	<i>MSSA</i>	<i>P-value</i>
n	130	67	
Hosp Mortality:	85 (65.4%)	42 (62.7%)	0.83
ICU Mortality:	68 (52.3%)	32 (47.8%)	0.65

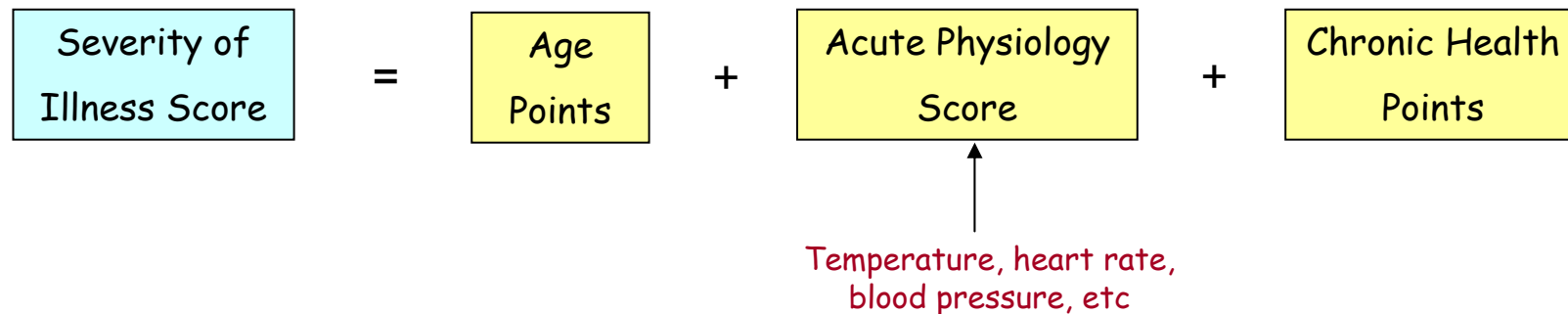
No significant difference in hospital mortality found between the two groups.

Confounding Variables:



APACHE II Score

(Acute Physiology and Chronic Health Evaluation Score)



- Predicts patient outcome on day 1
- Reflects severity of illness on other days

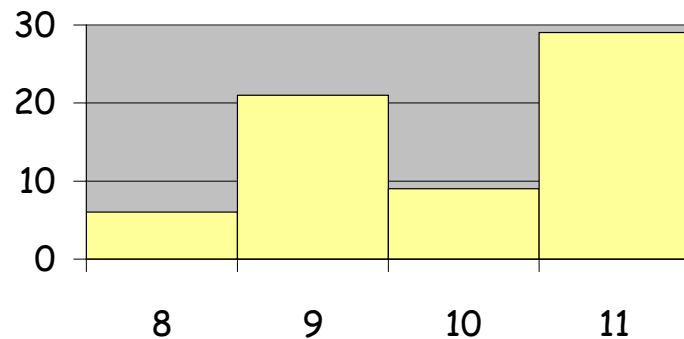
• 2 case-matched studies, one including APACHE II, one without

Case Matching:

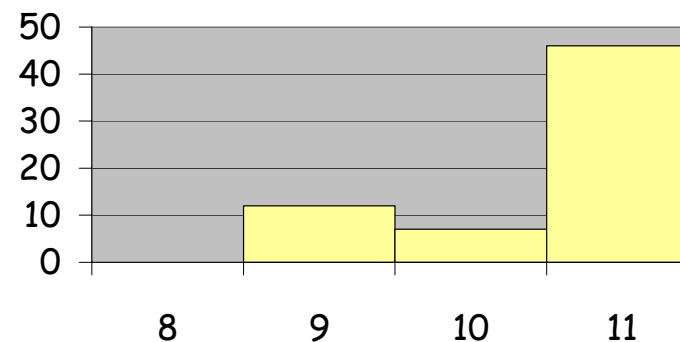
- **Gender:** Male/Female. Match \Rightarrow 2 points.
- **Age:** Yrs. Difference < 5 yrs \Rightarrow 3 points.
 $5 \leq$ Difference $\leq 10 \Rightarrow$ 2 points.
- **Source Acquired:** Community / Hospital / ICU. Match = 2 points.
- **Chronic Disease History:** Y/N. Match = 2 points.
- **APACHE II Score:** Difference $\leq 4 \Rightarrow$ 2 points.

\Rightarrow 11 points for a perfect match.

1) APACHE II score included



2) APACHE II score not included



Case Matching: Results

1) Mortality: 64.6% in MSSA group, 61.5% in MRSA group.

		MRSA group:	
		Survived	Did not Survive
MSSA group:	Survived	13	10
	Did not Survive	12	30

66.2% had a concordant outcome.

McNemar's test
p-value = 0.83

No significant
difference in hospital
mortality between the
2 matched groups!

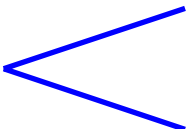
2) Mortality: 64.6% in both groups.

		MRSA group:	
		Survived	Did not Survive
MSSA group:	Survived	8	15
	Did not Survive	15	27

53.8% had a concordant outcome.

McNemar's test
p-value = 1

Logistic Regression Models - 1

1) Hospital outcome  Survived
Did not survive

Important predictors:

age, TPN, chronic disease history, systolic blood pressure, respiration rate, platelet count, sedation, organ failures, APACHE II score, TISS score.

Group membership is NOT a predictor of hospital outcome.

2) Group membership  MRSA
MSSA

Only variables known on the day of bacteraemia considered.

Logistic Regression Models - 2

Variable	Symbol	Co-efficient
Intercept	α	3.66
APACHE II score	β_1	-0.04
Glasgow Coma Score	β_2	0.15
Time spent in ER prior to ICU admission	β_3	-1.18
Heart rate	β_4	0.02
Platelet count	β_5	0.01
Albumin	β_6	-0.34
Bilirubin	β_7	-0.12
Type of Surgery (1 = elective, 2 = emerg, 3 = no surgery)	β_8	-1.01
Mean blood pressure	β_9	-0.02
Chronic disease history (1 = Yes, 0 = No)	β_{10}	-1.32
TISS score	β_{11}	-0.03
Renal failure (1 = Yes, 0 = No)	β_{12}	1.06

p = probability of
MRSA

$$\text{Log}(p/1-p) = 3.66 - 0.04 \beta_1 + 0.15 \beta_2 - 1.18 \beta_3 + 0.02 \beta_4 + 0.01 \beta_5 - 0.34 \beta_6 - 0.12 \beta_7 - 1.01 \beta_8 - 0.02 \beta_9 - 1.32 \beta_{10} - 0.03 \beta_{11} + 1.06 \beta_{12}$$

Logistic Regression Models - 3

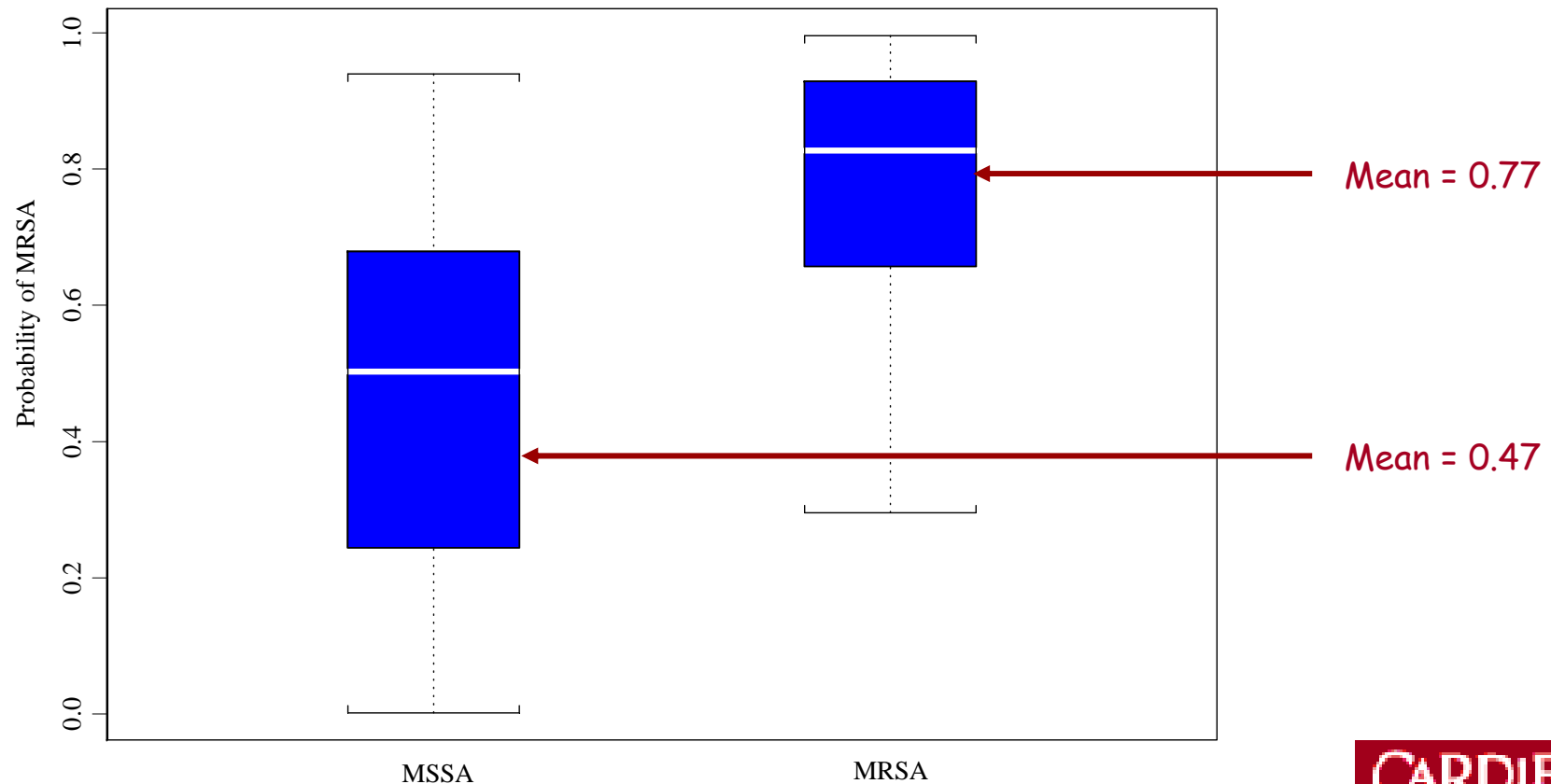


Figure 1. Probability of MRSA (from model) for patients with MRSA and MSSA

Conclusion

"There is **no increased mortality** associated with MRSA as opposed to MSSA for patients in the ICU of the University Hospital of Wales"

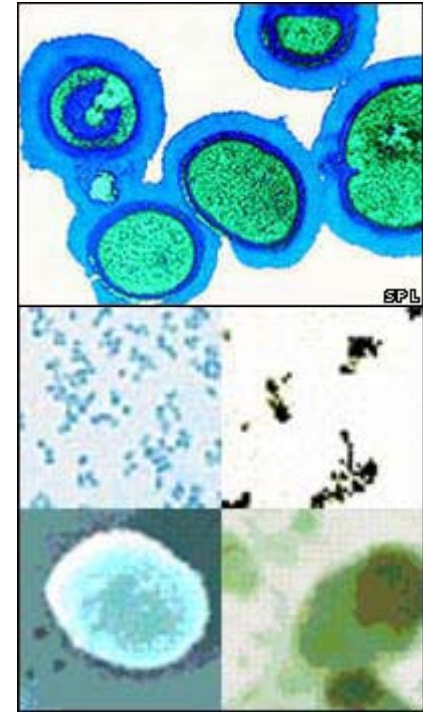
Reference

Cosgrove SE et al (2003). "Comparison of mortality associated with methicillin-resistant and methicillin-susceptible *Staphylococcus aureus* bacteraemia: A meta-analysis." *Clinical Infectious Diseases* **36** (1): 53-59.

- 31 studies. 24 found no difference in outcome, 7 found higher mortality rates for MRSA.
- Meta-analysis found higher mortality rates for MRSA
- Difference is likely to be related to a delay in appropriate therapy

Summary

- No increased mortality in patients with MRSA as opposed to MSSA.
- Treatment: Vancomycin
 - Expensive
 - More toxic
 - Not as easy to administer
 - Not as effective for the treatment of MSSA
- A model which accurately predicts whether a patient has MRSA or MSSA would be a useful tool to aid early treatment decisions.





Any Questions/Comments?

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