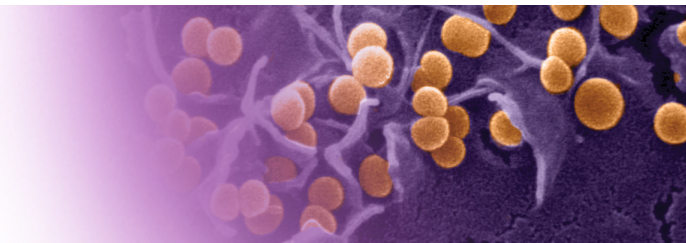


MRSA gene hunt

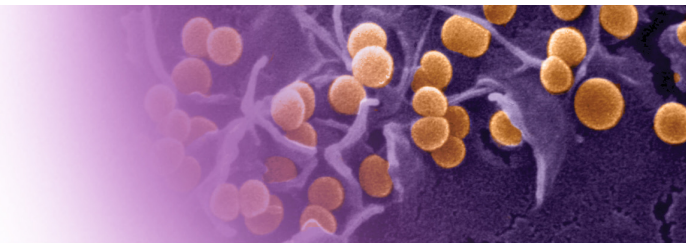
Gene ID card answers



Gene	Protein product	Role/Function	MSSA 476	MRSA MW2	Classification
<i>ccrA & ccrB</i>	Cassette chromosome recombinase A and B	Allows new chunks, or "cassettes" of DNA to be inserted into the bacterial genome. This helps the bacteria to acquire new genes.	✓	✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input checked="" type="checkbox"/>
<i>ear</i>	Enterotoxin B	This protein attacks cell membranes which can lead to the cell bursting and dying as a result.		✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input checked="" type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>int (region 3)</i>	Integrase	Helps insert DNA copied from viral RNA or DNA into the bacterial genome.	✓		Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input checked="" type="checkbox"/>
<i>fusB1</i>	Fusidic acid resistance protein	This protein blocks the antibiotic fusidic acid, making the bacteria resistant to common antibiotic skin creams and ointments.	✓		Antibiotic resistance <input checked="" type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>hsdR, hsdS, hsdM</i>	Restriction modification enzymes	These proteins act as a barrier against 'free-for-all' horizontal transfer of DNA protecting the bacteria's genome from invading fragments of DNA which could "weaken" it. The hsdM enzyme adds chemical markers to the bacteria's own DNA. The hsdS enzyme recognises these markers and foreign unmodified DNA entering the cell which the hsdR enzyme will chop up.	✓		Antibiotic resistance <input type="checkbox"/> Enzyme <input checked="" type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input type="checkbox"/>

MRSA gene hunt

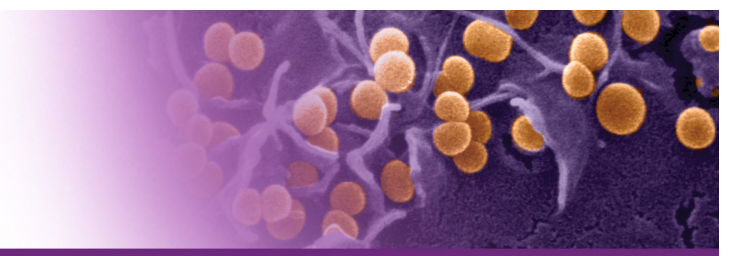
Gene ID card answers



Gene	Protein product	Role/Function	MSSA 476	MRSA MW2	Classification
<i>orfX</i>	Surface protein / gene insertion site	A surface protein which marks the sites on the genome where mobile cassettes can insert themselves.	✓	✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input checked="" type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>lukS & lukF</i>	Panton-Valentine leukocidine chain precursor	These proteins form the Panton-Valentine leukocidin complex. A type of toxin which kills white blood cells. Two subunits (<i>lukS</i> and <i>lukF</i>) are secreted by the bacterium and meet up in the cell membranes of target cells where they form a ring with a hole in the middle. This causes the contents of the cell to leak out and the cell to die.		✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input checked="" type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>mecA</i>	Penicillin binding protein	This protein is involved in synthesising the bacterial cell wall, allowing growth and division. Penicillin works by binding these proteins and blocking them. <i>mecA</i> codes for a version that does not bind well with penicillin, allowing growth to continue unchecked.		✓	Antibiotic resistance <input checked="" type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>sec4</i>	Enterotoxin type c precursor	This protein is a precursor to an enterotoxin. This means it has to be modified by another enzyme to become an active toxin. Once activated the toxin can damage cells in the gut which leads to symptoms such as diarrhoea.		✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input checked="" type="checkbox"/> Mobile genetic element <input type="checkbox"/>
<i>sel2</i>	Enterotoxin L	This enterotoxin is a type of superantigen and is capable of causing a variety of symptoms by initiating damage to the host's cells. It stimulates the body to produce large numbers of T-cells which destroy all healthy cells around or near the area infected with <i>S. aureus</i> . This can cause extensive damage to tissues and major organs sending the body into shock.		✓	Antibiotic resistance <input type="checkbox"/> Enzyme <input type="checkbox"/> Surface protein <input type="checkbox"/> Toxin <input checked="" type="checkbox"/> Mobile genetic element <input type="checkbox"/>

MRSA gene hunt

Gene ID card answers



Q1a). Which genes were found in MSSA 476?

Eight genes can be found in MSSA 476 genome, these are: *ccrA* & *ccrB*, *int*, *fusB1*, *hsdR*, *hsdS* & *hsdM* and *orfX*.

Q1b) Which genes were found in MRSA MW2?

Nine genes can be found in MRSA MW2 genome. These are: *ccrA* & *ccrB*, *ear*, *orfX*, *lukS*, *lukF*, *mecA*, *sec4* and *sel2*.

Q1c) Which genes were found in both strains?

Only three of the genes were found in both strains: *ccrA* & *ccrB* and *orfX*

Q2. Which genes could be termed as virulence factors, i.e. gives the bacterium a greater capacity to cause disease?

lukS, *lukF*, *ear*, *sec4*, *sel2* (cytotoxins and enterotoxins)

Q3. Which genes might give one strain an advantage over other strains?

Antibiotic resistance genes

Q4. What processes do you think underlie the evolution and spread of antibiotic-resistance in bacteria?

Natural selection and acquisition of new genes via horizontal gene transfer.