

ACCESS Typing and Research*

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**Western Australian
Methicillin-Resistant *Staphylococcus aureus* (MRSA) and
Vancomycin Resistant Enterococcus (VRE)
Epidemiology and Typing Report
(MRSA & VRE)**

1 July 2009 to 30 June 2010

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1 Overview

From 1st July 2009 to the 30th June 2010, 5,711 methicillin resistant *Staphylococcus aureus* (MRSA) isolates from 4,531 patients and 95 vancomycin-resistant enterococci (VRE) from 92 patients were referred to *ACCESS* (Australian Collaborating Centre for *Enterococcus* and *Staphylococcus* Species) *Typing and Research* for epidemiological typing. Only unique isolates (duplicates excluded) are presented in this report.

1.1 MRSA: Key Results 1st July 2009 to 30th June 2010

MRSA isolated between July 2009 – June 2010 (4,691 unique isolates) are composed of:

- CA-MRSA 3,929 (83.8%)
- HA-MRSA 762 (16.2%)

The CA-MRSA can be divided according to their possession of Panton-Valentine leucocidin (PVL) and hence the potential to cause significant clinical disease

- 877 (22.3%) of CA-MRSA were PVL positive
 - These were most likely from clinical specimens (93.2%) in contrast with PVL negative isolates (72.3%)
 - The proportion of PVL positive CA-MRSA has increased (2% of CA-MRSA in 2003/2004, 4% in 2004/2005, 6% in 2005/2006, 11% in 2006/2007, 17% in 2007/2008 and 20% in 2008/2009).
 - The PVL positive clones notified were predominantly
 - The Queensland clone (ST93-IV [2B]) which comprised 15.9% of all CA-MRSA isolated
 - The Western Samoan Phage pattern CA-MRSA (WSPP) (ST30-IV [2B]) which comprised 3.4% of all CA-MRSA isolated
- 3,052 (77.7%) of CA-MRSA were PVL negative
- Although 55 CA-MRSA pulsotypes were identified, there were three predominant PVL negative clones
 - WA MRSA-1 (ST1-IV[2B]) – 40.4% of CA-MRSA
 - WA MRSA-2 (ST78-IV[2B]) – 23.7% of CA-MRSA
 - WA MRSA-3 (ST5-IV[2B]) – 8.8% of CA-MRSA

The proportion of MRSA identified as HA-MRSA has remained stable since 2006/07

- 725 (95.1%) HA-MRSA were UK EMRSA-15 (ST22-IV[2B]): 60% clinical specimens and 40% colonisation. Forty four (6.1%) were from health care workers.
- 22 (2.9%) HA-MRSA were ST239-MRSA-III [3A] including two health care workers
- The remaining HA-MRSA included
 - Six UK EMRSA-16 (ST36-II[2A]),
 - Five Irish-2 EMRSA (ST8-VI[4B]),
 - Three New York/Japan EMRSA (ST5-II[2A]) and,
 - One variant of UK EMRSA-15 (ST217-IV[2B]).

1.2 VRE: Key Results 1st July 2009 to 30th June 2010

- 93 unique isolates of VRE were referred for *van* gene characterisation and molecular typing: the majority (94.6%) from screening specimens.
- 89 (96%) were *vanB E. faecium*. Of these 57 (64%) were PFGE type 34 (identified in four institutions) and 11 (12%) were PFGE type 29 (identified in four institutions).

Section 2
MRSA Nomenclature

2 MRSA Nomenclature

Since July 2003, the Australian Collaborating Centre for *Enterococcus* and *Staphylococcus* Species ([ACCESS Typing and Research](#)) (formerly known as the Gram-positive Bacteria Typing and Research Unit) has employed the international MRSA nomenclature system described by Dr Mark Enright *et al* (The evolutionary history of methicillin-resistant *Staphylococcus aureus* (MRSA) *Proc Natl. Acad Sci. USA* 99:7687-7692). This system provides a universally standardised MRSA nomenclature allowing MRSA clones to be readily compared between laboratories. It is based upon the combination of seven housekeeping genes sequence types (STs) using multilocus sequence typing (MLST) and the SCC*mec* type using multiplex PCR. The MRSA genotype is therefore the sum of the SCC*mec* type and the type of its recipient chromosome. For example, an MRSA clone of ST22 and SCC*mec* type IV is referred to as ST22-IV(2B).

2.1 MLST

MLST is a highly discriminatory method of characterising MRSA. For each of the seven housekeeping gene fragments, different sequences are assigned as distinct alleles, and an isolate is defined by the alleles of each of the seven housekeeping loci (the allelic profile or ST). The ST can be compared with other strains using the program BURST located on the MLST website (www.saureus.mlst.net). As there are many alleles for each loci, isolates are highly unlikely to have identical ST by chance, and therefore isolates with the same ST are considered members of the same clone.

2.2 Clonal Complex (CC)

Clonal complexes are defined as a group of multi-locus genotypes in which every genotype shares at least 5 loci in common with at least one other member of the group. Clonal complexes are thus mutually exclusive and are designed to group direct descendents of an ancestral type.

2.3 SCC*mec*

[ACCESS Typing and Research](#) uses the guidelines published by the International Working Group on the Classification of Staphylococcal Cassette Chromosome Elements (IWG-SCC*mec*). Eight SCC*mec* types have been identified globally. The structural type is indicated by a roman numeral with a lowercase letter indicating the subtype. The *ccr* gene complex and the *mec* gene complex follow in parentheses.

Types I(1B), II(2A), III(3A) and VI(4B) (previously known as IV_{paediatric}) are frequently associated with “healthcare-associated MRSA” while types IV(2B), V(5C2), VII(5C1) and VIII(4A) are frequently associated with “community-associated MRSA”. Where the combination of the *ccr* gene allotype and the class of the *mec* gene complex has not been described, the SCC*mec* element is described as “novel”.

Using MLST/SCC*mec* typing [ACCESS Typing and Research](#) has identified several MRSA clones which previously were collectively known as “WA MRSA”. These clones have been fully characterised using a variety of molecular and non-molecular methods.

MRSA have been identified as either healthcare-associated or community-associated and assigned a MLST/SCC*mec* type. The previous nomenclature applied to healthcare-associated MRSA has also been reported.

Section 3

Tests performed by *ACCESS*

July 2009 to June 2010

3 Tests performed by *ACCESS* Typing and Research

Table 1: Tests performed by *ACCESS* Typing and Research, July 2009 to June 2010

	Number of MRSA isolates tested
Routine Antibigram (9 antibiotics)	5,769
<i>mecA/nuc</i> PCR	564
Panton Valentine leucocidin (PVL) PCR	1,405
Coagulase Gene – Restriction Fragment Length Polymorphism (RFLP) PCR Assay	4,878
Resistogram (2 chemicals)	33
Pulsed-Field Gel Electrophoresis (PFGE)	1,390
Urease Reaction	5,769
Multi Locus Sequencing Typing (MLST)	50
SCC <i>mec</i> PCR	57
Mupirocin 200µg disc	74
Ciprofloxacin Etest®	128
<i>spa</i> typing	14
Total Number of Tests Performed	20,131

Susceptibilities were determined by disk diffusion for gentamicin, erythromycin, tetracycline, trimethoprim, ciprofloxacin, gentamicin, rifampicin, fusidic acid and mupirocin. Standard French susceptibility testing interpretative criteria (CA SFM) were applied for fusidic acid results and previously published interpretative criteria were applied for mupirocin results (Finlay *et al*, 1997). CLSI criteria were used to interpret results for the other agents. A resistogram was determined by the disk diffusion method for mercuric chloride (0.4 mmol/L), and phenylmercuric acetate (5 mmol/L).

Clones are initially identified by phenotype (antibiogram and urease production) and coagulase PCR-RFLP. PFGE, PVL PCR, MLST and SCC*mec* typing are performed as required. Molecular testing (apart from PVL PCR on select isolates) is not performed on duplicate isolates.

Section 4
MRSA isolated in Western Australia
July 2009 to June 2010

4 MRSA isolated in Western Australia, July 2009 to June 2010

From 1 July 2009 to 30 June 2010, 5,711 MRSA isolates from 4,531 patients were referred to [ACCESS Typing and Research](#) for epidemiological typing. Unique isolate data, (n=4,691 - duplicate isolates excluded) are presented in this report. A duplicate isolate is defined as an isolate with an identical phenotype to an isolate received from the same patient within the previous 12 month period.

Table 2: Unique isolates of MRSA in Western Australia, July 2009 to June 2010

MRSA	Patient Isolates n=4,565 (97.3%)		Staff Isolates n=126 (2.7%)		n (%)
	Clinical	Screen	Clinical	Screen	
HA-MRSA	462	253	0	47	762 (16.2)
CA-MRSA, PVL-negative	2,191	789	15	57	3,052 (65.1)
CA-MRSA, PVL-positive	820	50	5	2	877 (18.7)
Total MRSA	3,473	1,092	20	106	4,691

4.1 Relationship of age to MRSA

Increasing age is a risk factor for infection or colonisation with HA-MRSA and CA-MRSA. The mean age of patients infected/colonised with HA-MRSA is significantly higher ($T=17.2174$) (mean 68 years, median 76 years) compared to patients with CA-MRSA (mean 49 years, median 49 years): a reflection of the increasing health care contact amongst the middle-aged and elderly. While the rate of PVL-negative CA-MRSA increases with age, the rate of PVL-positive CA-MRSA is highest among children and the young adult age groups (teens to 20s). The mean age of patients infected/colonised with PVL positive CA-MRSA was 29 years (median 26 years) – significantly younger ($T=24.9554$) than patients with PVL negative CA-MRSA (mean 55 years, median 60 years).

Figure 1: Median age and range (box plot) of patients infected or colonised with HA-MRSA and CA-MRSA

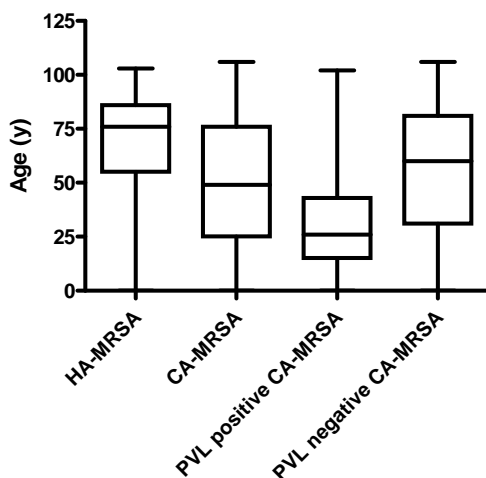


Figure 2: Proportion of HA-MRSA and CA-MRSA by age, July 2009 to June 2010

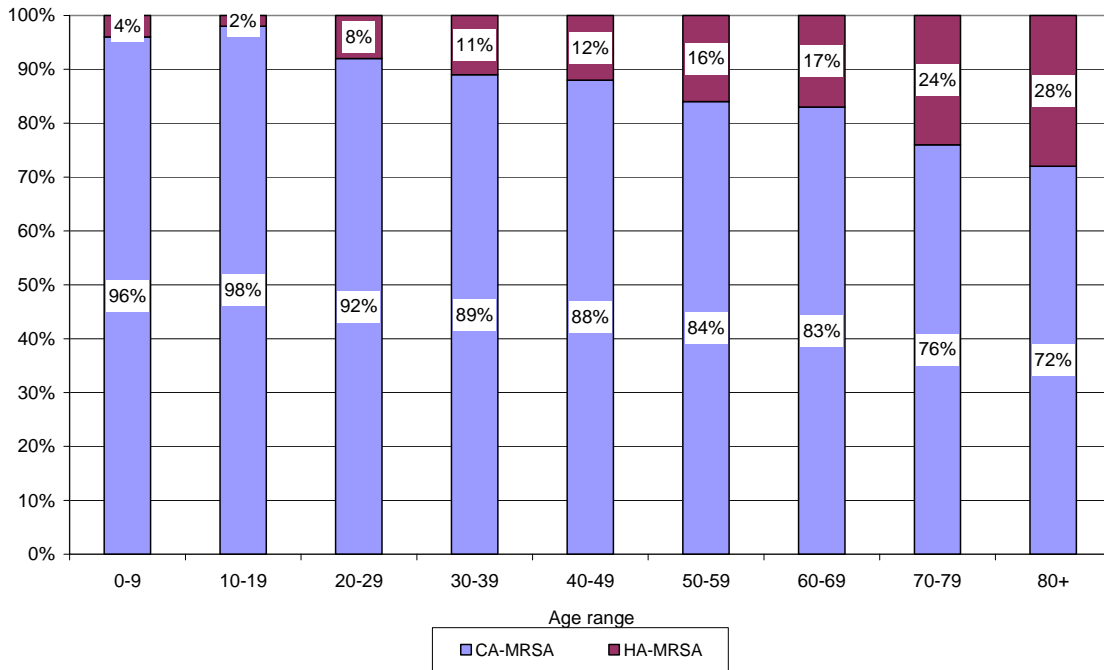


Figure 3: Rate of HA-MRSA (per 100,000 population) by age, July 2009 to June 2010

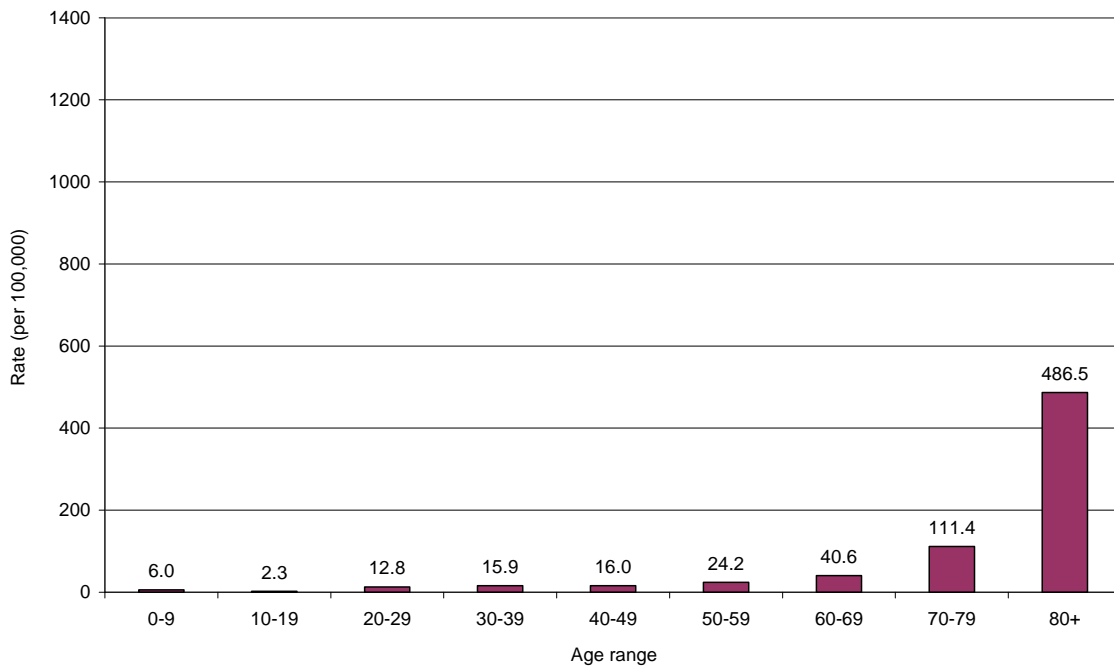


Figure 4: Rate of CA-MRSA (per 100,000 population) age, July 2009 to June 2010

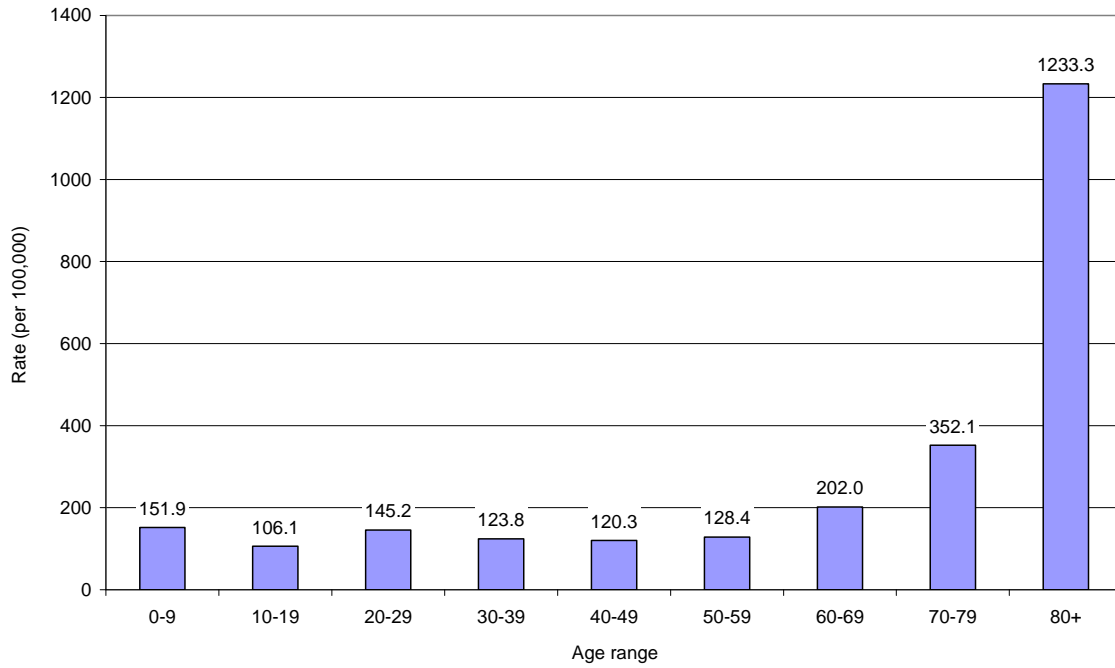


Figure 5: Proportion of known PVL-positive and PVL-negative CA-MRSA by age, July 2009 to June 2010

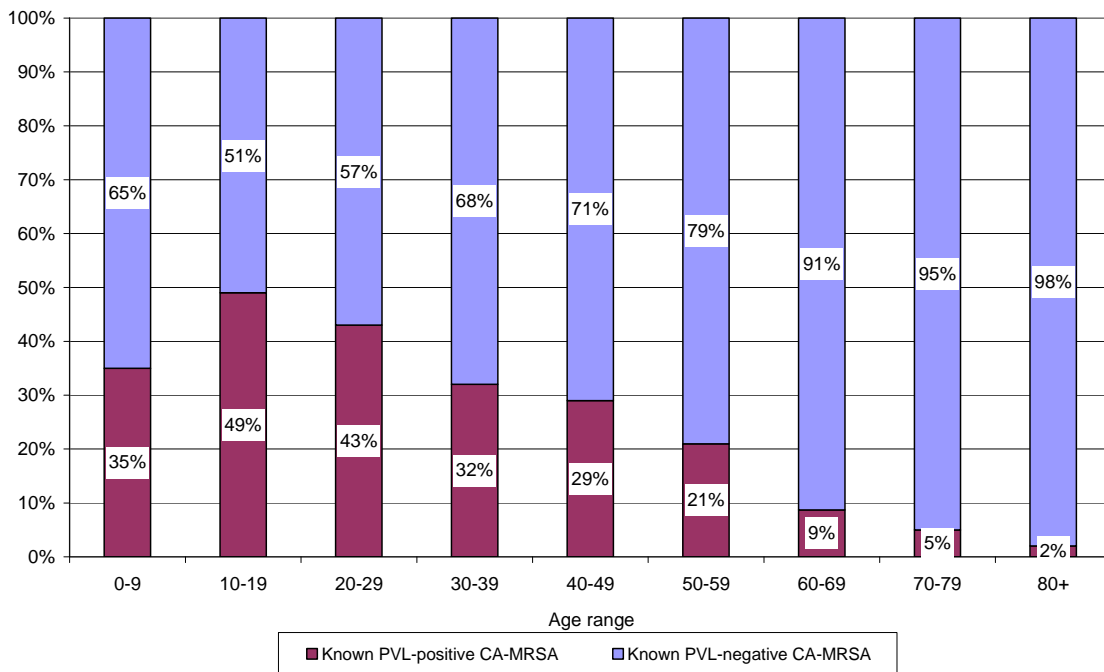


Figure 6: Rate (per 100,000 population) of known PVL-negative CA-MRSA by age, July 2009 to June 2010

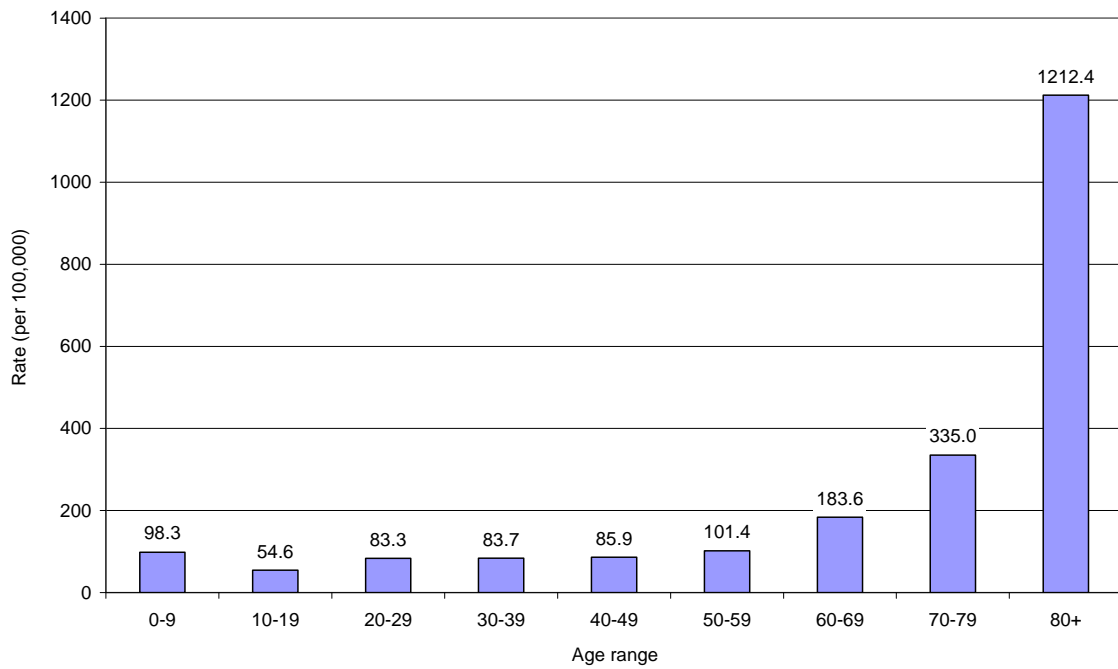
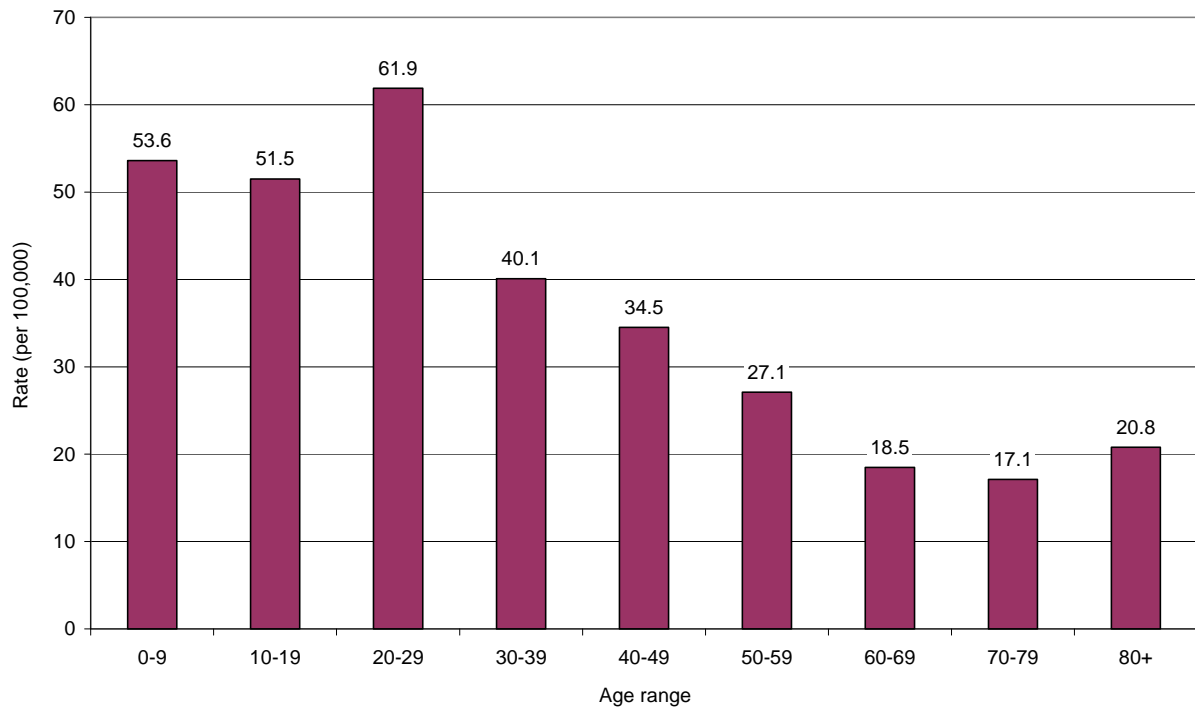


Figure 7: Rate (per 100,000 population) of known PVL-positive CA-MRSA by age, July 2009 to June 2010



4.2 Healthcare-associated MRSA

The early MRSA clones were healthcare-associated (HA-MRSA). HA-MRSA probably originated through the transfer of *SCCmec* into a limited number of *S. aureus* lineages. The antimicrobial resistance genes associated with *SCCmec* types I, II and III conferred an advantage to the bacteria in a healthcare setting.

In contrast to CA-MRSA, HA-MRSA clones are frequently ciprofloxacin resistant (98% compared to 7% resistance in CA-MRSA) and, apart from UK EMRSA-15, carry *SCCmec* types I, II or III.

Table 3: HA-MRSA isolated in Western Australia, July 2009 to June 2010

MLST- <i>SCCmec</i>	Clone	CC*	Patient Isolates n=715 (93.8%)		Staff Isolates n= 47 (6.2%)		n (%)
			Clinical	Screen	Clinical	Screen	
ST22-IV(2B)	UK EMRSA-15, Barnim EMRSA	22	435	246	0	44	725 (95.1)
ST239-III(3A)	Aus-2 EMRSA, Aus-3 EMRSA	8	14	6	0	2	22 (2.9)
ST36-II(2A)	UK EMRSA-16 / USA200	30	4	1	0	1	6 (0.8)
ST8-VI(4B)	Irish-2 EMRSA	8	5	0	0	0	5 (0.7)
ST5-II(2A)	New York/Japan MRSA / USA100	5	3	0	0	0	3 (0.4)
ST217-IV(2B)	UK EMRSA-15 variant A	22	1	0	0	0	1 (0.1)
Total			462	253	0	47	762

*Clonal Complex

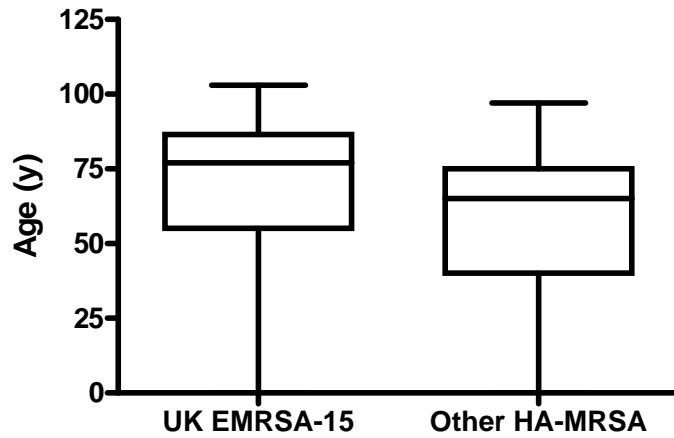
4.2.1 UK EMRSA-15 (ST22-IV[2B])

Introduced into WA in 1997 by overseas healthcare workers, UK EMRSA-15 is the State's most prevalent HA-MRSA. This strain is characterised by ciprofloxacin (+/- erythromycin) resistance although variants and multiresistant strains (7% of total) occur.

From 1st July 2009 to 30th June 2010, 725 UK EMRSA-15 were referred from 30 laboratories. UK EMRSA-15 was detected in all Public Health Regions, however the majority (89%) of patients resided in the Metropolitan region which along with the Great Southern has the highest prevalence (38 and 33/100,000 population respectively). Forty four UK EMRSA-15 were isolated from staff screening swabs.

The mean age of patients with UK EMRSA-15 is 69 years (median 76y); a reflection of the frequent isolation of UK EMRSA-15 from patients residing in nursing homes.

Figure 8: Median age and range (box plot) of patients infected or colonised with UK EMRSA-15 compared to other HA-MRSA.



UK EMRSA-15 is usually PVL negative however in 2009/2010, 15 patients were identified with a PVL-positive strain. An increased MIC to gentamicin ($\geq 4\text{mg/L}$) and/or ciprofloxacin susceptibility are markers for PVL-positive ST22-IV(2B). In the 2009/2010 year, 80% of isolates with a gentamicin MIC $\geq 4\text{mg/L}$ and 31% of ciprofloxacin susceptible UK EMRSA-15 were PVL positive. Patients infected with PVL positive UK EMRSA-15 frequently have a history of travel to the Indian subcontinent.

Figure 9: Annual number of referred strains of UK EMRSA-15 isolated in Western Australia, July 1997 to June 2010

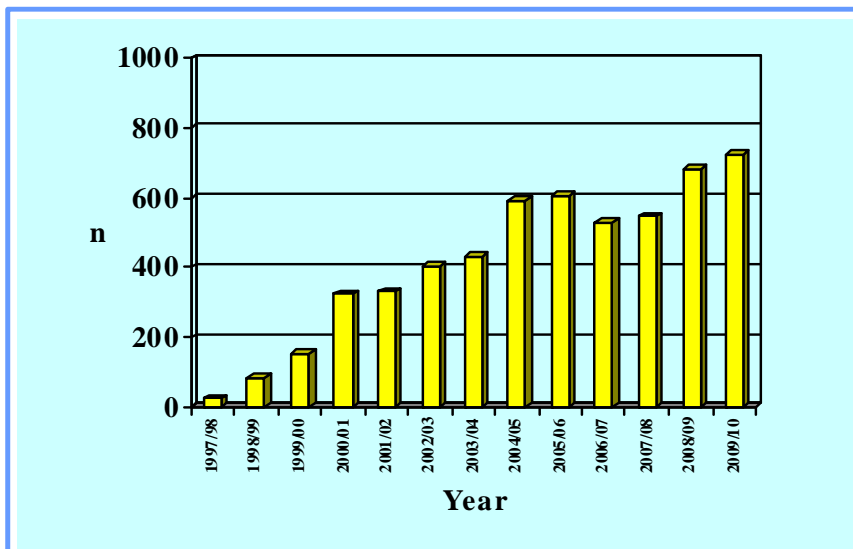
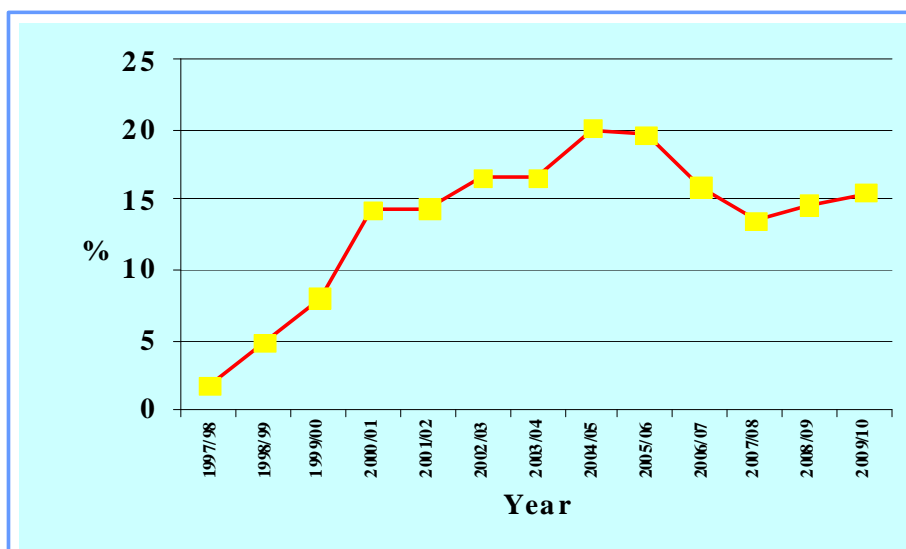


Figure 10: UK EMRSA-15 as a percentage of the annual number of referred MRSA isolated in Western Australia, July 1997 to June 2010



4.2.2 Aus-2/3 EMRSA (ST239-III[3A])

Aus-2/3 EMRSA is a multiresistant clone, thought to have originated on the eastern seaboard of Australia, where it is still the predominant clone in hospitals (www.antimicrobial-resistance.com). A “search and destroy” policy implemented by the Department of Health in 1982 has prevented this clone from becoming established in WA hospitals.

From 1st July 2009 to 30th June 2010, 22 Aus-2/3 EMRSA were referred from nine laboratories in four Public Health Regions (Metropolitan, Kimberley, Southwest and the Wheatbelt).

Figure 11: Annual number of referred strains of Aus-2/3 EMRSA isolated in Western Australia, July 2000 to June 2010

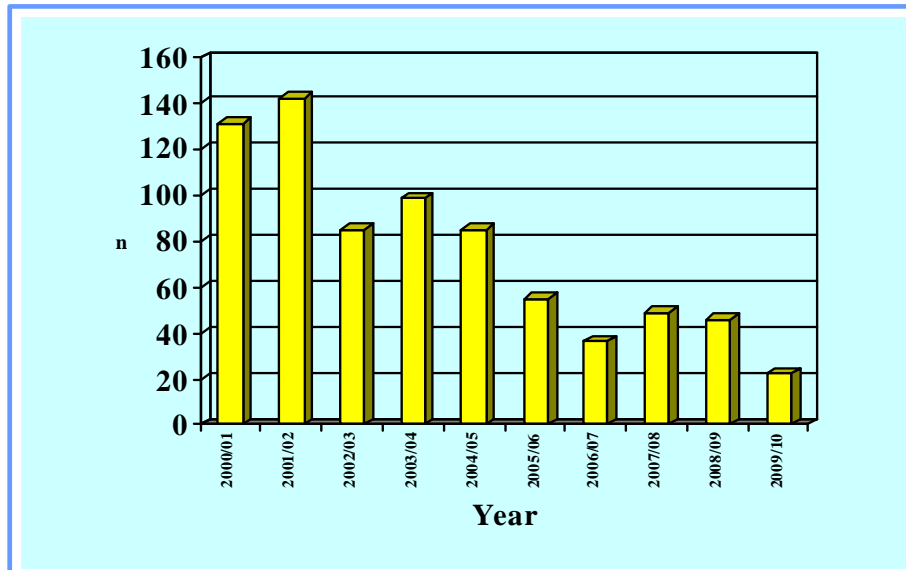
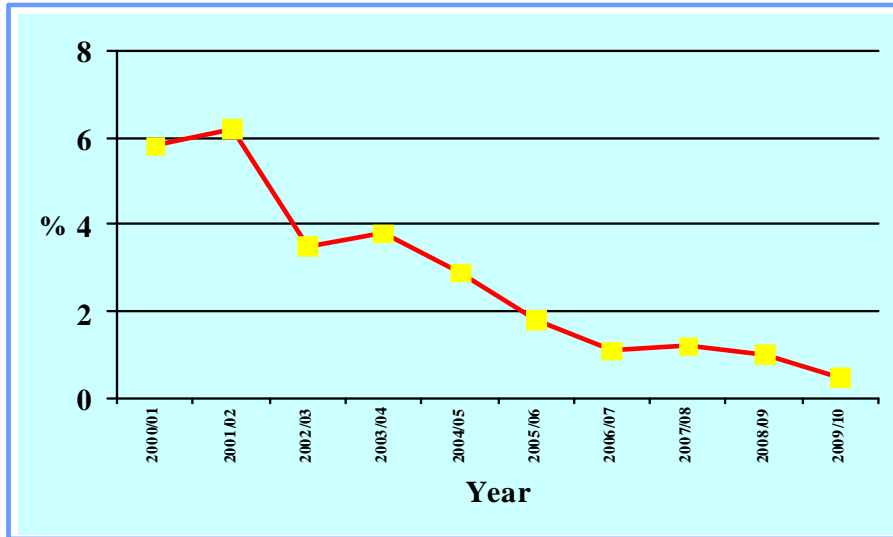


Figure 12: Aus-2/3 EMRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2000 to June 2010



4.2.3 New York/Japan MRSA (ST5-II[2A])

In the early 1990s this strain was reported as the dominant clone in Japanese hospitals and by the mid-1990s was the dominant clone in New York metropolitan hospitals with spread to several neighbouring states. Reports indicated that the New York/Japan clone was replacing the pre-existing HA-MRSA clones. An outbreak in the south west of Western Australia in 2005 was brought under control by the Health Department by the application of standard outbreak management strategies. The index case was a colonised health care worker who had previously been hospitalised overseas (Coombs *et al*, 2007).

From 1st July 2009 to 30th June 2010, three New York/Japan MRSA were referred from three laboratories in two Public Health Regions (Metropolitan and Southwest). Two of the three strains were indistinguishable from the South West outbreak strain. The New York/Japan strain is characterised by resistance to erythromycin and ciprofloxacin and is frequently multiresistant (15% of strains).

Figure 13: Annual number of referred strains of New York/Japan MRSA isolated in Western Australia, July 2003 to June 2010

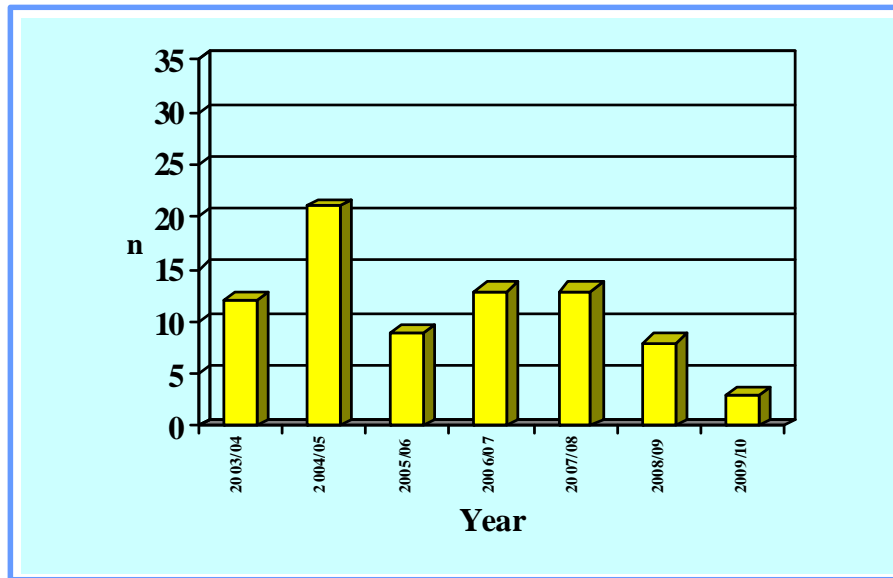
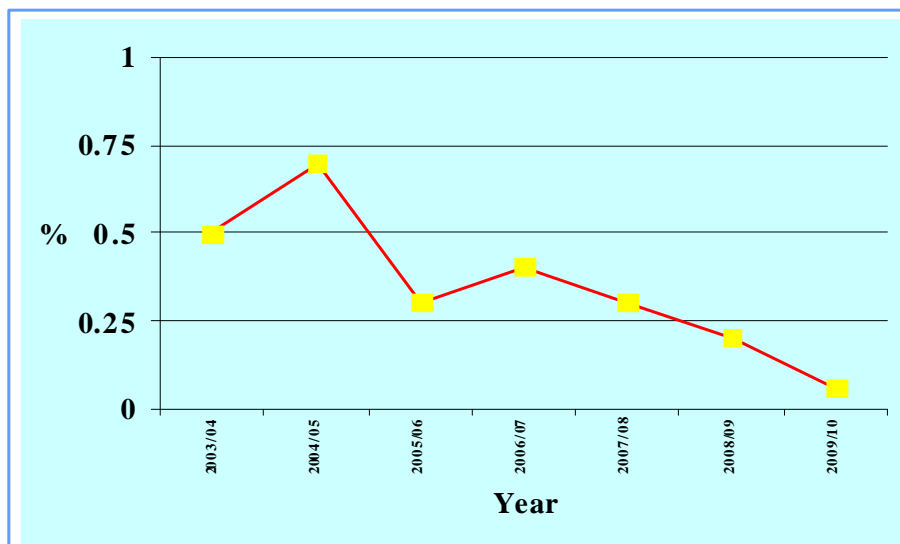


Figure 14: New York/Japan MRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.2.4 UK EMRSA-16 (ST36-II[2A])

UK EMRSA-16 was one of the predominant MRSA clones in the UK healthcare setting until the 1990s. In recent years this strain has become increasingly rare. UK EMRSA-16, characterised by resistance to erythromycin and ciprofloxacin, caused an outbreak in 2002 - 2003 in a Perth metropolitan hospital - the index case was a colonised health care worker. Since this time only small numbers of isolates have been detected.

From 1st July 2009 to 30th June 2010, six UK EMRSA-16 were referred from three laboratories in the Metropolitan region. One patient had a Canadian residential address.

Figure 15: Annual number of referred strains of UK EMRSA-16 isolated in Western Australia, July 1999 to June 2010

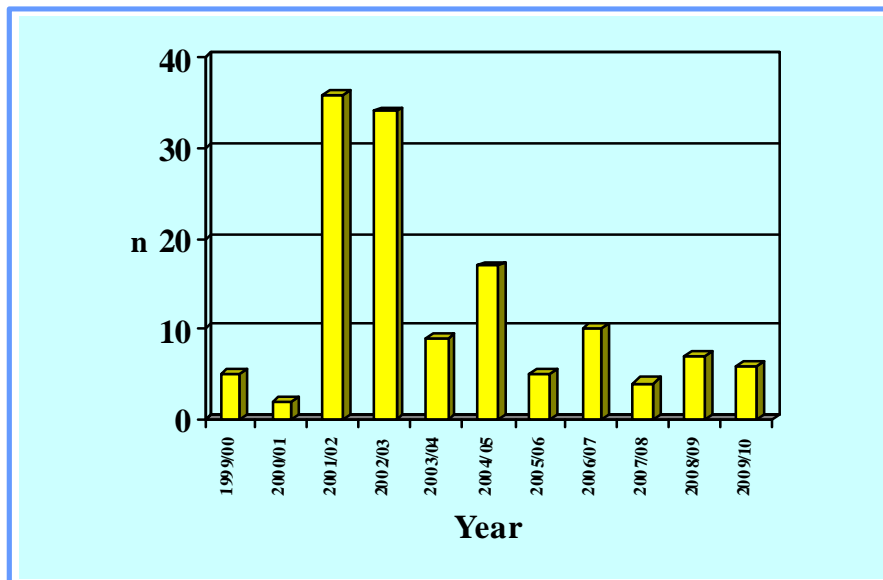
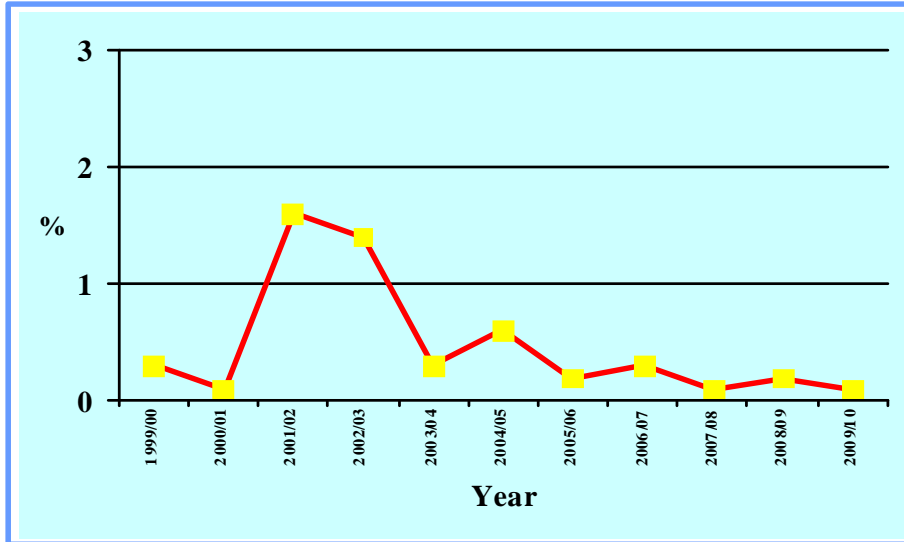


Figure 16: UK EMRSA-16 as a percentage of the annual number of referred MRSA isolated in Western Australia, July 1999 to June 2009



4.2.5 Irish-2 EMRSA (ST8-VI[4B])

Irish-2 EMRSA, characterised by erythromycin, ciprofloxacin and trimethoprim resistance, was first isolated in Ireland and the UK but is now only sporadically reported in Europe and Australia.

From 1st July 2009 to 30th June 2010, five Irish-2 EMRSA were referred from three Metropolitan laboratories.

Figure 17: Annual number of referred strains of Irish-2 EMRSA isolated in Western Australia, July 1997 to June 2010

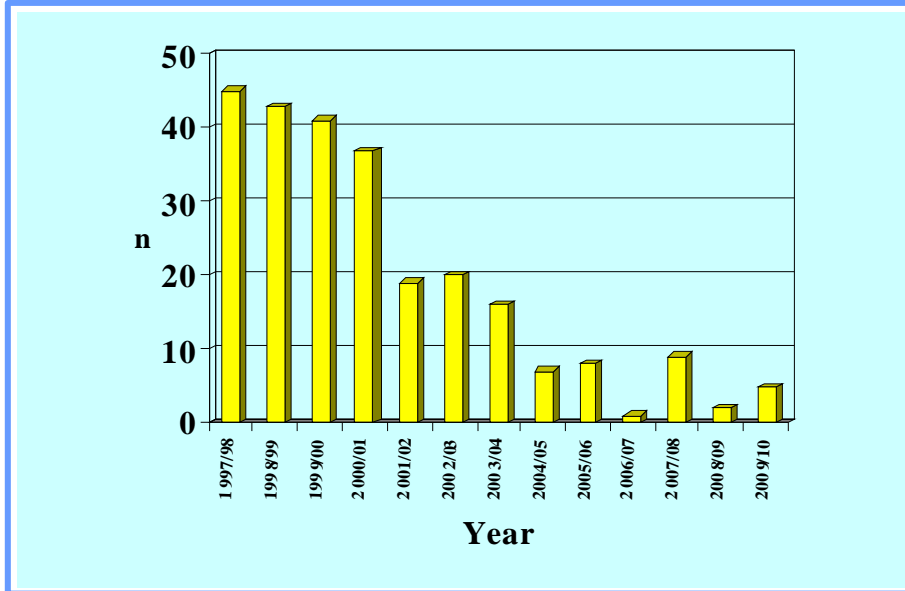
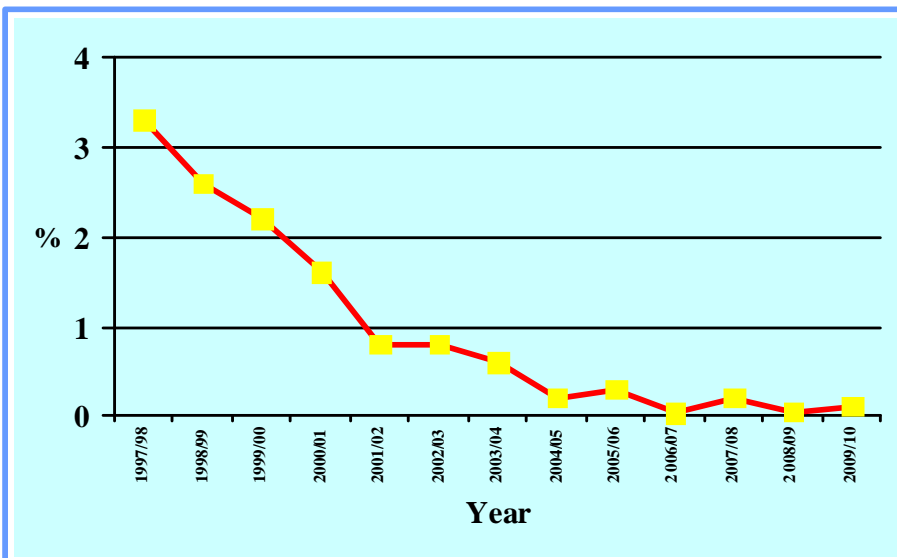


Figure 18: Irish-2 EMRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 1997 to June 2010



4.3 Community-associated MRSA

The earliest reports of CA-MRSA infections involved indigenous people living in remote communities in the sparsely populated Kimberley region of WA. Prior to the global evolution and expansion of CA-MRSA, five CA-MRSA lineages were identified in this region. However since 1989 the CA-MRSA population in WA has become genetically diverse consisting of 106 unique PFGE strains from which 64 MLST/SCC*mec* types have been characterised. Up to 46 MLST/SCC*mec* CA-MRSA clones are thought to have evolved within this region. While SCC*mec* IV and V are the predominant SCC*mec* elements, SCC*mec* VIII and several novel and composite SCC*mec* elements are present in 30% of these strains. The emergence of MRSA in diverse *S. aureus* clonal complexes suggests horizontal transmission of the SCC*mec* element has occurred on multiple occasions.

PVL is a necrotizing toxin that causes leukocyte destruction and tissue necrosis and is associated with abscesses and severe pneumonia. It is present in the majority of community-associated MRSA studied in Europe and USA. Initial studies have shown Western Australia community-associated MRSA infrequently carry the genes encoding PVL. However, due to importation of overseas and interstate CA-MRSA, the overall prevalence of PVL positive clones is increasing in WA. To date six interstate or overseas origin PVL-positive clones have been identified:

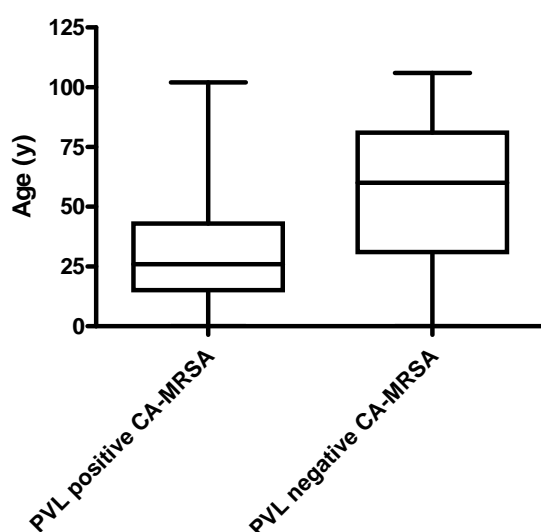
ST30-IV(2B)	Western Samoan clone (WSPP) also known as the South Western Pacific clone or the Oceania MRSA
ST93-IV(2B)	Qld Clone
ST59-V _T (5C2&5)	Taiwan CA-MRSA
ST8-IV(2B)	USA300
ST80-IV(2B)	European CA-MRSA
ST772-V(5C2)	Bengal Bay Clone

Further investigations are required to determine if the PVL-positive WA MRSA-1 strains (approximately 1% of strains) are “USA400 MRSA” or WA MRSA-1 that have acquired the PVL genes.

Based on clone identification, 877/3,931 (22.3%) CA-MRSA (18.7% of total MRSA) characterised in Western Australia between 1st July 2009 and 30th June 2010 were PVL positive. Since 2003/2004, the following clones have increased significantly ($p \leq 0.0001$) in WA: Qld clone, WSPP, USA300, Taiwan clone, Bengal Bay Clone and WA MRSA-62. The Qld clone showed the greatest increase from 0.7% of all MRSA in 2003/2004 to 13.3% in 2009/2010 (Figure 20). The greatest prevalence of PVL positive infection and/or colonisation is in the Kimberley and Pilbara regions (287 and 115/100,000 population respectively) where the Qld clone and WSPP clones are frequently isolated.

The average age of patients infected/colonised with PVL positive CA-MRSA was 29 years (median 26 years) – significantly younger ($T=24.9554$) than patients with PVL negative CA-MRSA (mean 55 years, median 60 years). 93% of PVL positive CA-MRSA strains were isolated from clinical specimens, predominantly skin and soft tissue infections (as opposed to screening swabs), compared to 72% of PVL negative CA-MRSA.

Figure 19: Median age and range (box plot) of patients infected or colonised with PVL positive and PVL negative CA-MRSA



From 1st July 2009 to the 30th June 2010, 41 CA-MRSA clones (3,929 isolates, 55 pulsotypes) were characterised.

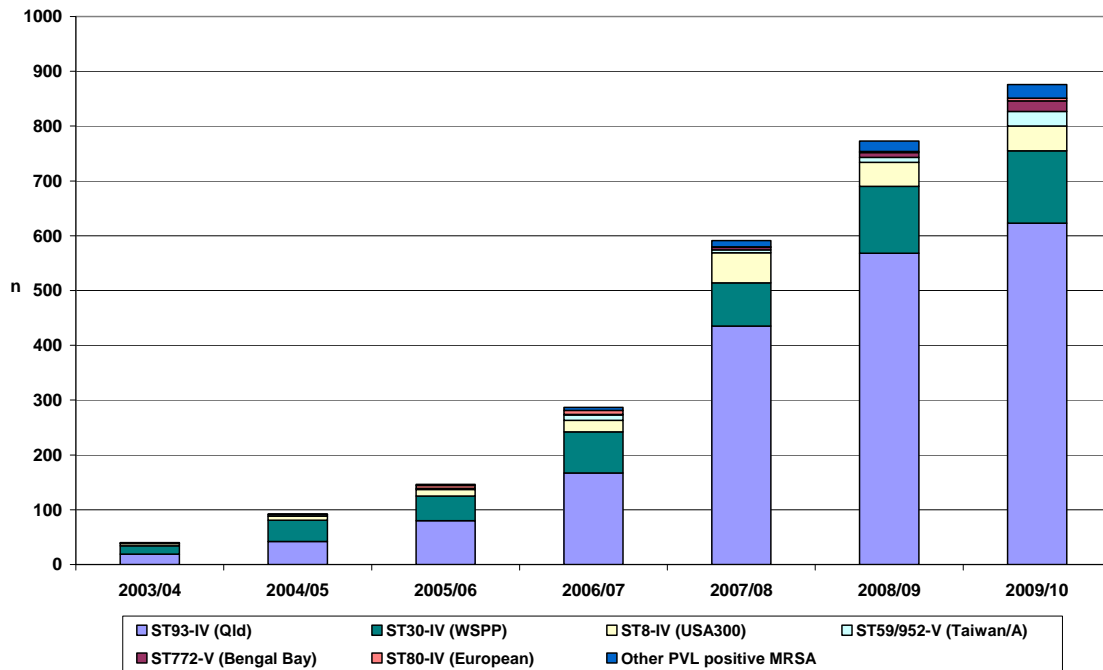
Table 4: CA-MRSA isolated in Western Australia, July 2009 to June 2010

MLST/SCC _{mec}	Clone	CC	Patient Isolates n= 3,850		Staff Isolates n= 79		n (%)
			Clinical	Screen	Clinical	Screen	
ST1-IV(2B)*	WA MRSA-1	1	1,163	390	12	24	1,589 (40.4)
ST78-IV(2B)	WA MRSA-2	88	647	269	1	16	933 (23.7)
ST93-IV(2B)**	Qld Clone	S	585	32	5	1	623 (15.9)
ST5-IV(2B)	WA MRSA-3	5	262	72	2	9	345 (8.8)
ST30-IV(2B)**	WSPP MRSA	30	124	9	0	1	134 (3.4)
ST8-IV(2B)**	USA300	8	43	2	0	0	45 (1.1)
ST59/952-V(5C2&5)**	Taiwan and Taiwan A CA-MRSA	59	26	1	0	0	27 (0.7)
ST772-V(5C2)**	Bengal Bay Clone	1	16	3	0	0	19 (0.5)
ST80-IV(2B)**	European CA-MRSA	80	3	2	0	0	5 (0.1)
Other known PVL-positive CA-MRSA clones**			23	1	0	0	24 (0.6)
Other known PVL-negative CA-MRSA clones			119	58	0	8	185 (4.7)
Total			3,011	839	20	59	3,929

Percentage figures relate to CA-MRSA isolates. *Approximately 1% of WA MRSA-1 are PVL positive.

**Known PVL-positive clone. PVL testing not routinely performed on all MRSA

Figure 20: PVL positive clones, 2003/2004 to 2009/2010



4.3.1 Queensland (Qld) (ST93-IV[2B])

The Qld clone is a known PVL-positive clone.

First detected on the east coast of Australia in the Caucasian population in 2000, this clone has become one of the most prevalent CA-MRSA isolated in Australia. Although the Queensland clone was first detected into WA in 2001, PVL positive ST93-MSSA was identified as the most prevalent *S. aureus* lineage in WA's remote indigenous communities in surveys performed in the mid 1990s and early 2000s (O'Brien *et al*, 2009).

From 1st July 2009 to 30th June 2010, 623 Qld clone MRSA were referred from 38 laboratories.

The Qld Clone was found in all public health regions in 2009/2010 however the prevalence was highest in the Kimberley (237/100,000 population). Isolates were also referred from the Cocos Islands (3), and from patients with interstate addresses (19) and overseas addresses (5) including France, the United Kingdom, the Philippines, Papua New Guinea and Pakistan. The average age of patients was 27 years (median 25 years); the youngest patient group of all the major clones.

Figure 21 : Annual number of strains of Qld Clone isolated in Western Australia, July 2003 to June 2010

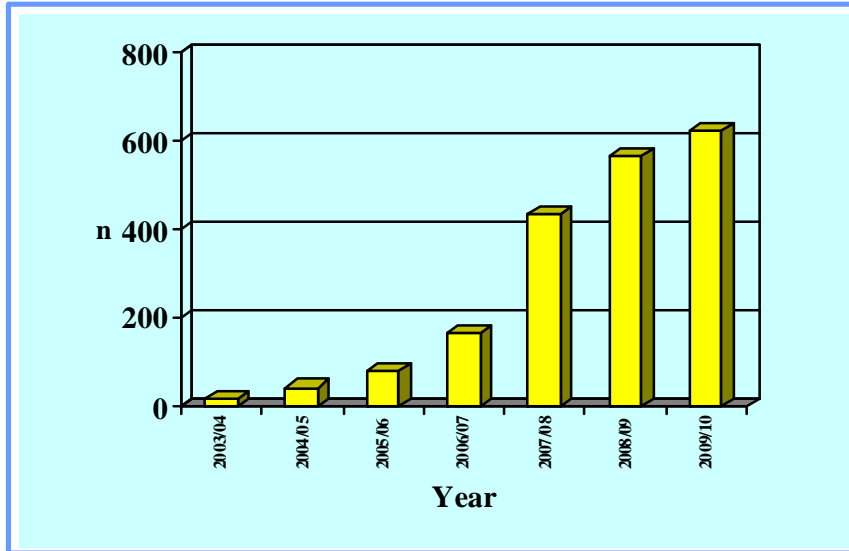
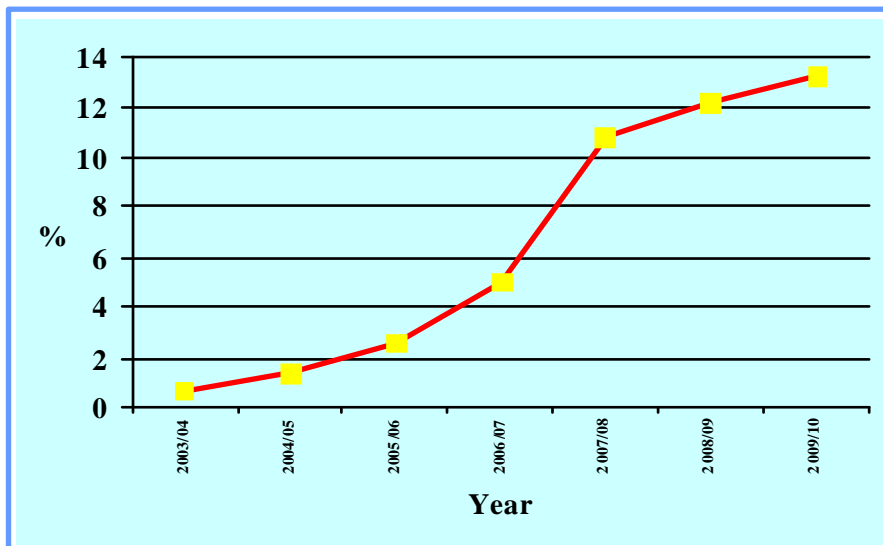


Figure 22: Qld Clone as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.3.2 Western Samoan CA-MRSA (WSPP) (ST30-IV[2B])

WSPP, also known as the South West Pacific (SWP) Clone or Oceania MRSA, is a known PVL positive clone. WSPP was first noted in Australia in 1997 in the Eastern States amongst Polynesians presenting with furunculosis.

From 1st July 2009 to 30th June 2010, 134 WSPP were referred from 29 laboratories. WSPP was the second most isolated PVL positive clone in WA. The highest number of strains (66) was detected in the Metropolitan region, however the highest prevalence was in the Kimberley and Pilbara regions (50 and 33/100,000 population respectively). Ten WSPP (7.5% of total) were isolated from patients with interstate addresses.

The average age of patients was 36 years (median 35 years). The male to female ratio was 1.7:1; the highest ratio amongst the major clones.

Figure 23: Annual number of referred strains of WSPP MRSA isolated in Western Australia, July 2000 to June 2010

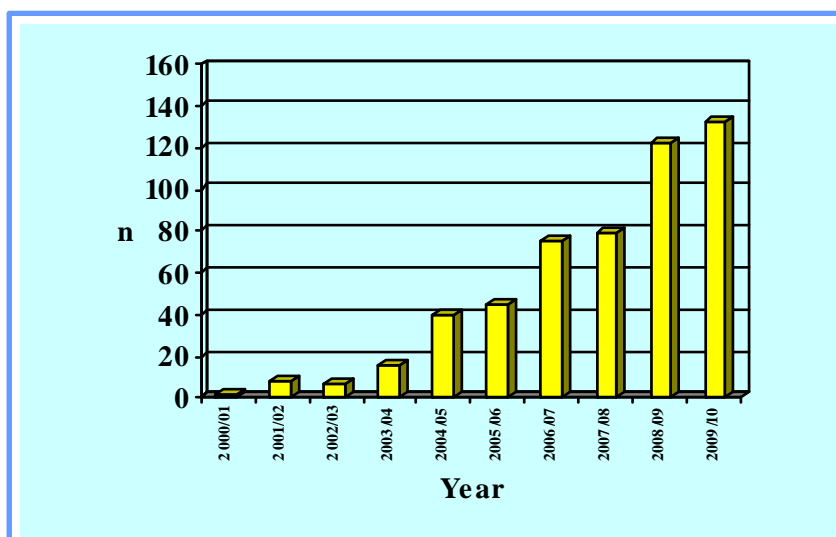
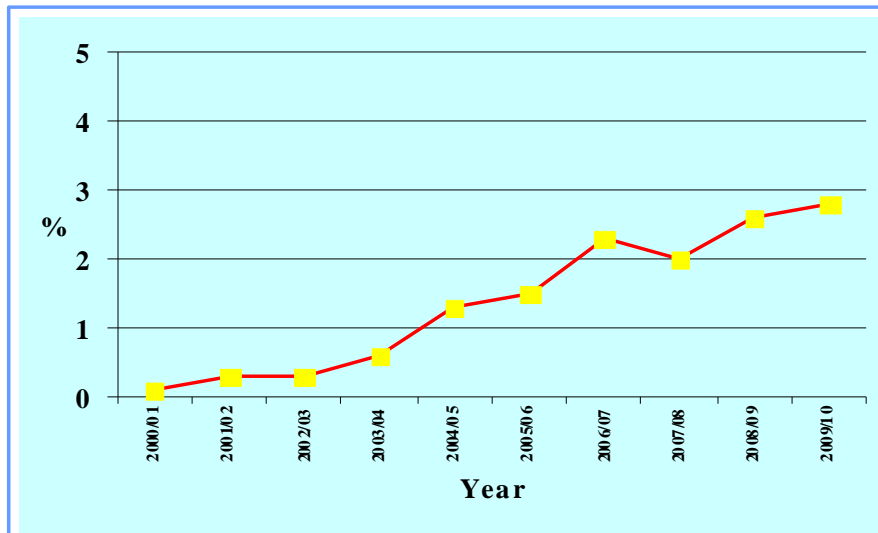


Figure 24: WSPP MRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2000 to June 2010



4.3.3 USA300 (ST8-IV[2B])

USA300 is a known PVL-positive clone.

USA300 has been the dominant MRSA strain in the North American community for several years and is now frequently isolated in the hospital setting. It has also been reported from other countries including Canada, Denmark, Germany, Japan, Switzerland and the UK. USA300 was first reported in WA in 2003 and is now the third most isolated PVL positive clone in WA (sixth most isolated CA-MRSA). Almost 50% of patients presenting with a USA300 infection report a recent travel history.

From 1st July 2009 to 30th June 2010, 45 USA300 were referred from 15 laboratories.

The majority (80%) of USA300 were isolated from patients in the Metropolitan region. No isolates were referred from the Kimberley, Pilbara or MidWest. One patient had an interstate address. The average age of patients with USA300 was 38 years (median 37 years).

Figure 25: Annual number of referred strains of USA300 isolated in Western Australia, July 2003 to June 2010

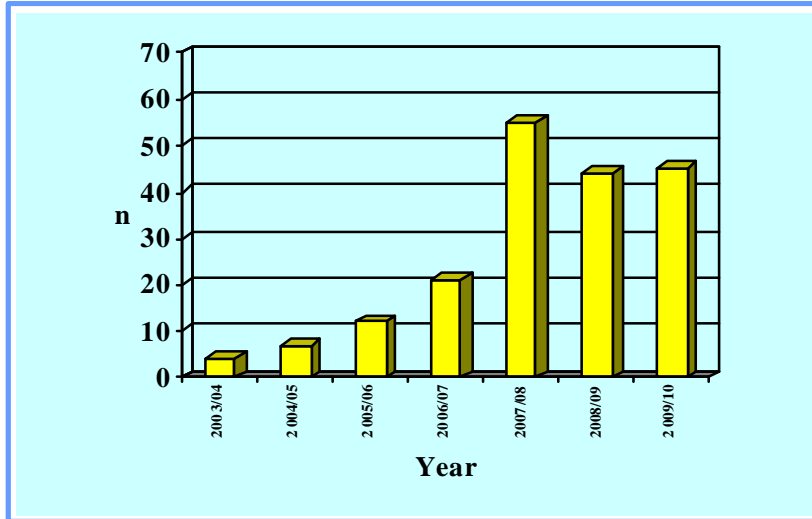
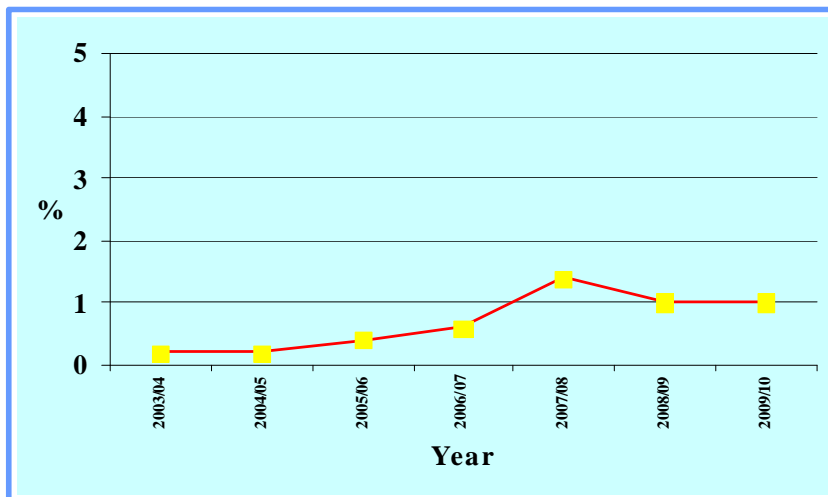


Figure 26: USA300 as a percentage of the annual number of MRSA isolated in Western Australia, July 2003 to June 2010



4.3.4 Taiwan CA-MRSA (ST59-V_T[5C2&5]) and Taiwan A CA-MRSA (ST952-V_T[5C2&5])

The Taiwan and Taiwan A CA-MRSA are known PVL-positive clones.

WA MRSA-52 (ST952-V_T[5C2&5]) is homogeneous to the Taiwan clone by microarray studies and differs by only one base pair by MLST and has therefore been renamed the Taiwan A clone.

The Taiwan clone is the predominant CA-MRSA in the Asia Pacific region and is an important cause of morbidity in Taiwan. This clone has acquired a novel type V SCC*mec* element (V [5C2&5], also known as V_T). The Taiwan clone and other CC59 strains have now been reported in other countries, including the United States of America (USA1000), Sweden, Germany, the United Kingdom and Vietnam.

From 1st July 2009 to 30th June 2010, 21 Taiwan CA-MRSA and six Taiwan A CA-MRSA were referred from 13 laboratories.

The majority (93%) of Taiwan CA-MRSA were isolated from patients in the Metropolitan region. One isolate was referred from a patient in the Great Southern and one from a patient in the South West. The average age of patients was 28 years (median 29 years).

Figure 27: Annual number of referred strains of Taiwan and Taiwan A CA-MRSA isolated in Western Australia, July 2003 to June 2010

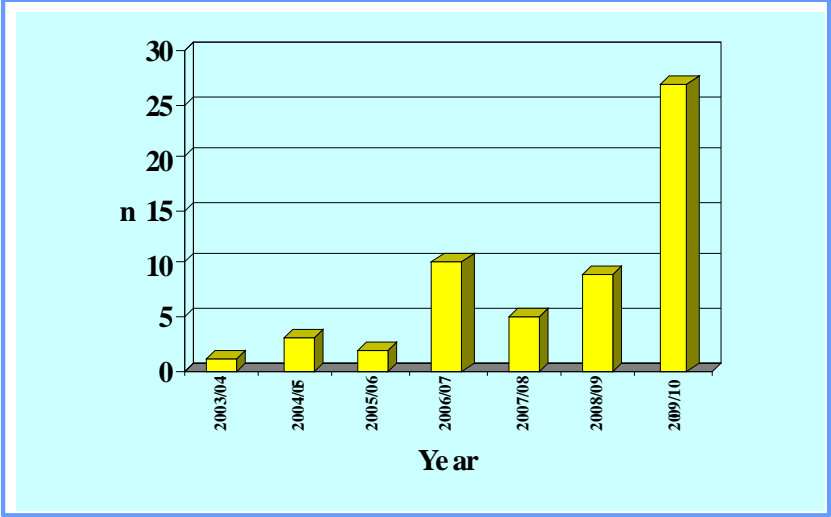


Figure 28: Taiwan and Taiwan A CA-MRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.3.5 Bengal Bay Clone (ST772-V[5C2])

The Bengal Bay clone is a multiresistant PVL-positive clone first reported in Bangladesh. The Bengal Bay clone has been identified in India, Malaysia and the United Kingdom.

From 1st July 2009 to 30th June 2010, 19 Bengal Bay Clone MRSA were referred from eight laboratories.

The average age of patients was 32 years (median 27 years).

Eighteen patients resided in the Metropolitan region and one patient had an Indian residential address. Several of the patients presenting with the Bengal Bay Clone in WA report recent travel to the Indian subcontinent.

Figure 29: Annual number of referred strains of Bengal Bay clone isolated in Western Australia, July 2006 to June 2010

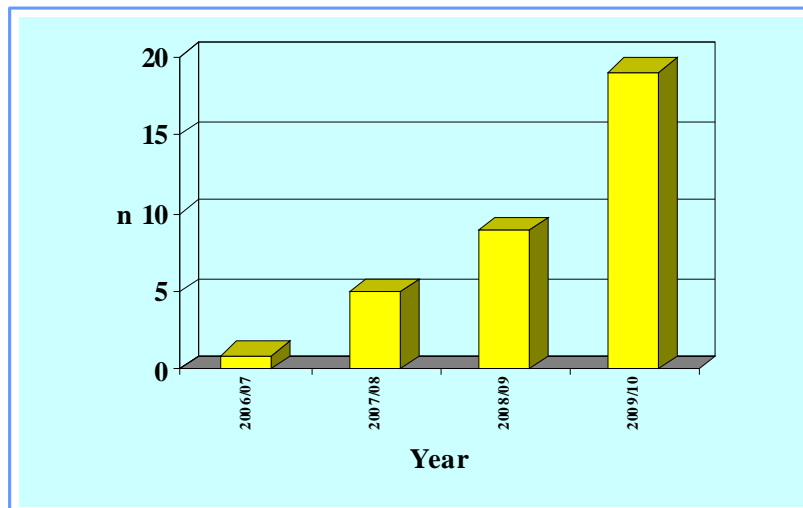
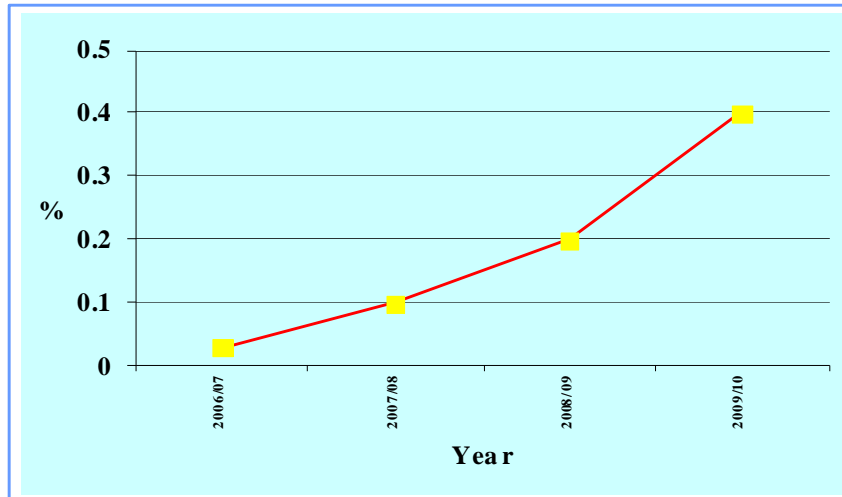


Figure 30: Bengal Bay clone as a percentage of the annual number of referred MRSA isolated in Western Australia , July 2006 to June 2010



4.3.6 European CA-MRSA (ST80-IV[2B])

The European CA-MRSA is a known PVL-positive clone. It is widespread in Europe and the Middle East. In Europe, it has been isolated in Austria, Denmark (where this strain was detected as early as 1993), France, Germany, Greece, Ireland, Malta, the Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom. In Greece, a considerable percentage of MRSA infections can be attributed to this strain. In the Middle East the European clone has been isolated in Abu Dhabi, Kuwait, Lebanon, Israel, Egypt, Algeria, and Tunisia. Travel associated cases have been reported in the European literature (patients returning from Saudi Arabia, Libya and Turkey). The European strain is not commonly isolated in WA.

From 1st July 2009 to 30th June 2010, five European CA-MRSA were referred from five laboratories. Four of the five patients had contact with the Middle East. All patients resided in the Metropolitan region.

Figure 31: Annual number of referred strains of European clone isolated in Western Australia, July 2005 to June 2010

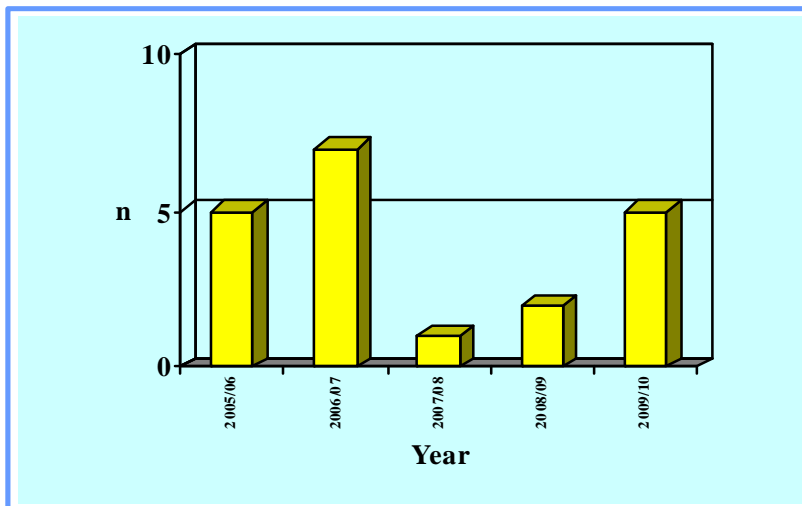
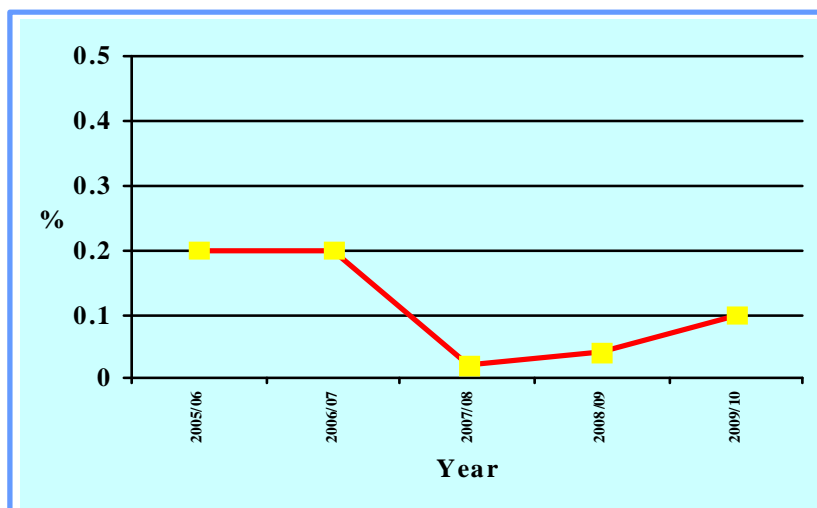


Figure 32: European clone as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2005 to June 2010



4.3.7 WA CA-MRSA

From 1st July 2009 to the 30th June 2010, 3,076 “WA CA-MRSA” were referred to [ACCESS Typing and Research](#). Using MLST-SCC*mec* typing 35 clones (48 pulsotypes) of WA MRSA were identified.

Table 5: WA CA-MRSA clones isolated in Western Australia, July 2009 to June 2010

MLST-SCC <i>mec</i>	Clone	CC	Patient Isolates n= 3,004 (97.7)		Staff Isolates n=72 (2.3)		n (%)
			Clinical	Screen	Clinical	Screen	
Clonal Complex 1							
ST1-IV(2B)	WA MRSA-1	1	1,163	390	12	24	1,589 (51.6)
ST573-V(5C2) [#]	WA MRSA-10	1	1	0	0	0	1 (0.03)
Clonal Complex 5							
ST5-IV(2B)	WA MRSA-3	5	262	72	2	9	345 (11.2)
ST575-IV(2B)	WA MRSA-25	5	2	1	0	0	3 (0.1)
ST835-novel	WA MRSA-40	5	1	2	0	0	3 (0.1)
ST835-V(5C2)	WA MRSA-46	5	3	1	0	0	4 (0.1)
ST835-IV(2B)	WA MRSA-48	5	7	10	0	0	17 (0.6)
ST6-IV(2B)	WA MRSA-51	5	1	0	0	0	1 (0.03)
ST73-IV(2B)	WA MRSA-65	5	11	5	0	1	17 (0.6)
ST6-IV(2B)	WA MRSA-66	5	1	0	0	0	1 (0.03)
ST5-IV(2B)	WA MRSA-71	5	15	3	0	0	18 (0.6)
ST5-IV(2B)	WA MRSA-74	5	1	0	0	0	1 (0.03)
ST5-V(5C2)	WA MRSA-81	5	1	0	0	0	1 (0.03)
ST5-V(5C2)	WA MRSA-86	5	1	0	0	0	1 (0.03)
ST835-V(5C2)	WA MRSA-87	5	1	0	0	0	1 (0.03)
ST5-V(5C2)	WA MRSA-90	5	1	0	0	0	1 (0.03)
ST5-novel	WA MRSA-94	5	1	0	0	0	1 (0.03)
ST5-IV(2B)	WA MRSA-96	5	1	0	0	0	1 (0.03)
ST149-IV(2B)	WA MRSA-98	5	0	1	0	0	1 (0.03)
ST835-novel	WA MRSA-99	5	1	0	0	0	1 (0.03)
ST835-novel	WA MRSA-103	5	1	0	0	0	1 (0.03)
Clonal Complex 8							
ST8-IV(2B)	WA MRSA-5	8	14	11	0	3	28 (0.9)

MLST-SCC <i>mec</i>	Clone	CC	Patient Isolates n= 3,004 (97.7)		Staff Isolates n=72 (2.3)		n (%)
			Clinical	Screen	Clinical	Screen	
ST576-IV(2B)	WA MRSA-31	8	2	1	0	0	3 (0.1)
ST1173-IV(2B)	WA MRSA-58	8	1	0	0	0	1 (0.03)
ST923-IV(2B)*	WA MRSA-62	8	13	1	0	0	14 (0.4)
ST1757-IV(2B)	WA MRSA-92	8	1	0	0	0	1 (0.03)
Clonal Complex 9							
ST834-IV(2B)	WA MRSA-13	9	3	0	0	0	3 (0.1)
Clonal Complex 30							
ST39-IV(2B)	WA MRSA-68	30	1	0	0	0	1 (0.03)
ST30-novel	WA MRSA-102	30	0	1	0	0	1 (0.03)
Clonal Complex 45							
ST45-V(5C2)	WA MRSA-4	45	7	0	0	0	7 (0.2)
ST45-IV(2B)	WA MRSA-23	45	1	0	0	0	1 (0.03)
ST45-IV(2B)	WA MRSA-75	45	18	12	0	0	30 (1.0)
ST45-V(5C2)	WA MRSA-84	45	2	1	0	0	3 (0.1)
Clonal Complex 59							
ST59-IV(2B)	WA MRSA-15	59	3	1	0	0	4 (0.1)
ST87-IV(2B)	WA MRSA-24	59	1	0	0	1	2 (0.06)
ST59-IV(2B)*	WA MRSA-55	59	7	0	0	0	7 (0.2)
ST59-IV(2B)*	WA MRSA-56	59	2	0	0	0	2 (0.06)
ST59-IV(2B)	WA MRSA-73	59	1	2	0	0	3 (0.1)
Clonal Complex 72							
ST72-IV(2B)	WA MRSA-44	72	3	2	0	1	6 (0.2)
ST72-V(5C2)	WA MRSA-91	72	0	0	0	1	1 (0.03)
ST72-novel	WA MRSA-97	72	1	0	0	0	1 (0.03)
Clonal Complex 88							
ST78-IV(2B)	WA MRSA-2	88	647	269	1	16	933 (30.3)
Clonal Complex 97							
ST953-IV(2B)	WA MRSA-54	97	5	1	0	0	6 (0.2)
Clonal Complex 121							
ST577-V(5C2)	WA MRSA-22	121	1	1	0	0	2 (0.06)
ST121-V(5C2)	WA MRSA-93	121	1	0	0	0	1 (0.03)

MLST-SCC <i>mec</i>	Clone	CC	Patient Isolates n= 3,004 (97.7)		Staff Isolates n=72 (2.3)		n (%)
			Clinical	Screen	Clinical	Screen	
Clonal Complex 152							
ST1633-V(5C2)*	WA MRSA-89	152	1	0	0	0	1 (0.03)
Clonal Complex 188							
ST188-IV(2B)	WA MRSA-38	188	1	0	0	0	1 (0.03)
Singleton							
ST883-IV(2B)	WA MRSA-47	S	2	1	0	1	4 (0.1)
Total			2,215	789	15	57	3,076

*Identified as a PVL-positive WA CA-MRSA clone.

Approximately 50% of WA MRSA-10 are PVL positive.

Percentage figures relate to the WA CA-MRSA isolates

Figure 33: Annual number of referred strains of WA MRSA isolated in Western Australia, July 2003 to June 2010

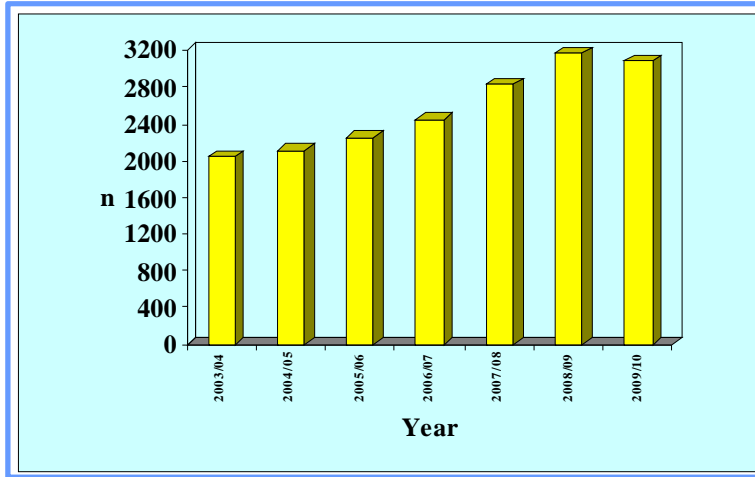
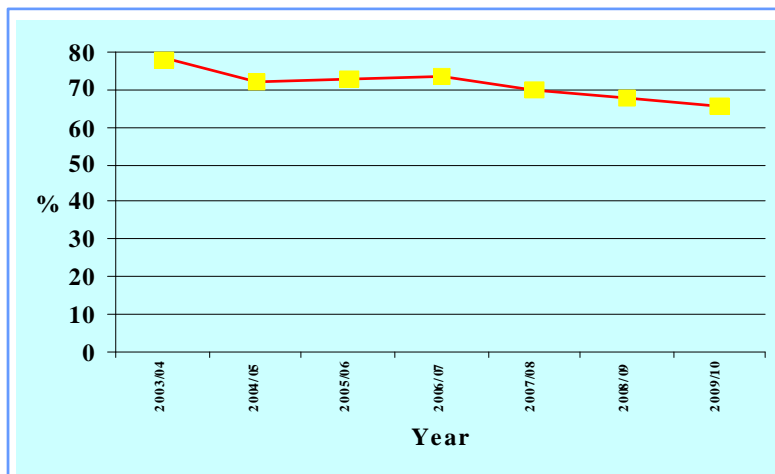


Figure 34: WA MRSA as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.3.8 WA MRSA-1 (ST1-IV[2B])

WA MRSA-1 was first isolated from a clinical specimen in 1995 and is now the most isolated MRSA clone isolated in WA. The vast majority (99%) of WA MRSA-1 are non-multiresistant, with erythromycin resistance (23% of strains) and fusidic acid resistance (17%) being the most common antimicrobial phenotype.

From 1st July 2009 to the 30th June 2010, 1,589 WA MRSA-1 were referred from 40 laboratories.

The highest number of strains (1,064) was detected in the Metropolitan region, however the highest prevalence was in the Kimberley and MidWest regions (345 and 218/100,000 population respectively).

Although WA MRSA-1 is the same clone type as USA400 (a predominant PVL-positive clone in the United States), WA MRSA-1 pre-dates USA400 by several years and is PVL-negative. A small proportion (~1%) of PVL-positive WA MRSA-1 have been detected in WA but these are believed to be imported strains of USA400.

Figure 35: Annual number of referred strains of WA MRSA-1 isolated in Western Australia, July 2003 to June 2010

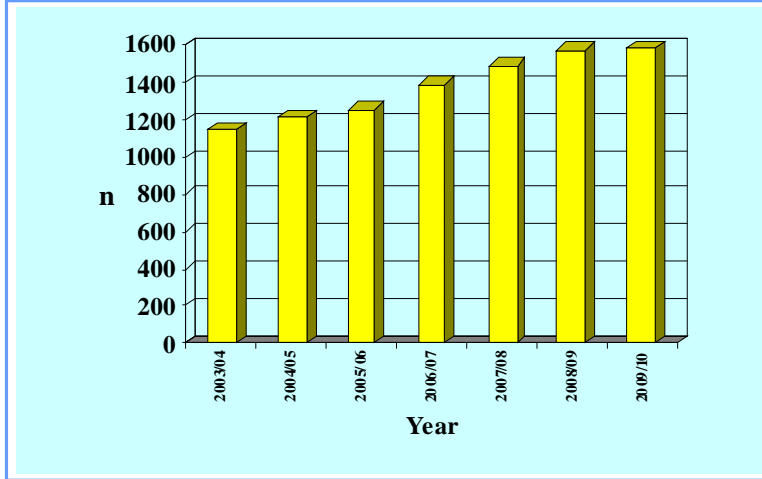
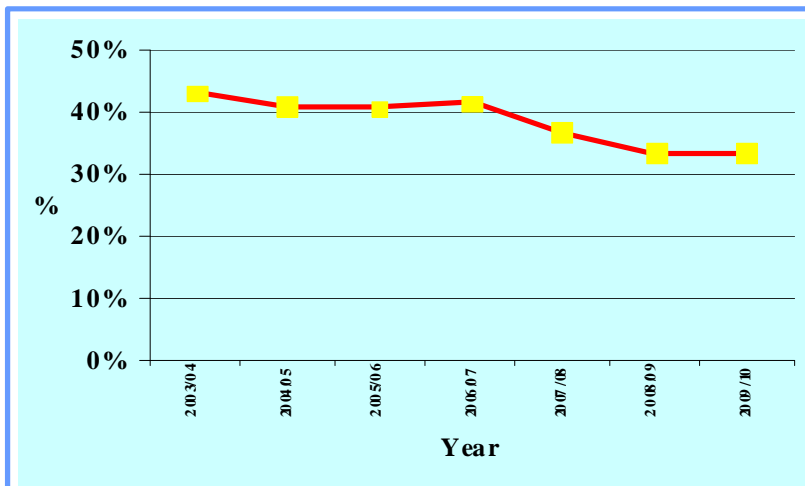


Figure 36: WA MRSA-1 as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.3.9 WA MRSA-2 (ST78-IV[2B])

WA MRSA-2 was first isolated in 1995 from a nasal screening swab. WA MRSA-2 is the second most isolated MRSA clone isolated in WA. 90% of strains are resistant to erythromycin.

From 1st July 2009 to the 30th June 2010, 933 WA MRSA-2 were referred from 39 laboratories.

The highest number of isolates (683) was detected in the Metropolitan region, however the highest prevalence was in the Kimberley and MidWest regions (88 and 82/100,000 population respectively).

Figure 37: Annual number of referred strains of WA MRSA-2 isolated in Western Australia, July 2003 to June 2010

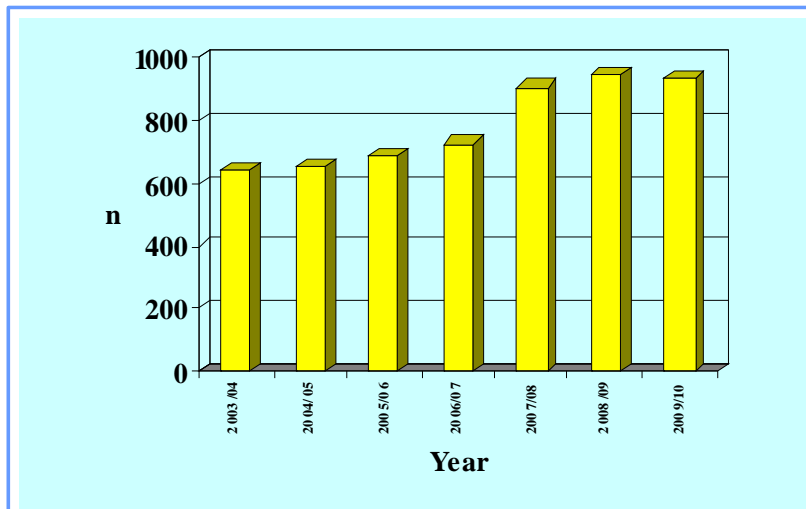
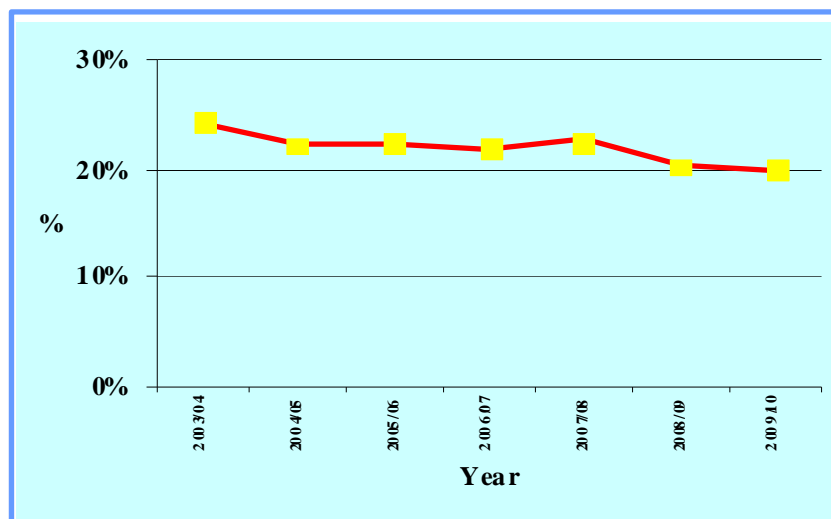


Figure 38: WA MRSA-2 as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



4.3.10 WA MRSA-3 (ST5-IV[2B])

WA MRSA-3 belongs to clonal complex 5 – one of the most diverse global clonal complexes.

WA MRSA-3 was first isolated in 1995 from a nasal screening swab. WA MRSA-3 is the fourth most isolated MRSA clone isolated in WA. Erythromycin resistance is the most common antimicrobial resistance phenotype (37% of strains). Ciprofloxacin resistance is also common (11%).

From 1st July 2009 to the 30th June 2010, 345 WA MRSA-3 were referred from 34 laboratories.

The highest number of isolates (220) was detected in the Metropolitan region, however the highest prevalence was in the Kimberley and Pilbara regions (94 and 50/100,000 population respectively).

Figure 39: Annual number of referred strains of WA MRSA-3 isolated in Western Australia, July 2003 to June 2010

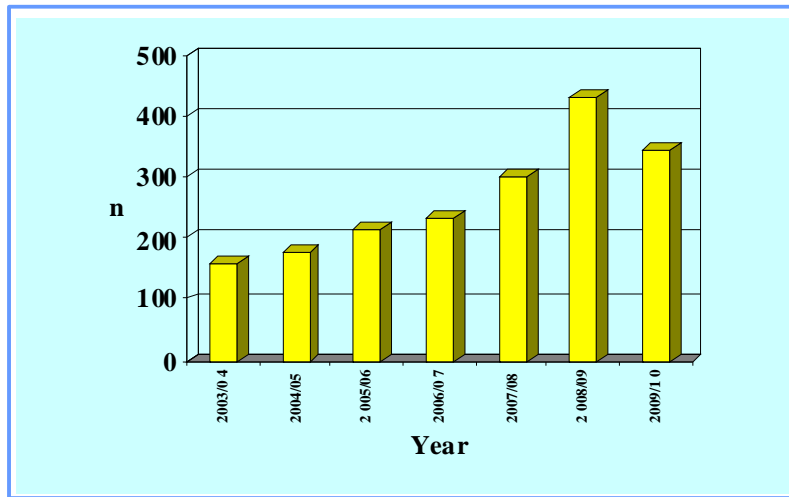
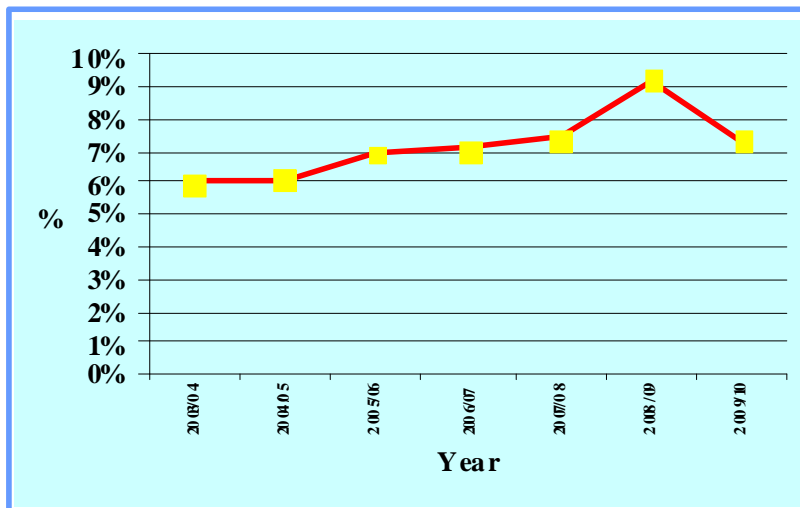


Figure 40: WA MRSA-3 as a percentage of the annual number of referred MRSA isolated in Western Australia, July 2003 to June 2010



Section 5

Number and Rate of MRSA in Western Australia by Public Health Region

5 Number and Rate of MRSA in Western Australia by Public Health Region

5.1 Regional data, 1st July 2009 to 30th June 2010

The majority (70%) of MRSA were referred from the Metropolitan region. The Mid West and Kimberley regions accounted for 6% of referred MRSA, the South West region 5% with all other regions contributing less than 5% of isolates. MRSA infection and/or colonisation rates were highest for the Kimberley region (857/100,000 population). The Metropolitan region has the highest rate of healthcare-associated MRSA (HA-MRSA) (40/100,000 population) while the Kimberley, Mid West and Pilbara regions had the highest rates of community-associated MRSA (CA-MRSA) (840, 427 and 319/100,000 population respectively). These same regions also had the highest rates of PVL-positive CA-MRSA (287, 115 and 87/100,000 population respectively).

Table 6: New MRSA cases notified to Department of Health by Public Health Region according to postcode of residence, July 2009 to June 2010

MLST/SCC <i>mec</i>	PFGE	Public Health Region									
		Kimb	Pilb	MidW	Gold	Wheat	Metro	SthW	GStH	Not WA	Total
Healthcare-associated MRSA											
ST239-III(3A)	Aus-2 EMRSA	1				1	9	2			13
ST239-III(3A)	Aus -3 EMRSA	2					7				9
ST22-IV(2B)	UK EMRSA-15	3	2	17	17	13	644	9	19	1	725
ST217-IV(2B)	UK EMRSA-15 Variant A						1				1
ST36-II(2A)	UK EMRSA-16						5			1	6
ST8-VI(4B)	Irish -2 EMRSA						5				5
ST5-II(2A)	New York/Japan MRSA						2	1			3
Total Healthcare-associated MRSA		6	2	17	17	14	673	12	19	2	762
PVL-negative community-associated MRSA											
ST1-IV(2B)	WA MRSA-1	118	52	138	54	39	1,064	78	40	6	1,589
ST78-IV(2B)	WA MRSA-2	30	15	52	11	35	683	78	25	4	933
ST5-IV(2B)	WA MRSA-3	32	23	21	18	6	220	14	10	1	345
ST45-V(5C2)	WA MRSA-4			2			3	2			7
ST8-IV(2B)	WA MRSA-5		1				24	3			28
ST573-V(5C2)	WA MRSA-10									1	1
ST834-IV(2B)	WA MRSA-13						3				3
ST59-IV(2B)	WA MRSA-15				1		3				4
ST577-V(5C2)	WA MRSA-22						2				2
ST45-IV(2B)	WA MRSA-23						1				1
ST87-IV(2B)	WA MRSA-24						2				2
ST575-IV(2B)	WA MRSA-25	1					2				3
ST576-IV(2B)	WA MRSA-31						3				3
ST188-IV(2B)	WA MRSA-38						1				1
ST835-novel	WA MRSA-40						3				3
ST72-IV(2B)	WA MRSA-44						5			1	6
ST835-V(5C2)	WA MRSA-46						4				4
ST883-IV(2B)	WA MRSA-47	3					1				4
ST835-IV(2B)	WA MRSA-48						17				17
ST6-IV(2B)	WA MRSA-51						1				1
ST953-IV(2B)	WA MRSA-54		2		1		3				6
ST1173-IV(2B)	WA MRSA-58						1				1
ST73-IV(2B)	WA MRSA-65	4	1	1	2	1	7	1			17
ST6-IV(2B)	WA MRSA-66						1				1
ST39-IV(2B)	WA MRSA-68					1					1
ST5-IV(2B)	WA MRSA-71						18				18
ST59-IV(2B)	WA MRSA-73						3				3
ST5-IV(2B)	WA MRSA-74							1			1

MLST/SCC <i>mec</i>	PFGE	Public Health Region									
		Kimb	Pilb	MidW	Gold	Wheat	Metro	SthW	GStH	Not WA	Total
ST45-IV(2B)	WA MRSA-75	1				1	26	2			30
ST5-V(5C2)	WA MRSA-81						1				1
ST45-V(5C2)	WA MRSA-84			1				1		1	3
ST5-V(5C2)	WA MRSA-86							1			1
ST835-V(5C2)	WA MRSA-87						1				1
ST5-V(5C2)	WA MRSA-90						1				1
ST72-V(5C2)	WA MRSA-91						1				1
ST1757-IV(2B)	WA MRSA-92						1				1
ST121-V(5C2)	WA MRSA-93						1				1
ST5-novel	WA MRSA-94						1				1
ST5-IV(2B)	WA MRSA-96						1				1
ST72-novel	WA MRSA-97						1				1
ST149-IV(2B)	WA MRSA-98						1				1
ST835-novel	WA MRSA-99						1				1
ST30-novel	WA MRSA-102			1							1
ST835-novel	WA MRSA-103						1				1
Total PVL-negative community-associated MRSA		189	94	216	87	83	2,113	181	75	14	3,052
PVL-positive community-associated MRSA											
ST59-IV(2B)	WA MRSA-55						7				7
ST59-IV(2B)	WA MRSA-56						1			1	2
ST923-IV(2B)	WA MRSA-62						13	1			14
ST1633-V(5C2)	WA MRSA-89						1				1
ST772-V(5C2)	Bengal Bay Clone						18			1	19
ST59-V(5C2&5)	Taiwan CA-MRSA						20		1		21
ST952-V(5C2&5)	Taiwan A CA-MRSA						5	1			6
ST8-IV(2B)	USA300 MRSA				1	2	36	4	1	1	45
ST93-IV(2B)	Qld Clone	81	38	51	12	32	307	52	26	24	623
ST30-IV(2B)	WSPP MRSA	17	15	4	5	7	67	6	3	10	134
ST80-IV(2B)	European Clone						5				5
Total PVL-positive community-associated MRSA		98	53	55	18	41	480	64	31	37	877
Total community-associated MRSA		287	147	271	105	124	2,593	245	106	51	3,929
Total MRSA		293	149	288	122	138	3,266	257	125	53	4,691

Kimb = Kimberley, Pilb = Pilbara, MidW = Midwest, Gold = Goldfields, Wheat = Wheatbelt, Metro = Metropolitan, SthW = South West, GStH – Great Southern, Not WA = Outside WA. MLST/SCC*mec* types may have multiple PFGE pulsotypes.

Table 7: MRSA notification rates per 100,000 population by Public Health Region according to postcode of residence, July 2009 to June 2010

		Kim	Pilb	MidWest	Gold	Wheat	Metro	SthW	GSth	Total
Population*		34,185	45,983	63,409	58,074	75,035	1,684,985	152,087	57,439	2,171,197
MLST/SCC <i>mec</i>	PFGE									
Healthcare-associated MRSA										
ST239-III(3A)	Aus-2 EMRSA	2.93				1.33	0.53	1.32		0.60
ST239-III(3A)	Aus -3 EMRSA	5.85					0.43			0.41
ST22-IV(2B)	UK EMRSA-15	8.78	4.35	26.81	29.27	17.33	38.22	5.92	33.08	33.35
ST217-IV(2B)	UK EMRSA-15 Variant A						0.06			0.05
ST36-II(2A)	UK EMRSA-16						0.30			0.23
ST8-VI(4B)	Irish -2 EMRSA						0.30			0.23
ST5-II(2A)	New York/Japan MRSA						0.12	2.93		0.14
Total Healthcare-associated MRSA		17.55	4.35	26.81	29.27	18.66	39.94	7.89	33.08	35.10
PVL-negative community-associated MRSA										
ST1-IV(2B)	WA MRSA-1	345.18	113.09	217.63	92.98	51.98	63.15	51.29	69.64	72.91
ST78-IV(2B)	WA MRSA-2	87.76	32.62	82.01	18.94	46.64	40.53	51.29	43.52	42.79
ST5-IV(2B)	WA MRSA-3	93.61	50.02	33.12	30.99	8.00	13.06	9.21	17.41	15.84
ST45-V(5C2)	WA MRSA-4			3.15			0.18	1.32		0.32
ST8-IV(2B)	WA MRSA-5		2.17				1.42	1.97		1.29
ST834-IV(2B)	WA MRSA-13						0.18			0.14
ST59-IV(2B)	WA MRSA-15				1.72		0.18			0.18
ST577-V(5C2)	WA MRSA-22						0.12			0.09
ST45-IV(2B)	WA MRSA-23						0.06			0.05
ST87-IV(2B)	WA MRSA-24						0.12			0.09
ST575-IV(2B)	WA MRSA-25	2.93					0.12			0.14
ST576-IV(2B)	WA MRSA-31						0.18			0.14
ST188-IV(2B)	WA MRSA-38						0.06			0.05
ST835-novel	WA MRSA-40						0.18			0.14
ST72-IV(2B)	WA MRSA-44						0.30			0.28
ST835-V(5C2)	WA MRSA-46						0.24			0.18
ST883-IV(2B)	WA MRSA-47	8.78					0.06			0.18
ST835-IV(2B)	WA MRSA-48						1.01			0.78
ST6-IV(2B)	WA MRSA-51						0.06			0.05
ST953-IV(2B)	WA MRSA-54		4.35		1.72		0.18			0.28
ST1173-IV(2B)	WA MRSA-58						0.06			0.05
ST73-IV(2B)	WA MRSA-65	11.70	2.17	1.58	3.44	1.33	0.42	0.66		0.78
ST6-IV(2B)	WA MRSA-66						0.06			0.05
ST39-IV(2B)	WA MRSA-68					1.33				0.05
ST5-IV(2B)	WA MRSA-71						1.07			0.83
ST59-IV(2B)	WA MRSA-73						0.18			0.14
ST5-IV(2B)	WA MRSA-74							0.66		0.05
ST45-IV(2B)	WA MRSA-75	2.93				1.33	1.54	1.32		1.38
ST5-V(5C2)	WA MRSA-81						0.06			0.05
ST45-V(5C2)	WA MRSA-84			1.58				0.66		0.09
ST5-V(5C2)	WA MRSA-86							0.66		0.05
ST835-V(5C2)	WA MRSA-87						0.06			0.05

Population*		Kimb	Pilb	MidWest	Gold	Wheat	Metro	SthW	GSth	Total
		34,185	45,983	63,409	58,074	75,035	1,684,985	152,087	57,439	2,171,197
ST5-V(5C2)	WA MRSA-90						0.06			0.05
ST72-V(5C2)	WA MRSA-91						0.06			0.05
ST1757-IV(2B)	WA MRSA-92						0.06			0.05
ST121-V(5C2)	WA MRSA-93						0.06			0.05
ST5-novel	WA MRSA-94						0.06			0.05
ST5-IV(2B)	WA MRSA-96						0.06			0.05
ST72-novel	WA MRSA-97						0.06			0.05
ST149-IV(2B)	WA MRSA-98						0.06			0.05
ST835-novel	WA MRSA-99						0.06			0.05
ST30-novel	WA MRSA-102			1.58						0.05
ST835-novel	WA MRSA-103						0.06			0.05
Total PVL-negative community-associated MRSA		552.87	204.42	340.65	149.81	110.62	125.40	119.01	130.57	140.57
PVL-positive community-associated MRSA										
ST59-IV(2B)	WA MRSA-55						0.42			0.32
ST59-IV(2B)	WA MRSA-56						0.06			0.05
ST923-IV(2B)	WA MRSA-62						0.77	0.66		0.64
ST1633-V(5C2)	WA MRSA-89						0.06			0.05
ST772-V(5C2)	Bengal Bay Clone						1.07			0.83
ST59-V(5C2&5)	Taiwan CA-MRSA						1.19		1.74	0.97
ST952-V(5C2&5)	Taiwan A CA-MRSA						0.30	0.66		0.28
ST8-IV(2B)	USA300 MRSA				1.72	2.67	2.14	2.63	1.74	2.03
ST93-IV(2B)	Qld Clone	236.95	82.64	80.43	20.66	42.65	18.22	34.19	45.27	27.59
ST30-IV(2B)	WSPP MRSA	49.73	32.62	6.31	8.61	9.33	3.98	3.95	5.22	5.67
ST80-IV(2B)	European Clone						0.30			0.23
Total PVL-positive community-associated MRSA		286.68	115.26	86.74	30.99	54.64	28.49	42.08	53.97	40.39
Total community-associated MRSA		839.55	319.68	427.38	180.80	165.26	153.89	161.09	184.54	180.96
Total MRSA		857.10	324.03	454.19	210.08	183.91	193.83	168.98	217.62	216.06

Metro = Metropolitan, Kimb = Kimberley, SthW = South West, Gold = Goldfields, Pilb = Pilbara, GSth – Great Southern, MidWest = Midwest, Wheatbelt = Wheatbelt

* Population figures (2008) obtained from Epidemiology Branch, Department of Health WA.

Figure 41: CA-MRSA and HA-MRSA notification rates per 100,000 population by public health region according to postcode of residence, July 2009 to June 2010

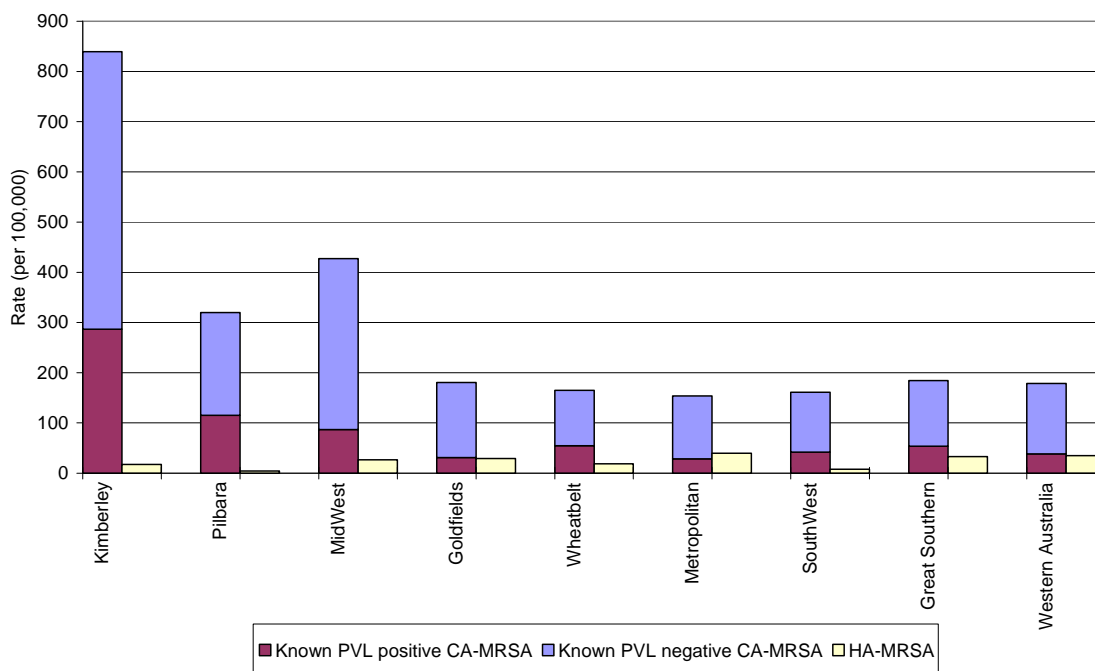
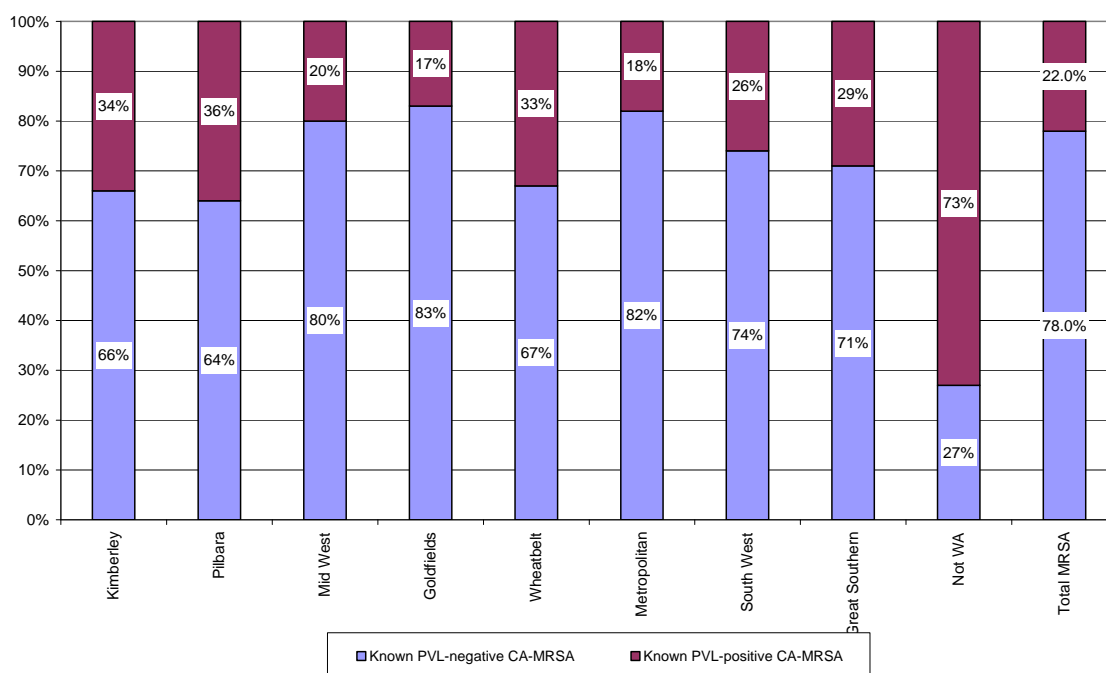


Figure 42: Proportion of known PVL-positive and PVL-negative CA-MRSA by public health region according to postcode of residence, July 2009 to June 2010



5.2 Trend data, July 2003 to June 2010

In Western Australia, cases of infection or colonisation with HA-MRSA remained constant compared to the previous 12 months. There were 760 isolates of HA-MRSA in the 2009/2010 financial year (16.2% of all MRSA) compared to 754 in 2008/2009 (16.2% of all MRSA). The majority of HA-MRSA in each year were UK EMRSA-15 (ranging from 75% in 2003/2004 to 95% in 2009/2010).

In WA, CA-MRSA numbers have significantly increased from 2003/2004 to 2009/2010 both for known PVL-positive and PVL-negative clones ($p < 0.0001$). Of the PVL-positive clones, the Qld clone, WSPP, USA300, Taiwan clone, Bengal Bay Clone and WA MRSA-62 increased significantly from 2003/2004 to 2009/2010 ($p \leq 0.0001$). The Qld clone showed the greatest increase from 0.7% of all MRSA in 2003/2004 to 13.3% in 2009/2010. In the same time period WSPP increased from 0.6% to 2.8%, USA300 increased from 0.2% to 1.0%, Taiwan clone increased from 0.04% to 0.45%, Bengal Bay Clone increased from 0% to 0.4% and WA MRSA-62 increased from 0% to 0.3%.

All public health regions showed significant increases in the number of known PVL-positive clones from 2003/2004 to 2009/2010. The greatest increases were seen in the Pilbara, Kimberley and Wheatbelt regions (1 [1%] to 53 [36%], 0 [0%] to 98 [33%] and 0 [1%] to 41 [30%] of all MRSA respectively).

In the past year (2008/2009 to 2009/2010), significant changes to the proportion of MRSA that are PVL positive occurred in five regions. The Pilbara, Kimberley, Great Southern and Southwest regions had significant increases in PVL positive clones (16% to 36% [$p = 0.0003$], 22% to 33% [$p = 0.0086$], 12% to 25% [$p = 0.0094$] and 16% to 25% [$p = 0.0110$] respectively). The Mid West region had a decrease in PVL positive clones (29% to 19%, $p = 0.0077$). This may have been due to the cessation of a community screening programme in Geraldton following increased notifications of the PVL-positive Qld clone in the 2008/2009 year.

Figure 43: Number of HA-MRSA and CA-MRSA, Western Australia July 2003 to June 2010

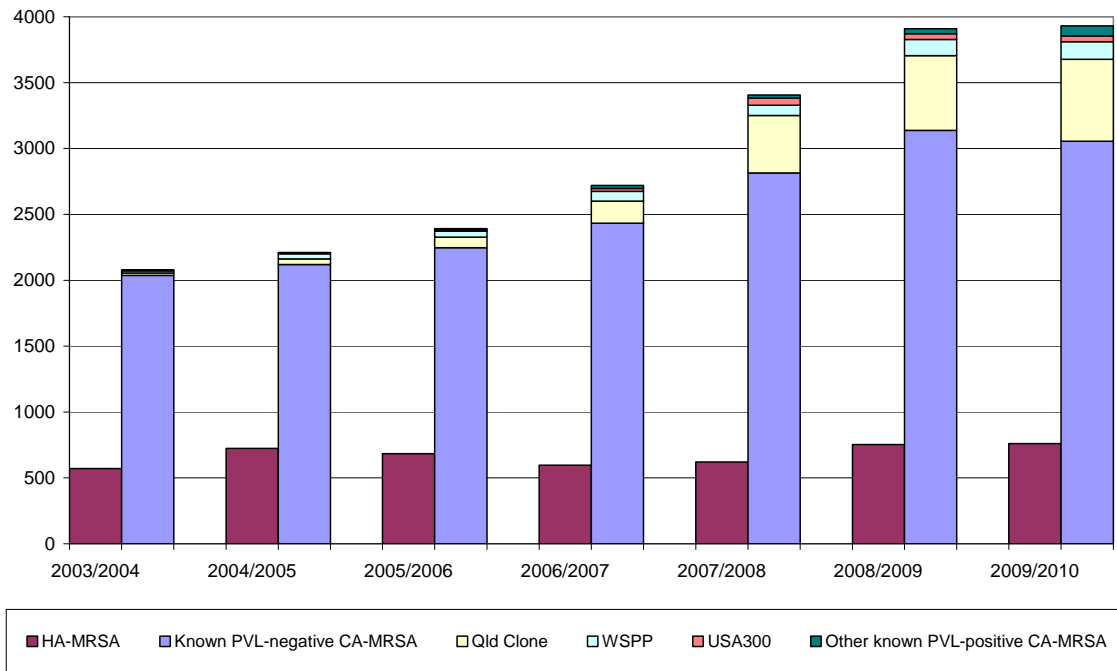


Figure 44: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Western Australia July 2003 to June 2010

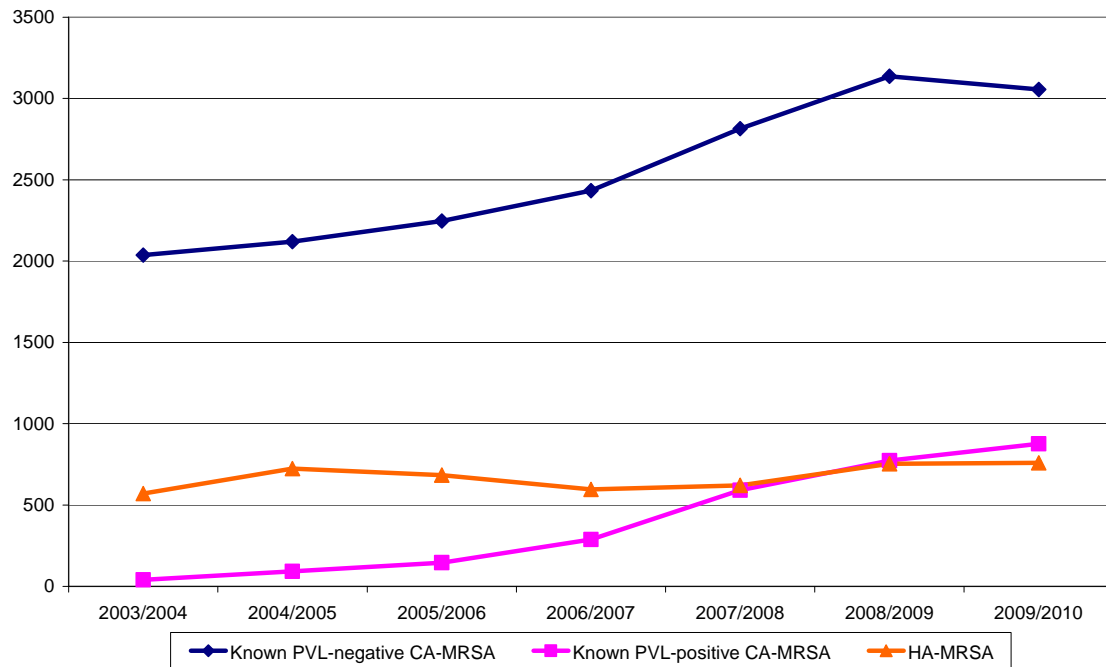


Figure 45: Number of HA-MRSA and CA-MRSA, Metropolitan region July 2003 to June 2010

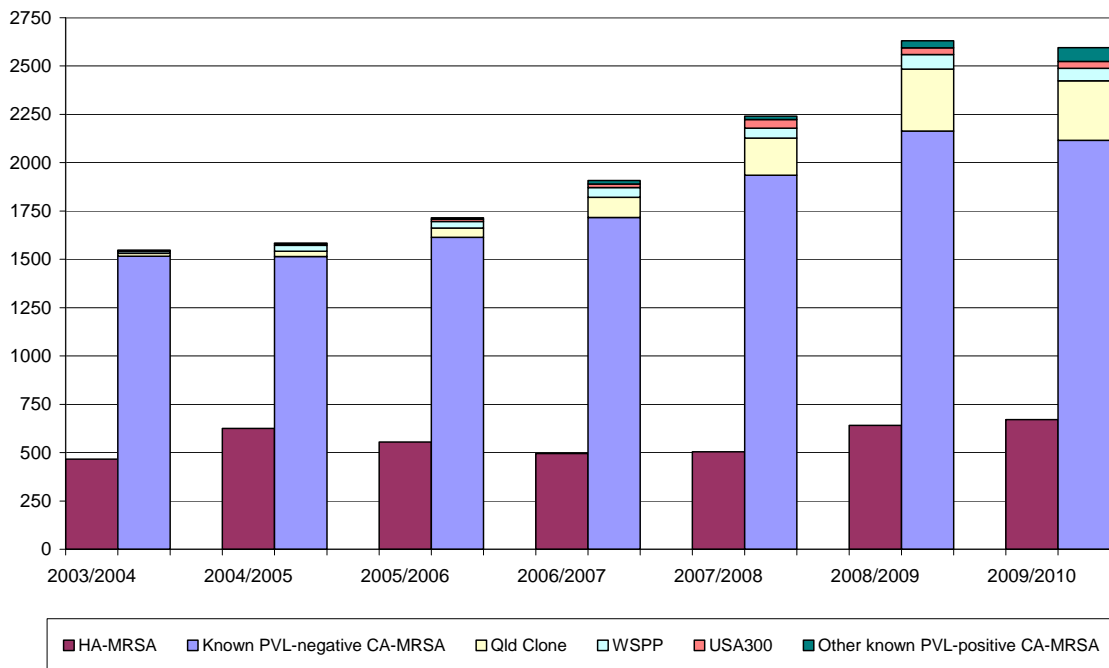


Figure 46: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Metropolitan region July 2003 to June 2010

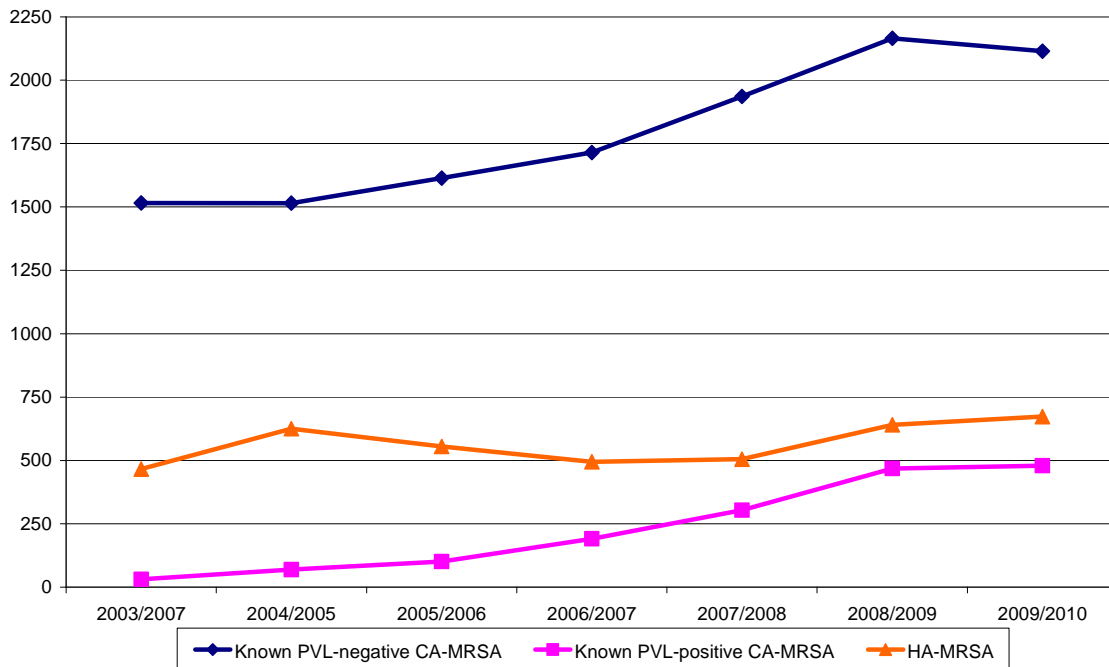


Figure 47: Number of HA-MRSA and CA-MRSA, Kimberley region July 2003 to June 2010

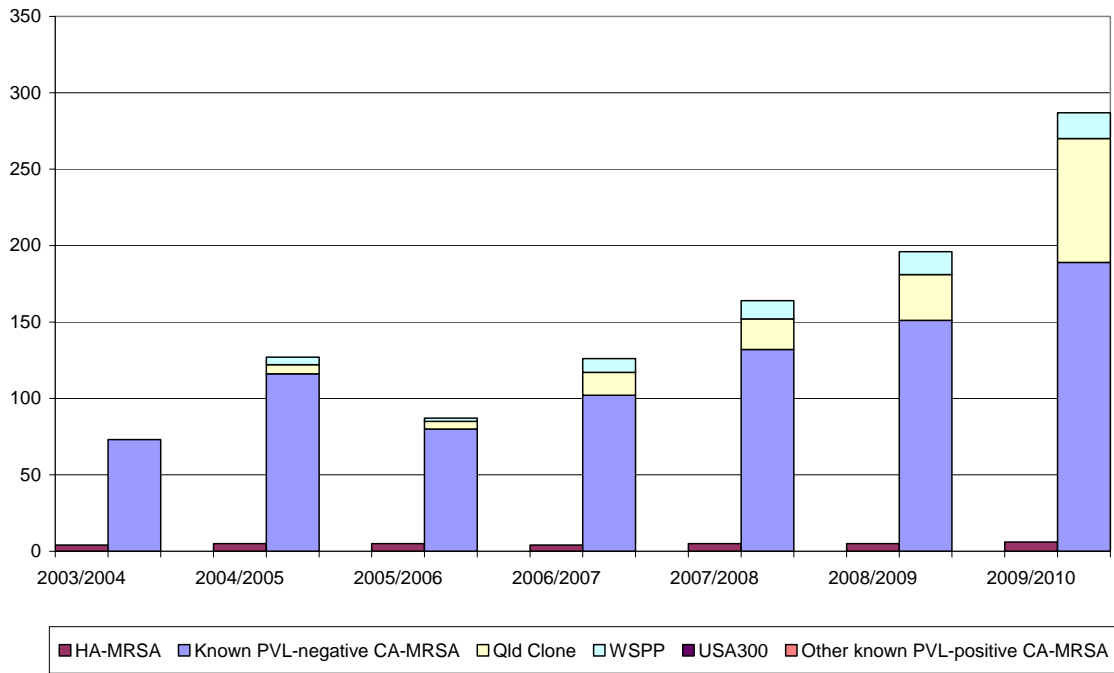


Figure 48: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Kimberley region July 2003 to June 2010

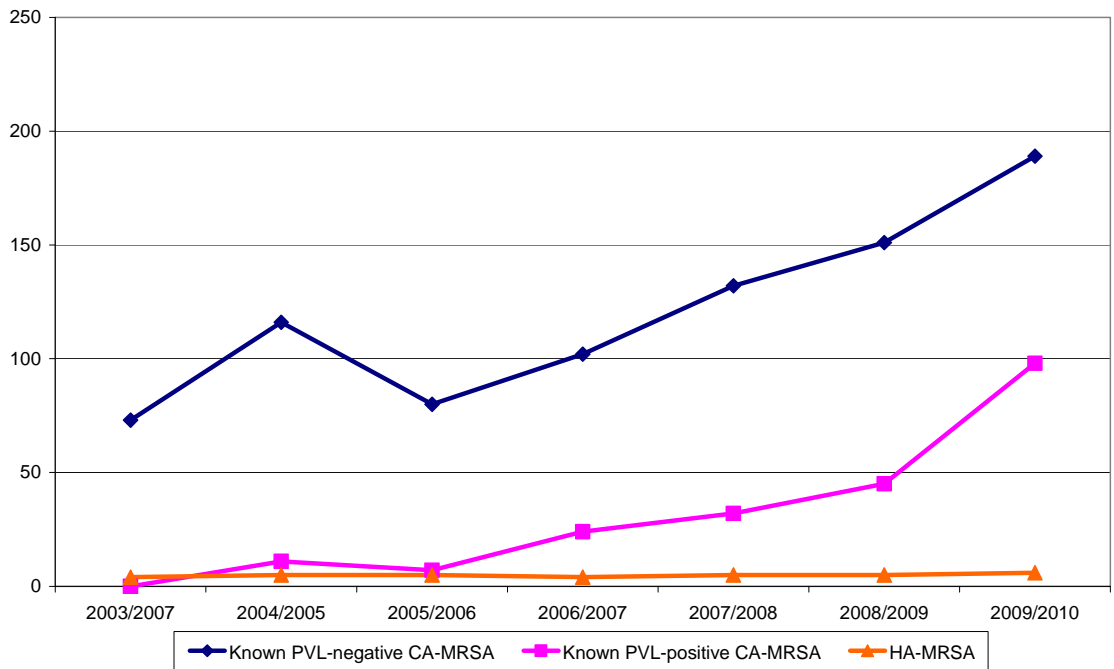


Figure 49: Number of HA-MRSA and CA-MRSA, Pilbara region July 2003 to June 2010

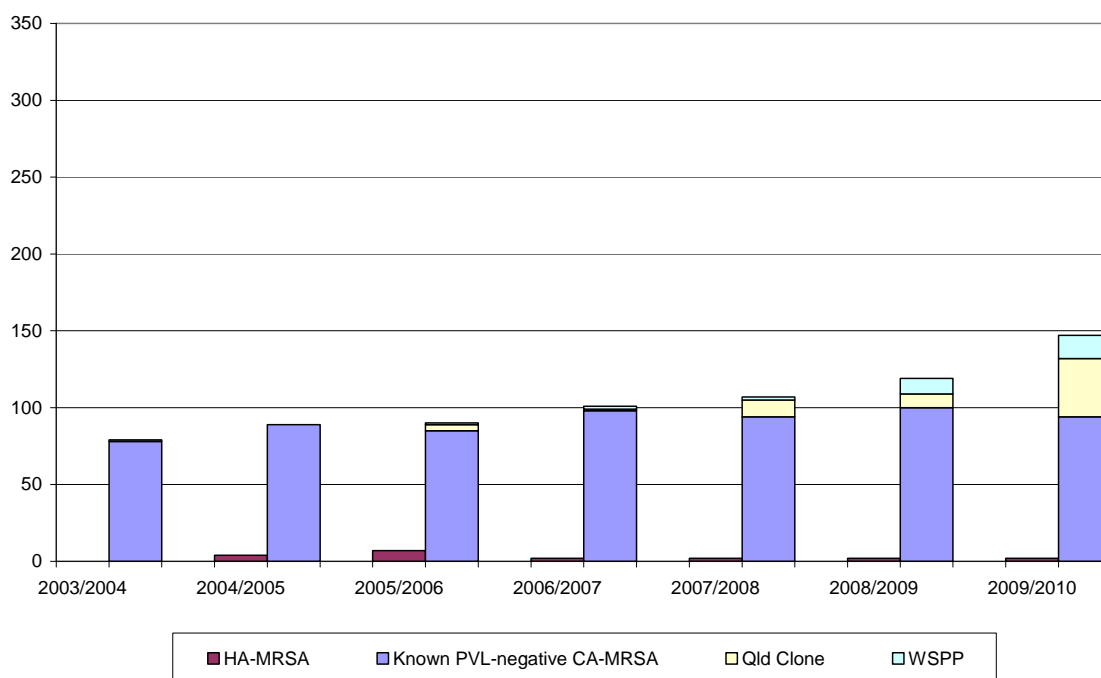


Figure 50: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Pilbara region July 2003 to June 2010

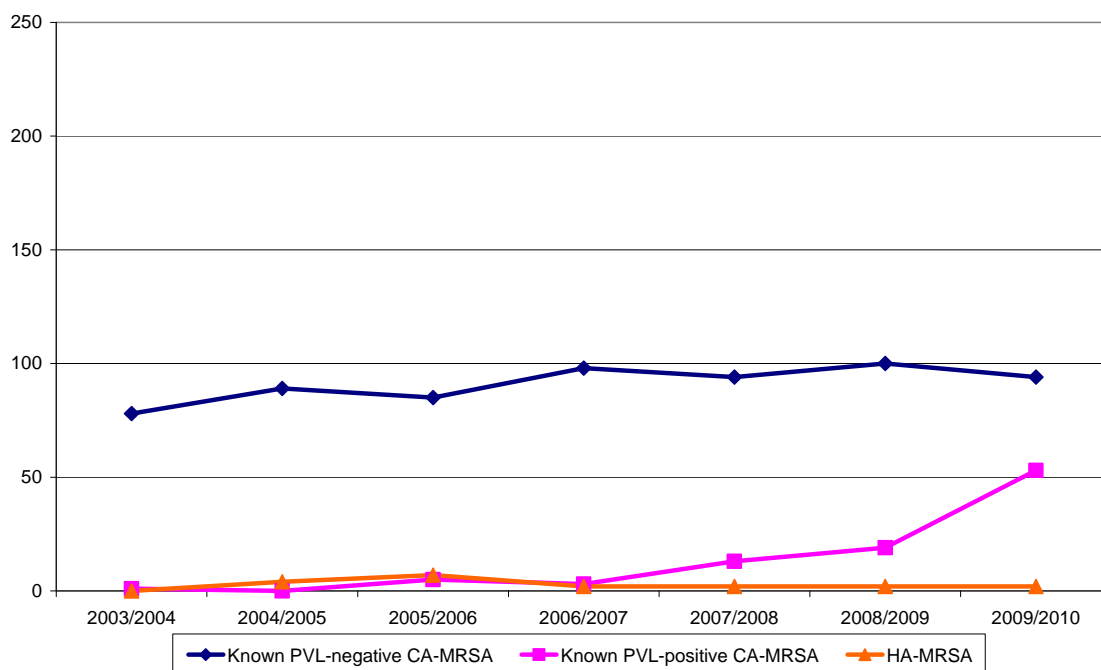


Figure 51: Number of HA-MRSA and CA-MRSA, Mid West region July 2003 to June 2010

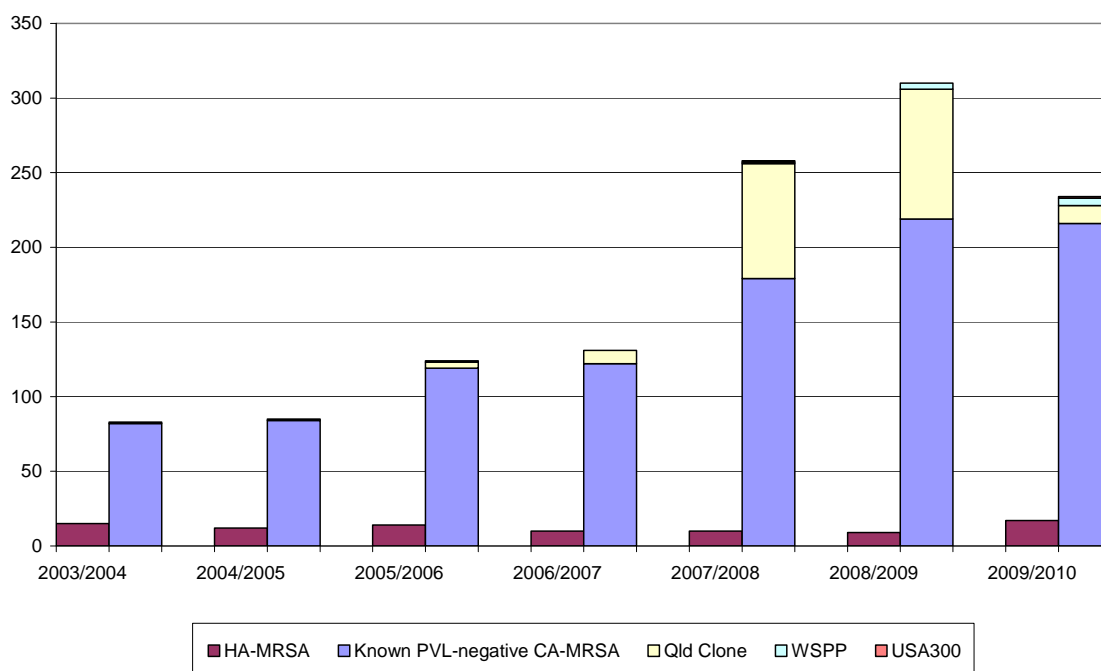


Figure 52: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Mid West region July 2003 to June 2010

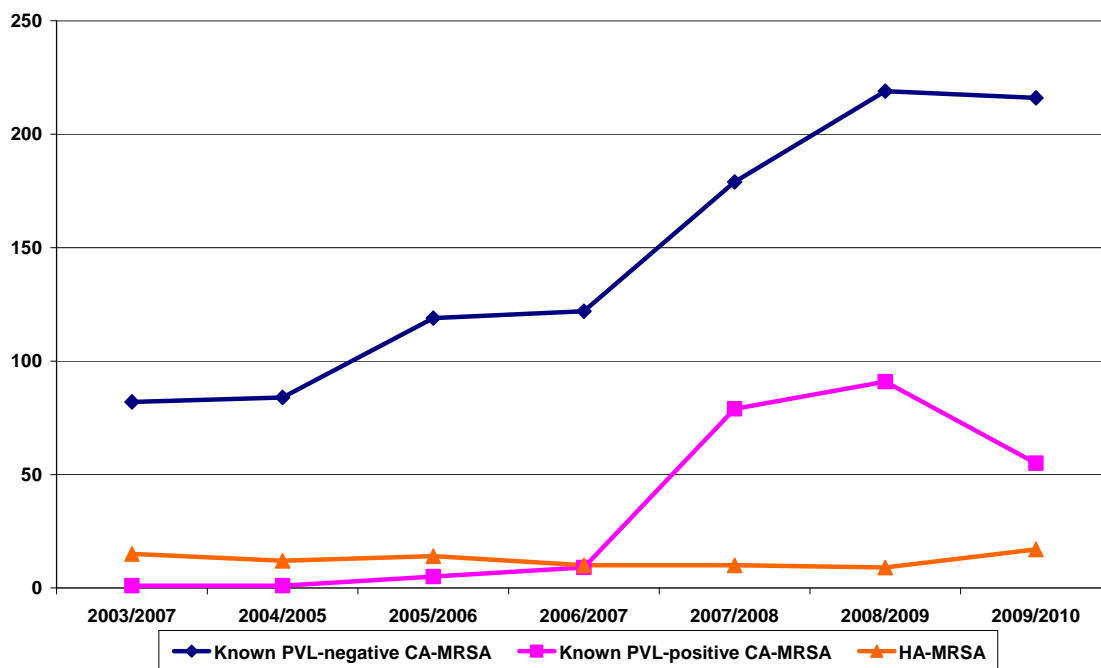


Figure 53: Proportion of HA-MRSA and CA-MRSA, Goldfields region July 2003 to June 2010

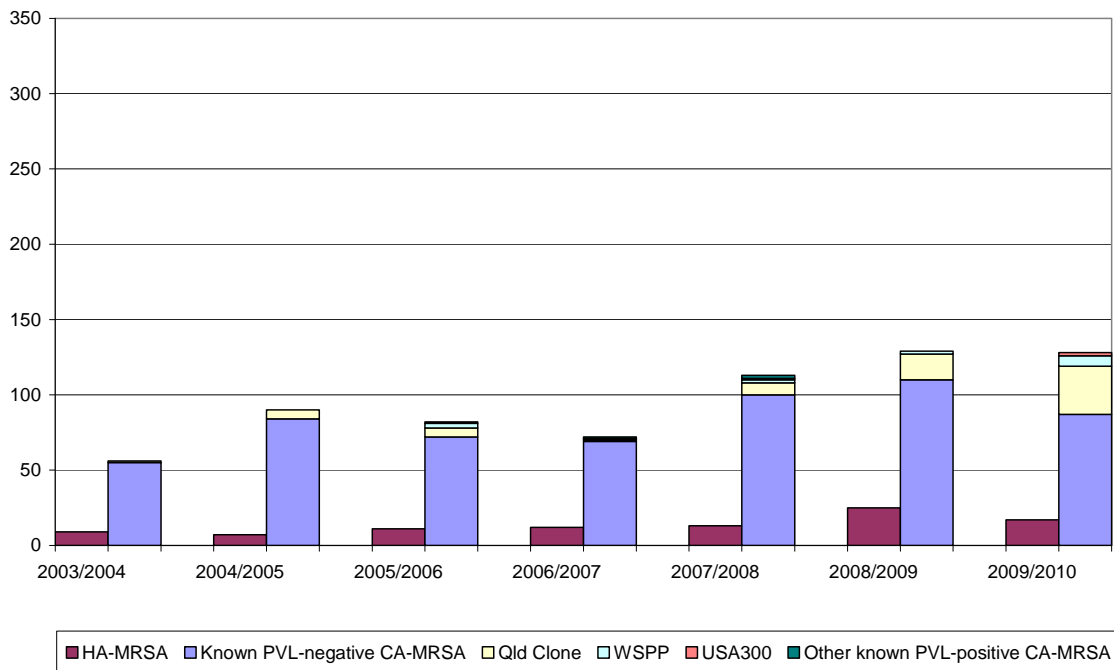


Figure 54: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Goldfields region July 2003 to June 2010

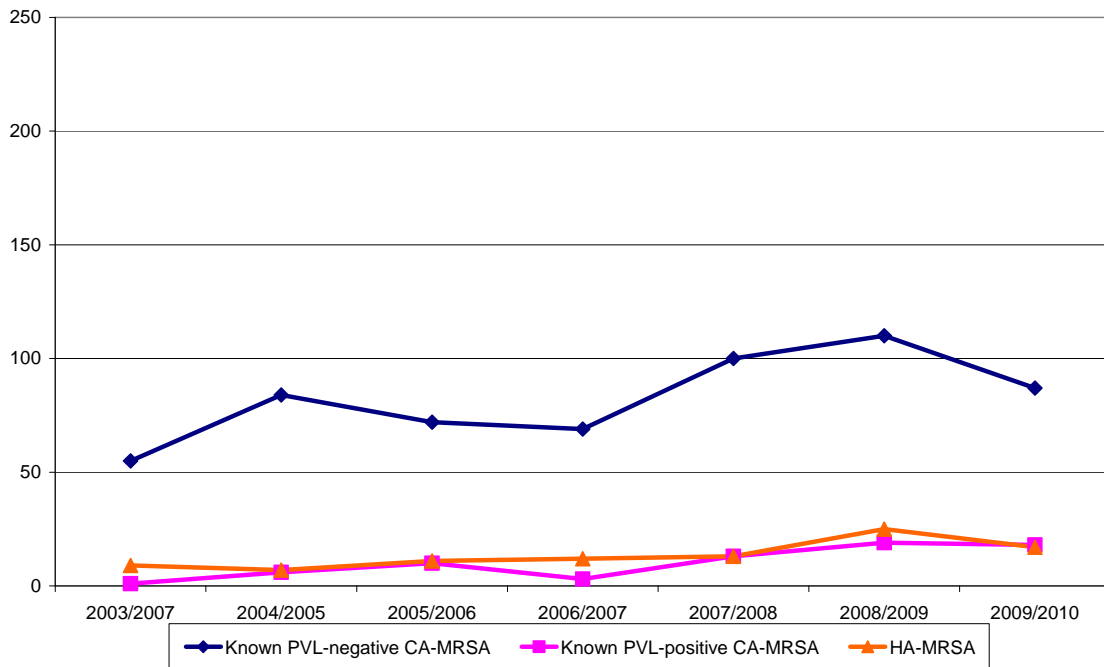


Figure 55: Proportion of HA-MRSA and CA-MRSA, Wheatbelt region July 2003 to June 2010

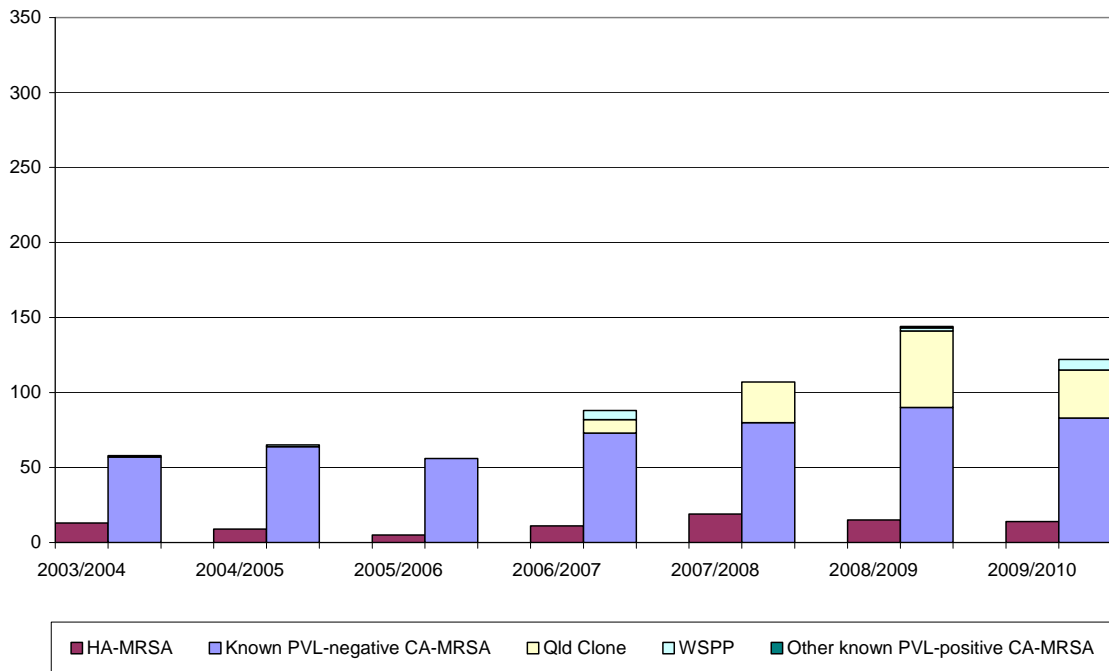


Figure 56: Number of known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Wheatbelt region July 2003 to June 2010

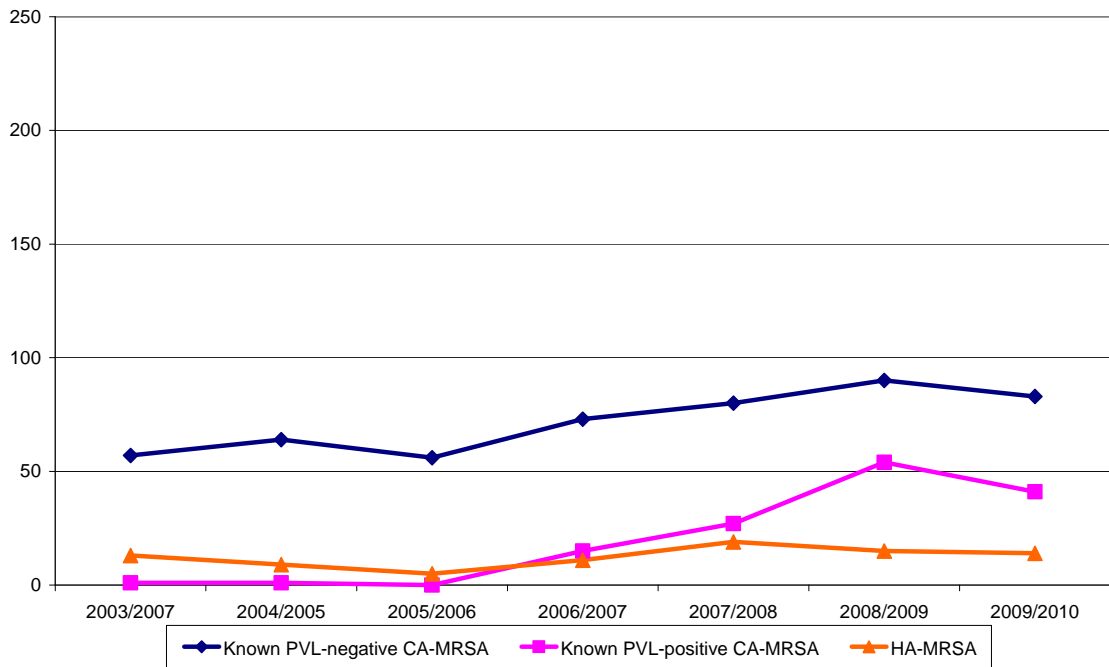


Figure 57: Proportion of HA-MRSA and CA-MRSA, South West region July 2003 to June 2010

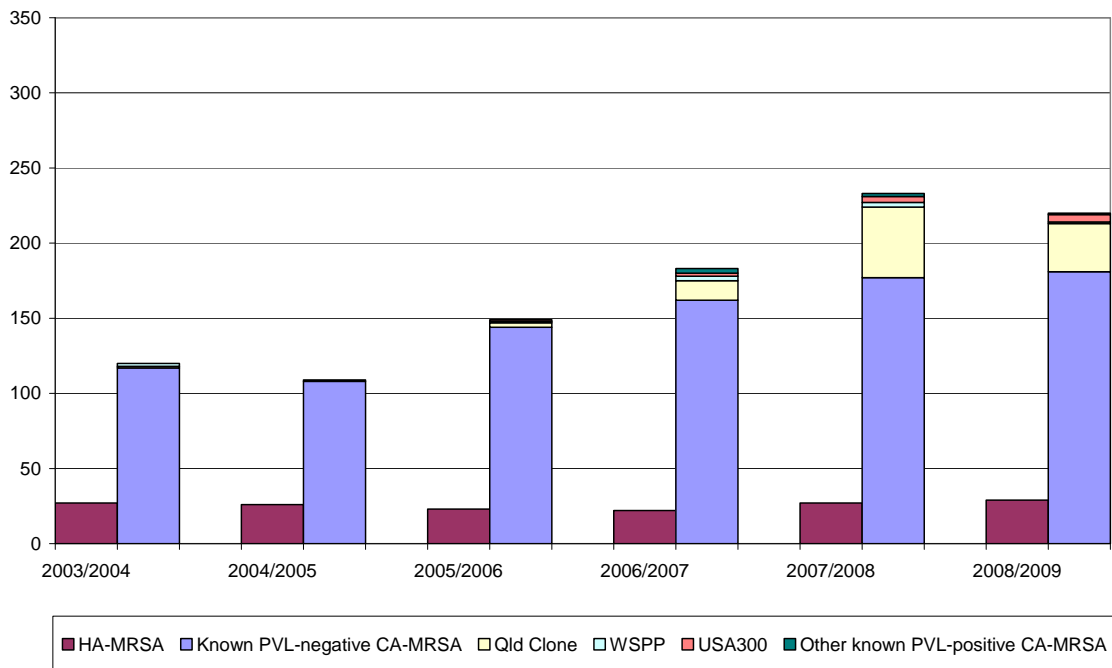


Figure 58: Number known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, South West region July 2003 to June 2010

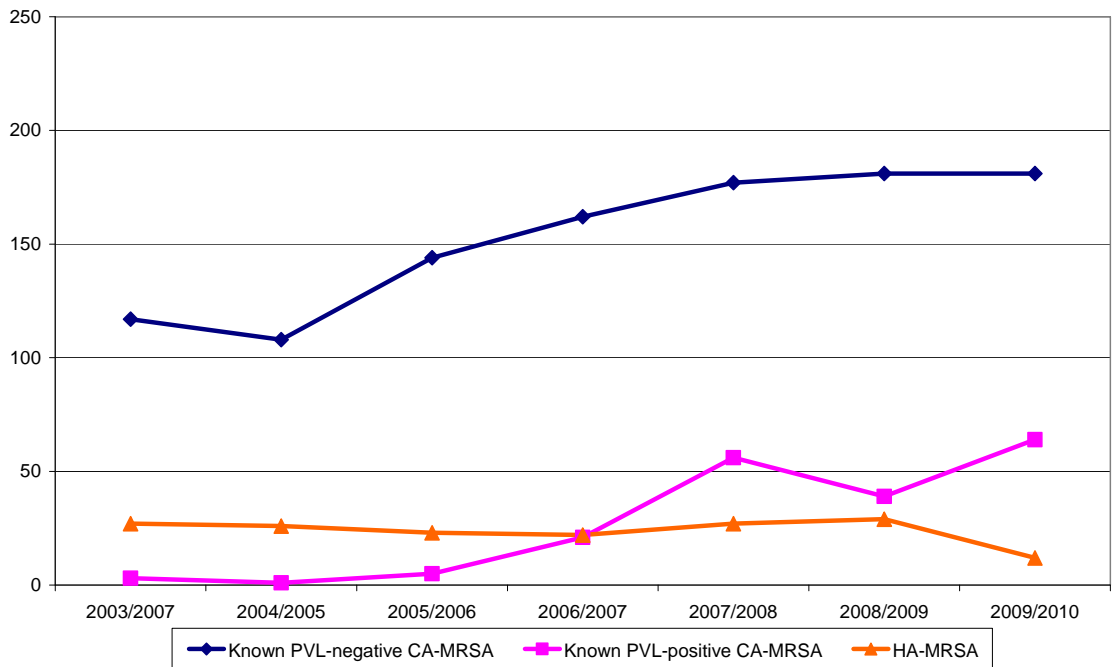


Figure 59: Proportion of HA-MRSA and CA-MRSA, Great Southern region July 2003 to June 2010

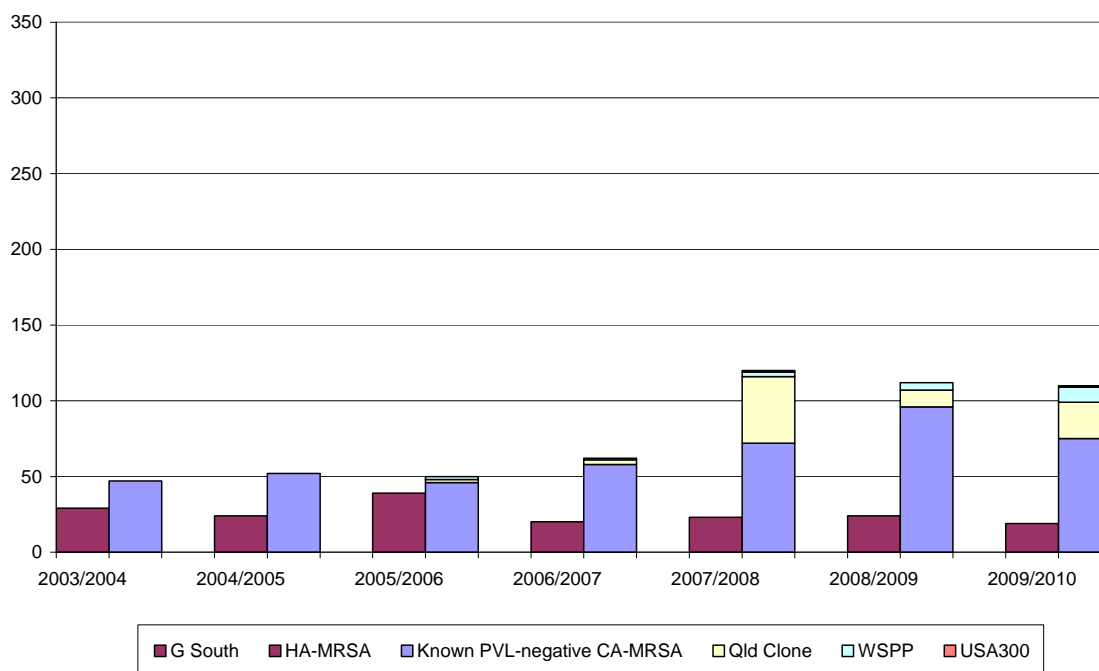
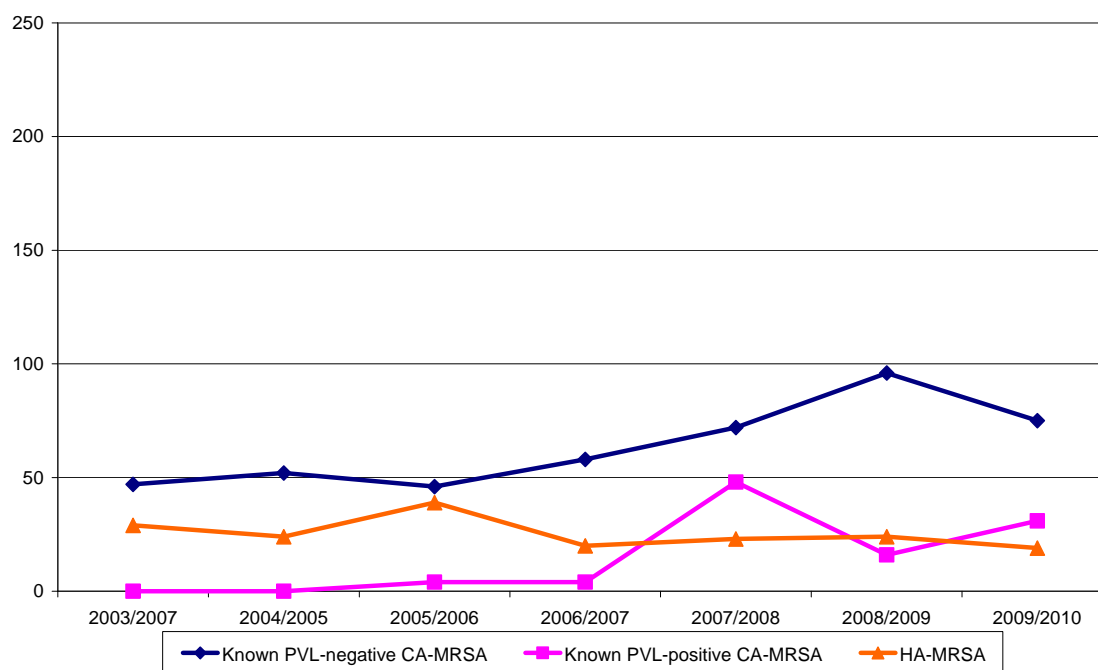


Figure 60: Number of PVL known PVL-positive and PVL-negative CA-MRSA and HA-MRSA, Great Southern region July 2003 to June 2010



Section 6
Vancomycin-resistant Enterococci
July 2009 to June 2010

6 Vancomycin-resistant *Enterococcus* species (VRE), July 2009 to June 2010

From 1st July 2009 to the 30th June 2010, 93 new carriers of VRE were identified. Five (5.4%) VRE were from clinical specimens (urine, wounds) and the remaining 88 were from screening specimens.

Table 8: *E. faecalis* referred to [ACCESS](#), July 2009 to June 2010

Referring Laboratory	PFGE and genotype		Total
	Unique <i>vanB</i>	Not sent for typing (<i>vanB</i>)	
13	3	1	4
Total	3	1	4

Table 9: *E. faecium* referred to [ACCESS](#), July 2009 to June 2010

Referring Laboratory	PFGE and genotype							Unique <i>vanB</i>	Not sent for typing (<i>vanB</i>)	Total
	26 <i>vanA</i>	28 <i>vanB</i>	29 <i>vanB</i>	31 <i>vanB</i>	34 <i>vanB</i>	36 <i>vanB</i>	37 <i>vanB</i>			
4						1				1
12	1	2	6		37			5	1	52
13			3	3	9	1	2	3		21
52					10			1	1	12
53			1		1					2
56			1							1
Total	1	2	11	3	57	2	2	9	2	89

Since 07/09/98 690 VRE have been referred to [ACCESS Typing and Research](#) for *van* gene PCR and molecular characterisation.

6.1 VRE Trend Data, September 1998 to June 2010

Figure 61: VRE isolates in WA, September 1998 to June 2010

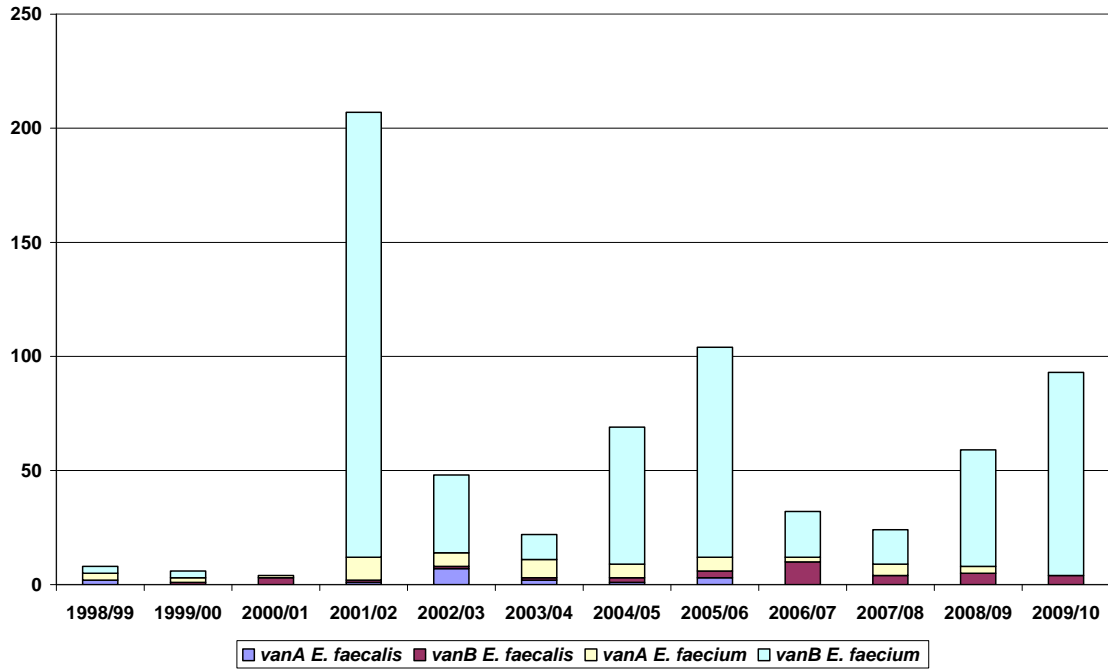
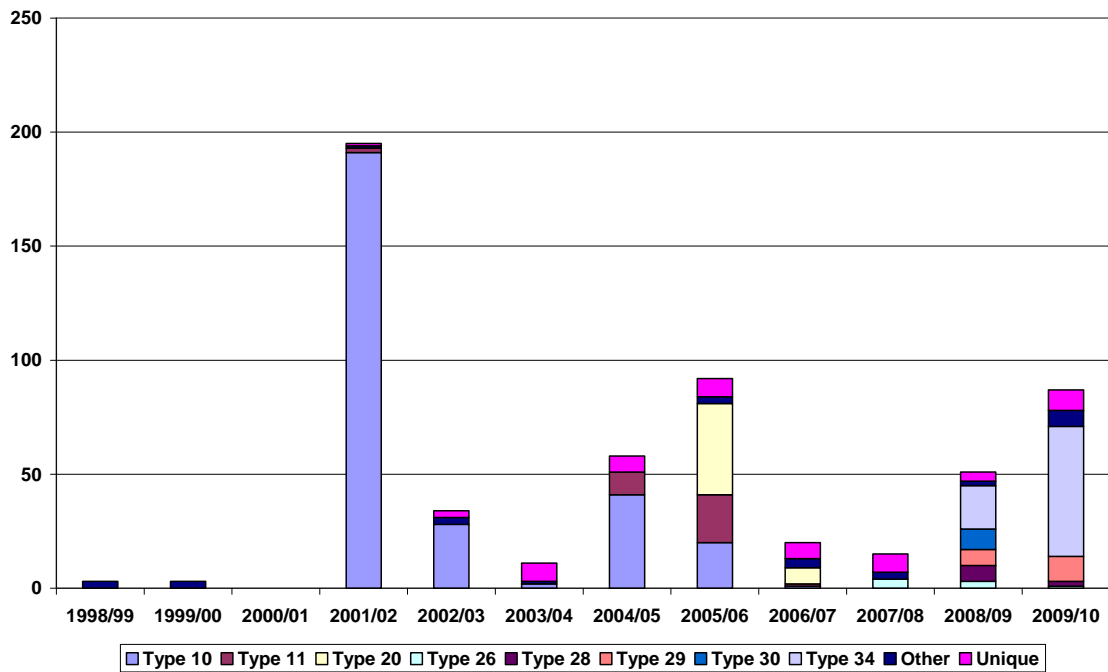


Figure 62: PFGE types of *vanB E. faecium*, September 1998 to June 2010



7 Appendix: Typing Characteristics of HA-MRSA, PVL positive and major CA-MRSA clones, July 2009 to June 2010

	Clone	MLST- SCC <i>mec</i>	Coagulase gene PCR- RFLP	PVL	Urease	Antibiogram (% resistant)							
						Gen	Ery	Tet	Cip	Tri	Fus	Rif	Mup
HA-MRSA	UK EMRSA-15	ST22-IV	22	Negative*	Negative	2	57	1	98	6	3	1	1
	Aus-2/3 EMRSA	ST239-III	24	Negative	Positive	95	100	100	86	82	0	5	14
	New York/Japan	ST5-II	36	Negative	Positive	0	100	0	100	33	0	0	0
	UK EMRSA-16	ST36-II	18	Negative	Positive	0	100	0	100	17	0	0	67
	Irish-2	ST8-VI	18	Negative	Negative	0	100	67	100	100	33	0	33
PVL positive CA-MRSA	Qld Clone	ST93-IV	32 or DNC	Positive	Positive	0	3	0	<1	0	<1	0	<1
	WSPP	ST30-IV	24	Positive	Positive	1	2	2	7	2	1	1	1
	USA300	ST8-IV	18	Positive	Positive	2	67	11	40	0	0	0	4
	Taiwan	ST59-V _T	40	Positive	Positive	0	57	81	0	0	0	0	0
	Bengal Bay Clone	ST772-V	34	Positive	Positive	100	100	0	100	84	0	0	0
	European CA- MRSA	ST80-IV	DNC	Positive	Positive	0	40	60	20	0	60	0	0
Major PVL negative CA- MRSA	WA 1	ST1-IV	20	Negative [#]	Positive	1	20	2	3	3	15	<1	2
	WA 2	ST78-IV	258	Negative	Positive	<1	96	1	3	4	<1	<1	1
	WA 3	ST5-IV	36	Negative	Positive	<1	34	2	17	1	1	0	0

Gen=gentamicin, Ery=erythromycin, Tet=tetracycline, Cip=ciprofloxacin, Tri=trimethoprim, Fus=fusidic acid, Rif=rifampicin, Mup=mupirocin

*Approximately 3% of UK EMRSA-15 are PVL positive. See section 4.2.1 for more information.

[#] Approximately 1% of WA MRSA-1 are PVL positive. See section 4.3.8 for more information.

DNC = does not cut

8 Acknowledgements

We gratefully acknowledge the following: the WA Genome Resource Centre, Department of Clinical Immunology and Biochemical Genetics, Royal Perth Hospital for sequencing; the Molecular Biology Laboratory at Royal Perth Hospital for MLST; Frances O'Brien, Curtin University School of Biomedical Science for the *SCCmec* typing; Hui-Leen Tan, Samantha Cramer, Yi Kong Chew and Lynne Wilson for clone determination of MRSA and VRE; the Department of Health WA for funding; and the public and private medical microbiology laboratories in Western Australia for referring the isolates.