Community-acquired *Staphylococcus aureus* bloodstream infections

Emerging Australian & international burden

A/Professor Leon Worth

VICNISS Coordinating Centre

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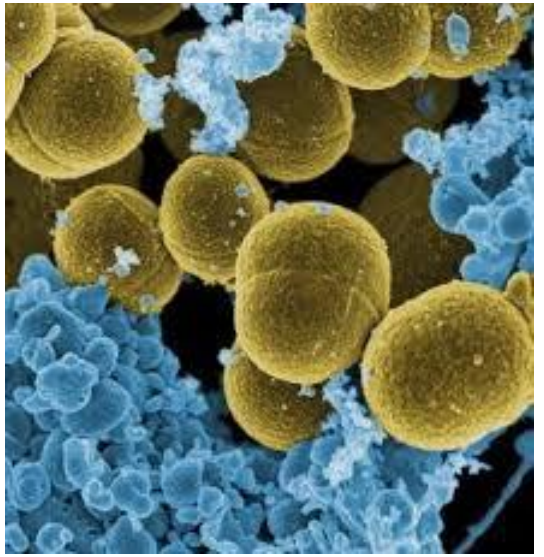
VICTORIA State Government

Doherty Institute
A joint venture between the University of Melbourne and Melbourne Health

Outline

- *Staphylococcus aureus* bloodstream infections
  - burden & significance
- Community-associated SAB events
- International trends
- Australian perspective
  - CA-SAB vs. HA-SAB
- Preventability & implications



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Staphylococcus aureus bloodstream infections

Staphylococcus aureus

- Frequent colonisation
  - colonises nares, skin, perineum of ~30% population
  - colonisation associated with healthcare exposure
- Invasive infection
  - skin and soft-tissue infections
  - bloodstream
- Severe disease
  - sepsis, infective endocarditis, deep-seated infections

Thomer L, *et al*. Annu Rev Pathol. 2016; 11:343-64

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Bloodstream infection: significance

- *S. aureus* a leading cause of bacteraemia
  - annual incidence 4.3-38.2 per 100,000 person-years (varies by region)
- 30-day all-cause mortality for *S. aureus* bacteraemia is 20%
  - largely unchanged since 1990s
- Epidemiologic classification SAB:
  - HA with hospital onset;
  - HA with community onset (infection in an outpatient who has had recent, extensive contact with the healthcare system); and
  - Community-acquired (CA).

Tong SY, *et al*. Clin Microbiol Rev. 2015; 28:603-61

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Risks for SAB

- Risk factors for invasive *S. aureus* infection & bacteraemia:
  - prosthetic devices: CVCs, surgical implants, orthopaedic prostheses
  - intravenous drug use
  - medical comorbidities: diabetes, HIV, immunosuppression, malignancy
  - haemodialysis
  - extremes of age (<1 and >70 years)
  - ethnicity
  - male gender

Tong SY, *et al*. Clin Microbiol Rev. 2015; 28:603-61

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Community-associated SAB

CA-SAB

- Higher mortality
  - CA-SAB 26% vs. HA-SAB 13%
- Risks for mortality:
  - increasing age
  - immunosuppression
  - alcoholism
  - haemodialysis
  - acute renal failure
  - septic shock
- CA-SAB later presentation, complicated infections

Kaech C. *et al*. Clin Microbiol Infect 2006

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CA-SAB vs. HA-SAB

	CA-SAB (N=198)	HA-SAB (N=232)	*P*-value
Age >60 years	40%	59%	<0.000
Deep infection			
• abscess	37%	26%	0.018
• pneumonia	31%	25%	NS
• osteomyelitis	36%	24%	0.006
• permanent FB	9%	24%	<0.000
• endocarditis	15%	11%	NS
• septic arthritis	13%	9%	NS

Forsblom E. *et al*. J Hosp Infect 2011

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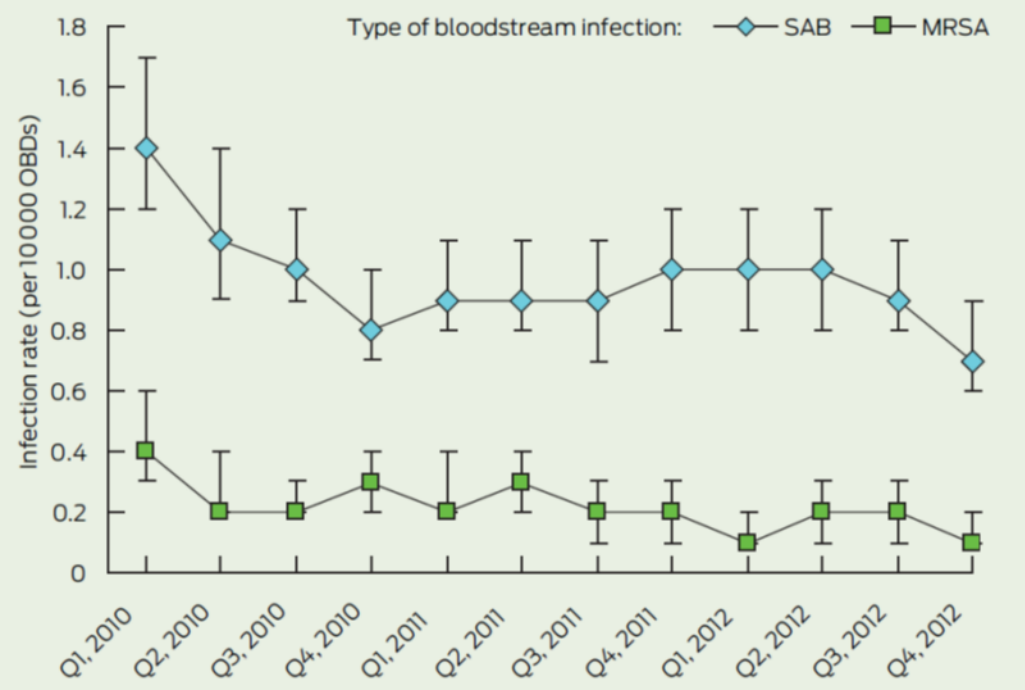
Healthcare-associated SAB

Victorian public hospitals



***Staphylococcus aureus* bloodstream infections**

>50% reduction during first 3-year period of surveillance

Worth LJ, *et al*. Med J Aust 2014

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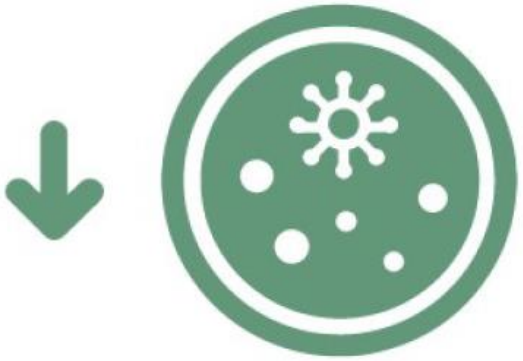
Healthcare-associated SAB

National trends

Changes in SAB rates over time



7.9%

decrease in SAB cases over the past 5 years

This is a decrease from **0.89** cases per 10,000 patient days in 2013–14 to **0.73** in 2017–18

Bloodstream infections associated with hospital care 2017–18, AIHW (20 Feb 2019)

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International trends: CA-SAB

Morbidity and Mortality Weekly Report

Vital Signs: Epidemiology and Recent Trends in Methicillin-Resistant and in Methicillin-Susceptible *Staphylococcus aureus* Bloodstream Infections — United States

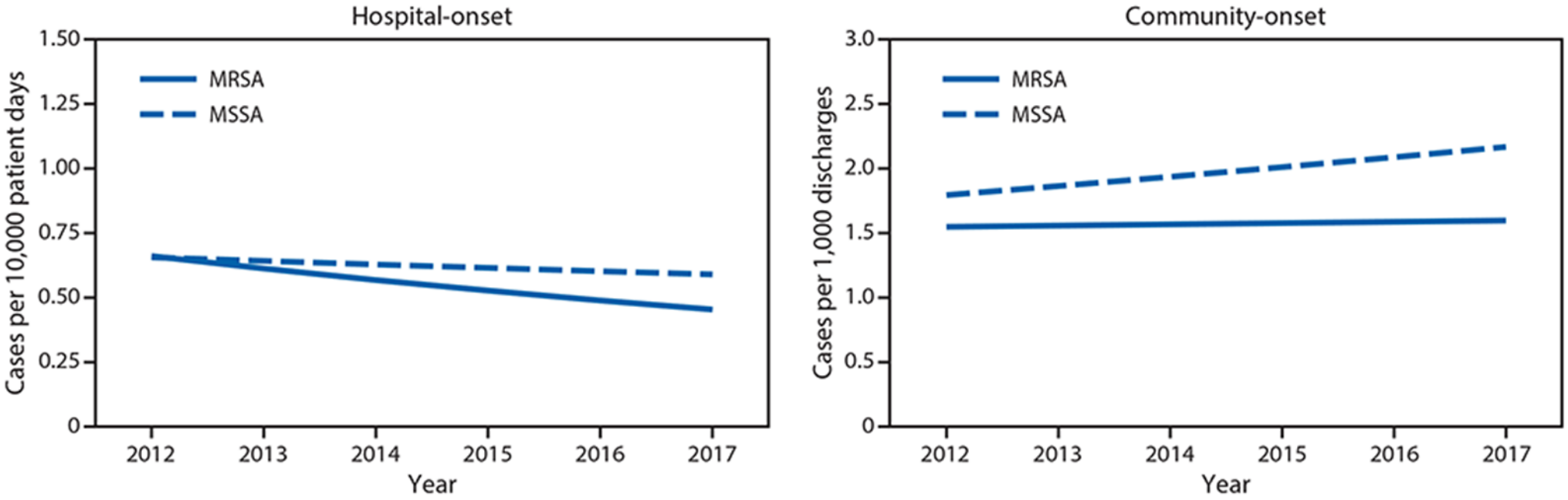
Athena P. Kourtis[1]; Kelly Hatfield[1]; James Baggs[1]; Yi Mu[1]; Isaac See[1]; Erin Epson[2]; Joelle Nadle[3]; Marion A. Kainer[4]; Ghinwa Dumyati[5]; Susan Petit[6]; Susan M. Ray[7]; Emerging Infections Program MRSA author group: David Ham[1]; Catherine Capers[1]; Heather Ewing[1]; Nicole Coffin[1]; L. Clifford McDonald[1]; John Jernigan[1]; Denise Cardo[1]

Method: Data from Emerging Infections Program (EIP) population surveillance and Premier and Cerner Electronic Health Record databases (2012–2017) evaluated.

Objectives:

- Examine incidence of hospital-onset and community-onset MRSA and MSSA bloodstream infections
- Estimate overall incidence of *S. aureus* bloodstream infections in the United States and associated in-hospital mortality

SAB: US hospitals 2012–2017



Increase in community-onset MSSA infections (3.9% per year, p<0.0001) from 2012 to 2017

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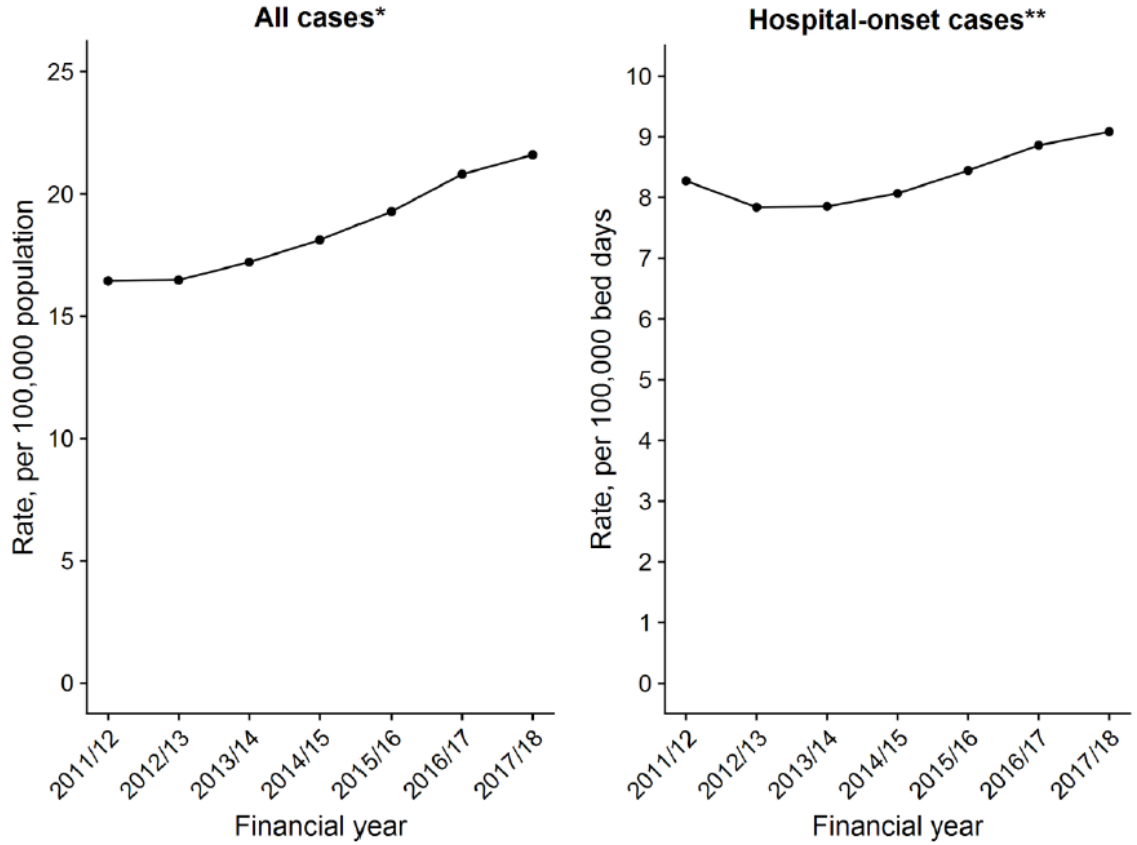
SAB: Public Health England

Figure 2: Trends in the rate of MSSA bacteraemia in England



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CA-SAB in Australia

Increased incidence of community-associated *Staphylococcus aureus* bloodstream infections in Victoria and Western Australia, 2011–2016

Nabeel Imam[1], Simone Tempone[2], Paul K Armstrong[2], Rebecca McCann[2], Sandra Johnson[1], Leon J Worth[1], Michael J Richards[3]

Methods:

- Retrospective analysis of surveillance data, 2011-2016
- Victorian Healthcare Associated Infection Surveillance System (VICNISS) – 93 public hospitals
- Healthcare Infection Surveillance Western Australia (HISWA) – 58 public hospitals

Objective:

- To review time-trends and determine incidence of CA-SAB in 2 Australian jurisdictions

Med J Aust 2019; 210: 87-88

Definitions

Healthcare-associated SAB: definition 1

The patient's first *S. aureus* blood culture was collected more than 48 hours after admission to this hospital or less than 48 hours after discharge.

Healthcare-associated SAB: definition 2

The patient's first *S. aureus* blood culture was collected less than or equal to 48 hours after hospital admission AND one or more of the following key clinical criteria (attributed to care at this hospital) was met for the patient episode of SAB:

a) SAB is a complication of the presence of an indwelling medical device (e.g. intravascular line, haemodialysis vascular access, CSF shunt, urinary catheter).
b) SAB occurs within 30 days of a surgical procedure where the SAB is related to the surgical site.
c) An invasive instrumentation or incision related to the SAB was performed within 48 hours.
d) SAB is associated with neutropenia contributed to by cytotoxic therapy. Neutropenia is defined as at least two separate calendar days with values of absolute neutrophil count <500 cells/mm3 (<0.5 x109/L) within a seven-day time period which includes the date the positive blood specimen was collected (day 1), the 3 calendar days before and 3 calendar days after.

Community-associated SAB

The patient's first *S. aureus* blood culture was collected less than or equal to 48 hours after hospital admission and none of the key clinical criteria in HA-SAB definition 2 were met.

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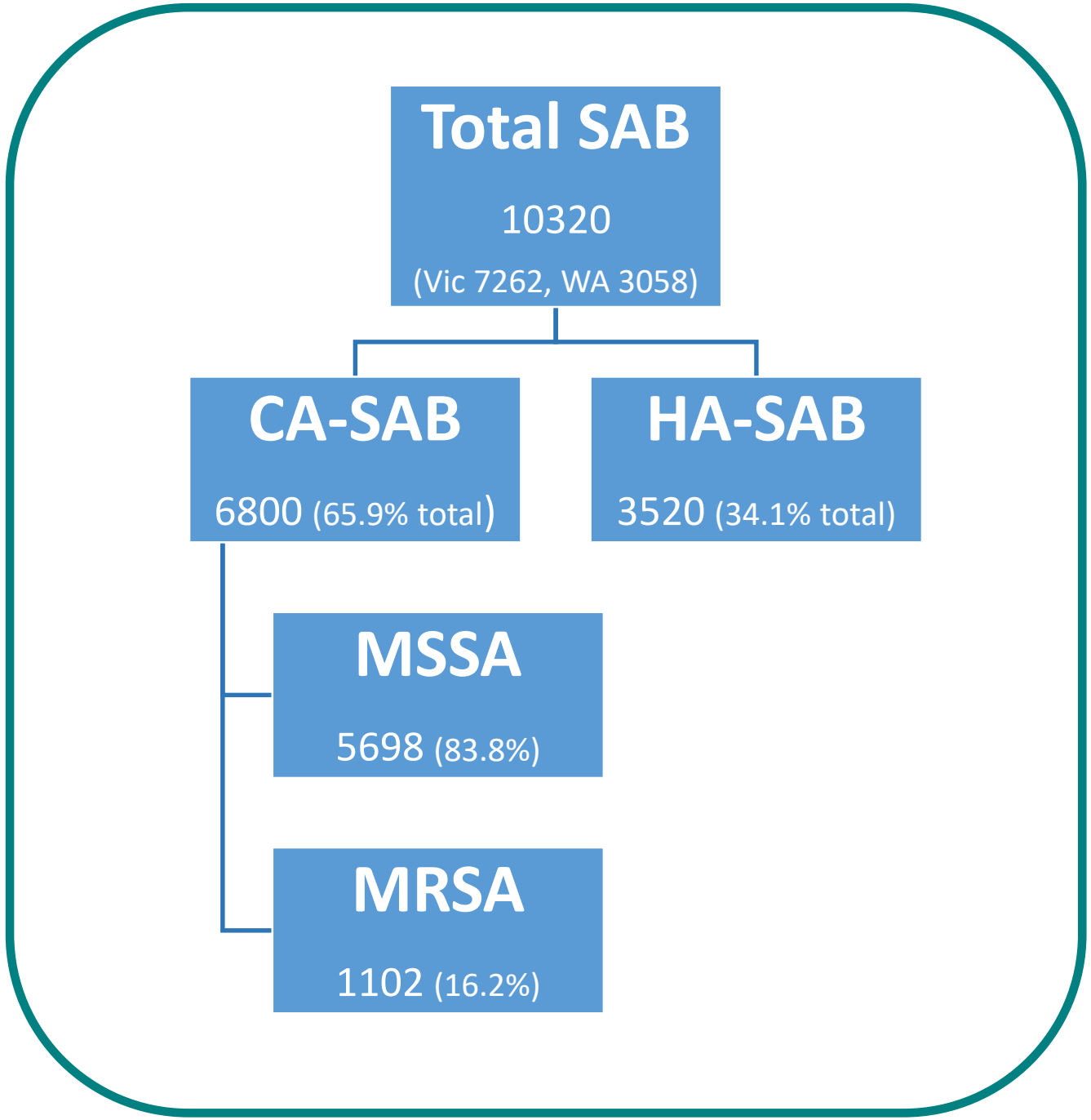
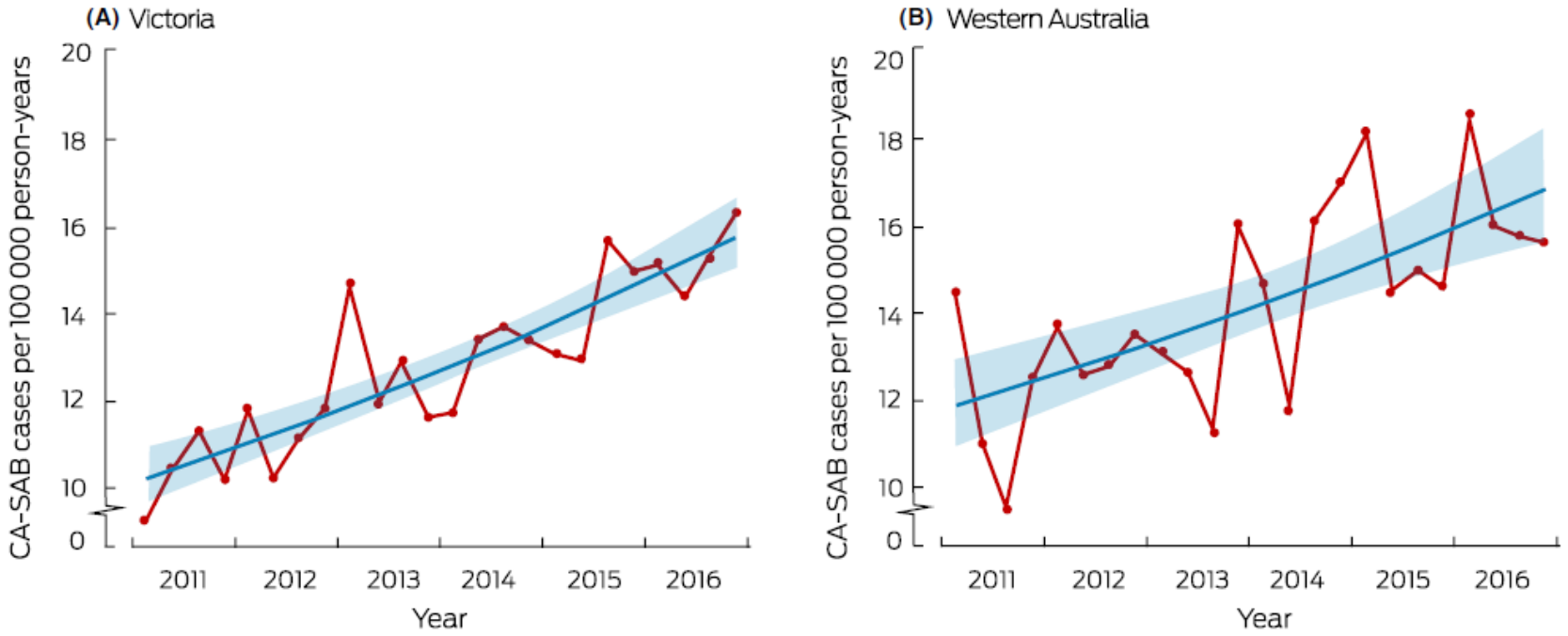

Total SAB
10320
(Vic 7262, WA 3058)
CA-SAB
6800 (65.9% total)
HA-SAB
3520 (34.1% total)
MSSA
5698 (83.8%)
MRSA
1102 (16.2%)

Incidence over time

Quarterly incidence of community-associated *Staphylococcus aureus* bloodstream infections (CA-SABs) in Victoria and Western Australia, 2011–2016, with trend lines and 95% confidence envelopes



Aggregate:
13.3 CA-SABs per 100 000 person-years

Vic: 8% increase per year
(95% CI 6–10%)

WA: 6% increase per year
(95% CI 4–9%)

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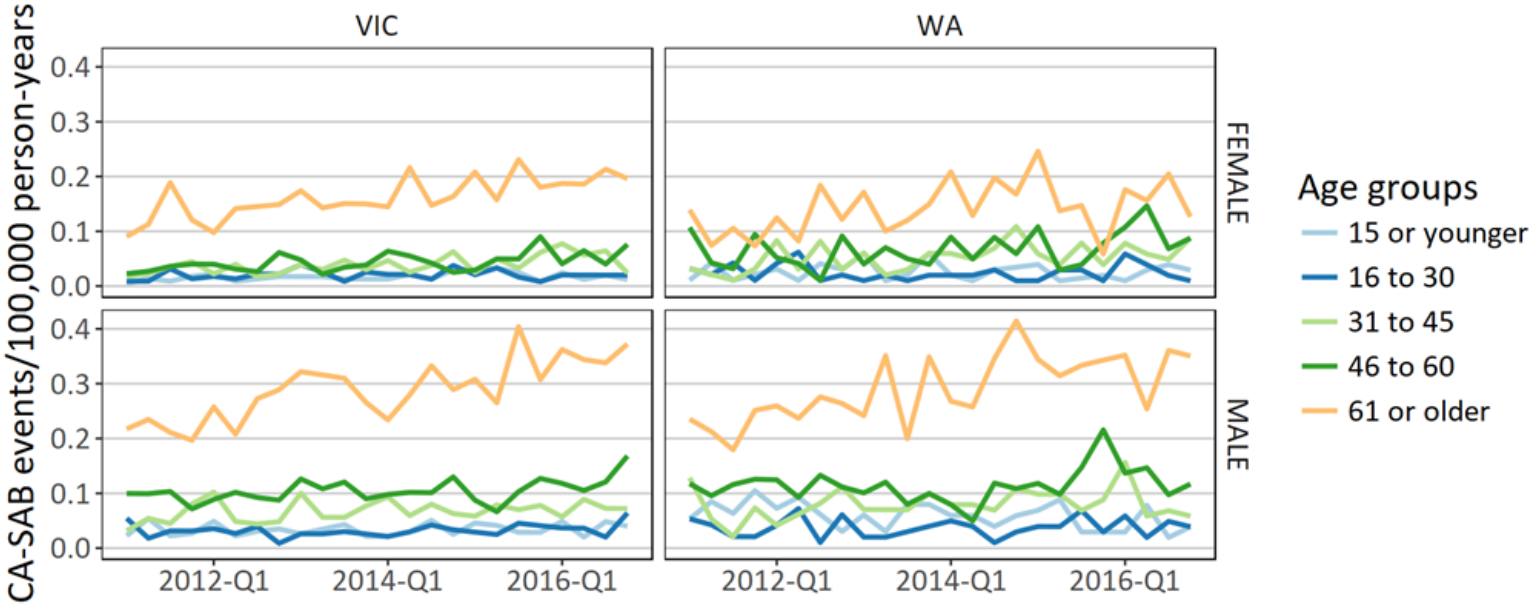
CA-SAB: in whom?



Increased incidence of CA-SAB in men >60 years:

- standardised incidence >50 cases per 100 000 person-years
- 2-fold higher than women of the same age

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Implications

- Findings consistent with others - greater disease burden in older populations and men
- Potential for emergent virulent *S. aureus* strains in the community or changes in host risk factors:
  - further evaluation of isolates responsible for infection
  - enhanced surveillance to evaluate risks for infection
    - residents of aged care facilities would be classified as CA-SAB in current study
- Limitations: likely underestimate of disease burden (e.g. patients managed in private sector not included in analysis)

Agostino JW, *et al*. Med J Aust 2017; 207: 388–393.
Turnidge JD, *et al*. Med J Aust 2009; 191: 368–373

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COMMUNICABLE DISEASES INTELLIGENCE

2019 Volume 43

https://doi.org/10.33321/cdi.2019.43.43

Australian Group on Antimicrobial Resistance (AGAR) Australian Staphylococcus aureus Sepsis Outcome Programme (ASSOP) Annual Report 2017

Geoffrey W Coombs, Denise A Daley, Yung Thin Lee, Stanley Pang on behalf of the Australian Group on Antimicrobial Resistance

ASSOP 2017

- Australian *Staphylococcus aureus* Sepsis Outcome Programme
  - 1 Jan to 31 Dec 2017
  - 36 participating Australian institutions
- Total of 2,515 SAB episodes
  - 77% community-onset
- All-cause mortality at 30 days: 14.8% (higher for MRSA)
- For MSSA:
  - antimicrobial resistance rare (exception: penicillin, erythromycin)
  - 30/2,035 isolates (1.5%) high-level mupirocin resistance

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Table 1: The number and proportion of methicillin-susceptible *Staphylococcus* aureus (MSSA) isolates non-susceptible to penicillin and the non-β-lactam antimicrobials, Australia, 2017

Antimicrobial	Number Tested	Breakpoint (mg/L)	Non-Susceptible	
			n	%
Penicillin	2,035	>0.12[a]	1,634	80.3
Vancomycin	2,035	>2[a]	0	0.0
Teicoplanin	2,034	>8[b]	0	0.0
		>2[c]	4	0.2
Rifampicin	1,991	>1[b]	8	0.4
		>0.5[c]	9	0.5
Fusidic Acid	2,035	>1[c]	65	3.2
Gentamicin	2,034	>4[b]	15	1.1
		>1[c]	23	0.7
Erythromycin	2,035	>0.5[b]	253	12.4
		>2[c]	216	10.6
Clindamycin	2,034	>0.5[a]	32	1.6
Tetracycline/ Doxycycline	2,029	>4[b]	65	3.2
		>2[c]	66	3.3
Co-trimoxazole	2,033	>2/38[b]	44	2.2
		>4/76[c]	39	1.9
Ciprofloxacin	2,030	>1[a]	53	2.6
Nitrofurantoin	1,922	>32[b]	4	0.2
		>64[c]	0	0
Daptomycin	2,036	>1[a]	4	0.2
Linezolid	2,037	>4[a]	0	0

a CLSI and EUCAST non-susceptible breakpoint

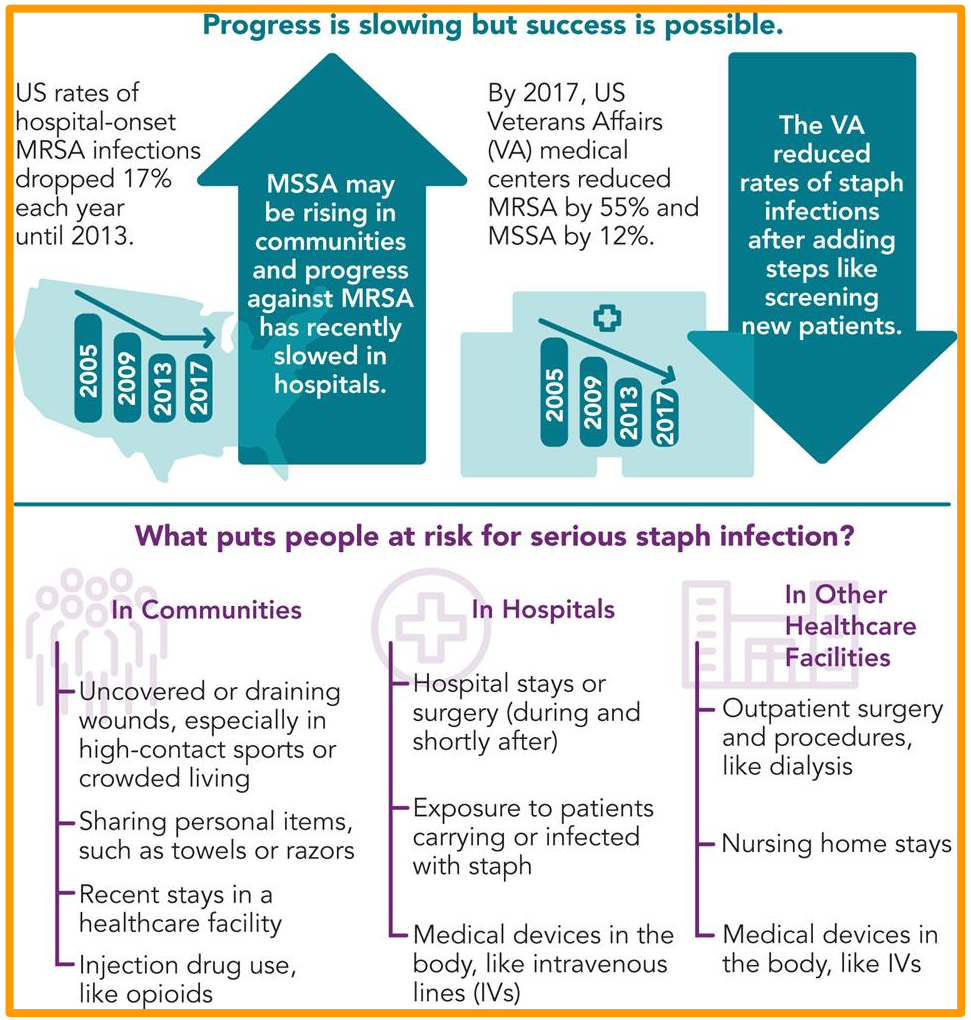
b CLSI non-susceptible breakpoint

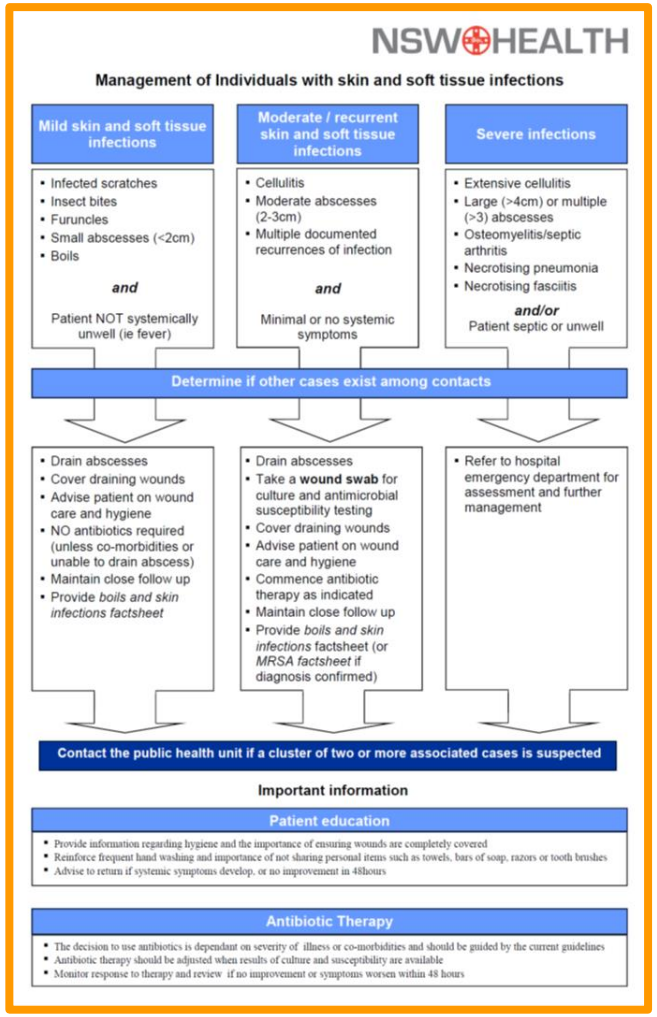
c EUCAST non-susceptible breakpoint

ASSOP 2017:
Antibiotic susceptibility of MSSA isolates

Preventability & implications

Public Health strategies





Public Health strategies:

- **CDC**
- **NSW Health**

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Challenges

- Awareness & education
  - national and jurisdictional agenda
  - need to identify and engage stakeholders
  - education for primary-care clinicians
- Identification
  - need to identify at-risk populations; appropriate risk matrix required
- Evidence
  - Does early intervention improve outcome?
- Resourcing…

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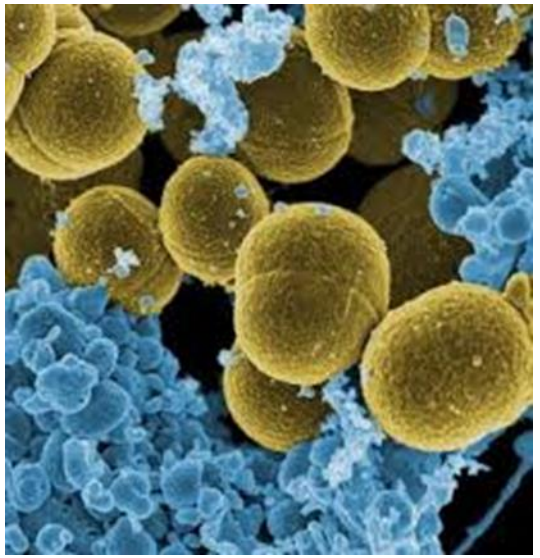
Summary

- Increasing burden of CA-SAB in Vic and WA
- Predominantly MSSA, susceptible strains
- Need for ‘next steps’:
  - typing of isolates
  - enhanced epidemiological surveillance
    - aged care (Vic), IVDU (WA) and other populations
- Public health strategies required



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