Bloodstream infections in patients on maintenance haemodialysis: rates, clinical features, microbiology, and outcomes

Ms Samantha Crimmins, Dr Wiraaj Agnihotri, Dr Germaine Wong, Dr Patricia Ferguson

No disclosures

THE UNIVERSITY OF SYDNEY

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Introduction

Why this research is important

- Over 12,000 Australians receive haemodialysis (HD)[1]
- They have 26x increased risk of bloodstream infections (BSI)[2]
- Infection is the second leading cause of death[3]

What we know and don't know

- BSI risk is 3x greater for CVC than AVF or AVG[4]
- But rates of BSI, organisms and outcomes are not stratified by access type

Our research

- Retrospective case series to describe these BSI

Methods – Retrospective Case Series

Participants

- Adults on HD in Western Sydney LHD with BSI from 2021-22
- District-wide database of positive blood cultures
- HD dataset from Western Renal Service

Case definition

- Each episode of positive blood was treated as a case
- ‘Contaminants’ excluded
- Repeat positive cultures within 14 days = 1 episode

Data collection

- Demographic details, access device, dialysis location and outcomes were obtained from electronic medical records

Methods – Statistical methods

Non-parametric quantitative variables

- Medians and interquartile ranges

Proportions of categorical variables

- Chi square test and Fisher's exact test, p=0.05

Rates

- Rates of BSI are presented per 1000 dialysis days according to the following formula:

$$BSI\ \ Rate = \frac{Number\ of BSI}{Dialysis\ \ days} \times 1000$$

Results – Characteristics of 70 patients

Table 1. Patient characteristics

Characteristic	(n=70) n (%) or median (IQR)
Patients	70 (100)
Male	45 (64)
Median age, years	63 (56-75)
Cause of kidney failure	
Diabetic nephropathy	35 (50)
Hypertension	7 (10)
Glomerulonephritis	11 (16)
Comorbidities	
Hypertension	57 (81)
Diabetes	44 (63)
Cardiac disease	48 (69)
Mental health condition	11 (16)
Prosthetic devices	
Prosthetic graft – smaller vessels	28 (40)
Pacemaker, defibrillator	8 (11)
Prosthetic joints	7 (10)
Prosthetic heart valves	4 (6)
Immunosuppression medication	7 (10)

92 infections, 70 patients, 102 organisms

Figure 1: Types of Infections

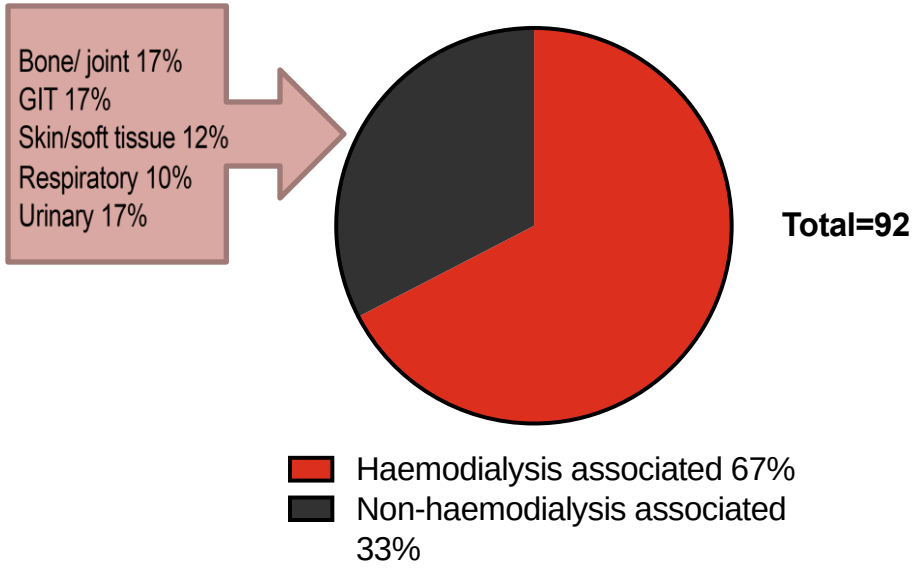
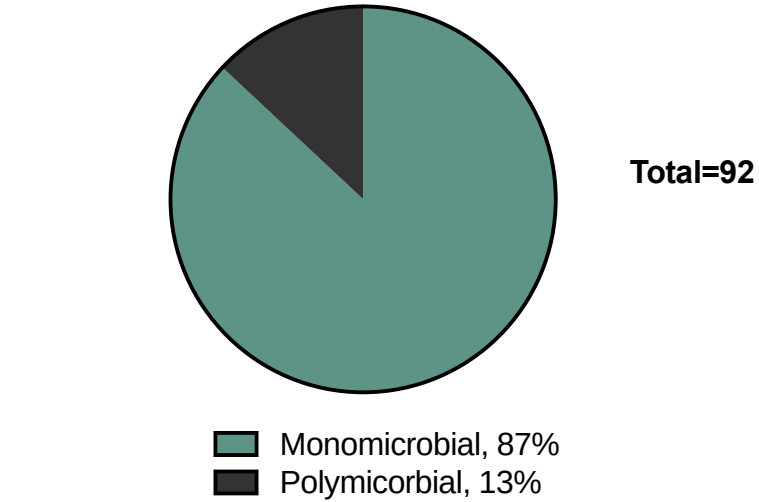


Figure 2: Number of causative organisms



Results - Rates

Table 2. Rates of bloodstream infections by access type and dialysis location per 1000 dialysis days

	AV fistula	AV graft	Tunnelled CVC	Non- Tunnelled CVC	Total
	Rate, (n/dialysis days 000s)	Rate, (n/dialysis days 000s)	Rate, (n/dialysis days 000s)	Rate, (n/dialysis days 000s)	Rate, (n/dialysis days 000s)
Hospital	0.28 (25/89.0)	0.65 (2/3.1)	0.71(37/51.8)	0.51(2/3.9)	0.45 (66/147.8)
Satellite	0.28 (16/58.0)	0.00 (0/2.7)	0.34 (8/23.9)	0.00 (0/1.9)	0.28 (24/86.3)
Home	0.03 (2/61.8)	0.00 (0/0.7)	0.00 (0/4.0)	0.00 (0/0.0)	0.03 (2/66.5)
Total	0.21 (43/208.7)	0.31(24/6.5)	0.57 (45/79.6)	0.35 (2/5.7)	0.31 (92/300.6)

Note. Abbreviation AV arteriovenous, CVC central venous catheter
*Westmead and Blacktown hospital, #Aurbun and Mt Druitt dialysis centres

102 organisms across 92 BSI

Table 3. Microorganisms of bloodstream infections by access type

Organisms (n = 102)	All access types (n = 92) n (%)	Central venous catheter (n = 47) n (%)	Arteriovenous fistula or graft (n = 45) n (%)
Staphylococcus aureus	**30 (33)**	11 (23)	**19 (42)**
Methicillin-resistant *S. aureus*	10 (11)	4 (9)	6 (13)
Coagulase negative *Staphylococci*	23 (25)	**23 (49)**	0 (0)
Escherichia coli	12 (13)	2 (4)	**10 (22)**
Enterococcus species	8 (9)	6 (13)	2 (4)
Vancomycin-resistant *Enterococci*	2 (2)	2 (4)	0 (0)
Streptococcus species	6 (7)	1 (2)	5 (11)
Klebsiella species	3 (3)	2 (4)	1 (2)
Serratia marcescens	3 (3)	0 (0)	3 (7)
Enterobacter cloacae	2 (2)	2 (4)	0 (0)
Fungi^	2 (2)	1 (2)	1 (2)
Other species*	12 (13)	7 (15)	5 (11)

p<0.001 OR 1.958 (95% CI 1.480-2.591)

p<0.001 OR 6.429 (95% CI 1.32-31.25)

^Fungi species: *Candida glabralta* (1), *Nakaseomyces bracarensis* (1)

*Other species: Citrobacter species (2), Aeromonas hydrophila (2), Stenotrophomonas maltophilia (2), *Listeria* species (1), *Clostridium perfringens* (1), *Pseudomonas aeruginosa* (1), *Phytobacter ursingii* (1), *Bacteroides fragilis* (1), *Cornyebacterium* species (1)

Results – Outcomes by type of BSI

Table 4. Outcomes by type of bloodstream infections

	Access-related BSI (n = 62)	Not Access Related BSI (n = 30)	Total BSI (n=92)
	n (%) or median (IQR)	n (%) or median (IQR)	n (%) or median (IQR)
Sepsis	29 (47)	13 (43)	42 (46)
Severe sepsis	2 (3)	5 (17)	7 (8)
Hospitalisation	58 (94)	29 (100)	88 (96)
Days in hospital	14 (10-25)	13 (8-24)	13 (8-24)
ICU admission	17 (27)	10 (33)	27 (29)
Days in ICU	3 (3-5)	3 (2-15)	3 (2-6)
Complications			
Endocarditis	6 (10)	0 (0)	6 (7)
Bone or joint infection	1 (2)	6 (20)	7 (8)
Thrombosis of access device	4 (6)	0 (0)	4 (4)
Died within 7 days	4 (6)	3 (10)	7 (8)
Died within 30 days	5 (8)	6 (20)	11 (12)
Days until death	1 (1-6)	9 (9-19)	1 (3-11)
Discharge to higher level of care	4 (6)	2 (7)	6 (7)

Note: Abbreviations BSI bloodstream infection, ICU intensive care unit

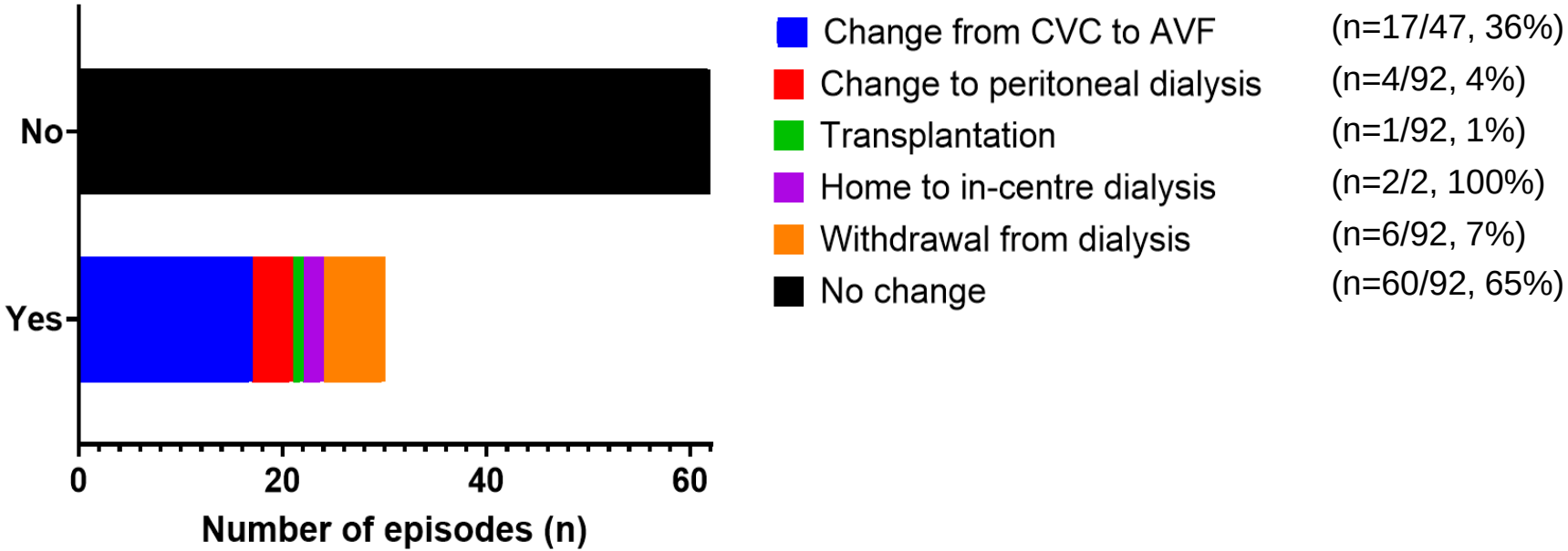
Results – Outcomes of BSI by organism type

Table 5. Outcomes of bloodstream infection by organism type

	Gram Positive n (%) or median (IQR)		S. *aureus* n (%) or median (IQR)			Gram negative (%) or median (IQR)		
Total	61	(100)	30	(100)		28	(100)	
Sepsis	27	(44)	16	(53)		14	(50)	
Days in hospital	11	(15-8)	23	(12-41)		11	(8-15)	
ICU admission	14	(23)	4	(13)		11	(39)	*p*=0.04, OR 2.68 (95% CI 1.03-6.60)
Endocarditis	6	(10)	5	(17)	*p*=0.02 OR 12.2 (95% CI 1.36-109.77)	0	(0)	
Died within 7 days	1	(2)	1	(3)		4	(14)	
Died within 30 days	7	(11)	4	(13)		4	(14)	
Discharge to higher level of care	4	(7)	3	(10)		2	(7)	

Results – Changes to kidney replacement therapy

Figure 3: Change in kidney replacement therapy following infection



Conclusions

- Rate of BSI was **0.31 per 1000 dialysis days**
- Rates of BSI were lowest for **AVF and home dialysis**
- **67% of infections were access-related**
- ***Staphylococcus aureus*** was predominant causative organism
- Outcomes are poor following infection with **30-day mortality at 12%**
- Outcomes were **poorer in those infected with *S. aureus***
- Over a **third of patients had a change in kidney replacement therapy** following infection

Next Steps

- Mandatory reporting of all BSI for patients on HD

    -Rates for benchmarking

Future research directions:

- Assessment of empiric antibiotic guidelines in WSLHD for BSI in HD patients
- Determining if an association exists between infection control practices and rates of infection between dialysis locations

References

1. ANZDATA Registry. *45th Report, Chapter 4: Haemodialysis. Australia and New Zealand Dialysis and Transplant Registry*. 2022. Adelaide, Australia.

2. Skov Dalgaard L, Nørgaard M, Jespersen B, et al. Risk and prognosis of bloodstream infections among patients on chronic hemodialysis: a population-based cohort study. *PLoS ONE* 2015; 10: e0124547. 2015/04/25. DOI: 10.1371/journal.pone.0124547.

3. Patel PR, Kallen AJ and Arduino MJ. Epidemiology, surveillance, and prevention of bloodstream infections in hemodialysis patients. *Am J Kidney Dis* 2010; 56: 566-577. Article. DOI: 10.1053/j.ajkd.2010.02.352.

4. Xue H, Ix JH, Wang W, et al. Hemodialysis access usage patterns in the incident dialysis year and associated catheter-related complications. *Am J Kidney Dis* 2013; 61: 123-130. Comparative Study. Research Support, N.I.H., Extramural. DOI: 10.1053/j.ajkd.2012.09.006.