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RESEARCH ARTICLE

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The burden of peripheral intravenous catheters in older hospital inpatients: A national cross-sectional study part of the ONE MILLION GLOBAL PERIPHERAL INTRAVENOUS CATHETERS COLLABORATION

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Abstract

Objectives: To investigate the burden of peripheral intravenous catheters (PIVCs) in older hospitalised patients.

Methods: A cross-sectional prospective observational study (2014/2015) to describe the characteristics, indications and outcomes of PIVCs among patients aged ≥65 from 65 Australian hospitals.

Results: Amongst 2179 individual PIVCs (in 2041 patients, mean age 77.6 years, 45% female, 58% in NSW), 43% were inserted by doctors and 74% used that day, meaning 25% were 'idle'. Overall, 18% (393/2179) exhibited signs of PIVC-related complications. Most commonly exhibited PIVC-related complications were tenderness (4.1%) and local redness (1.8%). Nearly one in three (29.1%) dressings was soiled, loosened or had come off, and only 36.8% had the time and date documented on the dressing. Both infusing IV medications (aOR 1.74, 95% CI 1.28–2.38, $p < 0.001$) and inserting the PIVC in a non-upper limb vein (aOR 3.40

[Correction added on 17 May 2022, after first online publication: CAUL funding statement has been added.]

compared to forearm [reference site], 95% CI 1.62–7.17, $p < 0.001$) were independently associated with PIVC failure. Phlebitis was exhibited in 7% (154) of the patients. Only infusing intravenous medications increased the likelihood of developing symptoms of phlebitis (aOR 1.61, 95% CI 1.01–2.57, $p = 0.05$). Increasing age was inversely associated with symptoms of phlebitis. Among the 1575 patients (79%) who rated their PIVC experience using the Likert scale 0–10 (where 10 = 'best possible'), the median score was 8 (IQR 6–10). Age in highest quartile (>84 years) was independently associated with lower likelihood of a high score (aOR 0.71, 95% CI 0.54–0.94, $p = 0.02$).

Conclusions: Given 1 in 5 PIVCs were identified with having complications, further research should focus on optimising PIVC use in older patients.

KEYWORDS

aged, cannula, infusions, intravenous, patient harm, patient outcome assessment

1 | INTRODUCTION

Peripheral intravenous catheters (PIVCs) are the most common vascular access devices available in Australian hospitals.[1-3] Nearly 8 million PIVCs are inserted in Australian hospitalised patients each year.[4] Although essential, these devices are not without risk, with up to 70% of them removed prematurely. These peripheral devices are prone to occlusion and dislodgment, and can cause inflammation of the vein as well as blood stream infection. More importantly, nearly half of all first PIVC insertion attempts fail, causing undue pain and anxiety in patients as a result of multiple failed attempts, and nearly a quarter of the insertions are not actually needed and place the patient at risk of infection unnecessarily.[3,4] There are over 3000 cases of IVC-associated blood-stream infections each year in Australia, with 1 in 10 patients dying, and many more experiencing morbidity.[5]

Older people are a particularly vulnerable population and when admitted to hospital, peripheral cannulation can often be difficult, with many requiring multiple attempts for successful insertion of a PIVC that ultimately fails shortly afterwards.[6-8] There are several contributing factors with older adults that makes cannulation and intravenous therapy challenging. These factors can include co-morbid conditions such as diabetes-related vascular diseases and renal diseases, as well as age-related changes to the skin, connective tissue and veins.[6,9-12] Therefore, the insertion of a PIVC can be difficult, as can the ongoing securement and dressing of the device, particularly in older adults with cognitive impairment.[13]

Nearly half of all same day hospital admissions in Australia are of people aged 65 and older, with almost all (90%) requiring some form of acute care that would require a vascular access device (medical, surgical and other acute care).[14] The number of older adults requiring acute hospitalisation is estimated to increase dramatically over the next two decades.[15-17] The burden of using a vascular access device in this growing population is likely to become a significant problem, which needs to be addressed in the short term, to ensure that appropriate policies and guidelines are implemented to reduce high complication rates.[14-16,18,19] In this context, we investigated the burden of PIVCs among older hospital inpatients in Australia.

Practice Impact

In this large national cross-sectional study of over 2000 PIVCs, we identified that almost 1 in 5 had PIVC-related clinical symptoms/signs, with additional deficits including soiling or lifting of dressings, lack of dating, or idle cannulae. PIVC practices should be optimised to reduce avoidable PIVC-related burden, and policies to support best practice need to be instituted.

Policy Impact

This study, in combination with other available data, indicates that there is substantial room for improvement in the management of PIVCs, including in older patients. Guidelines such as the recently launched Management of Peripheral Intravenous Catheters Clinical Care Standard may enable health services to assess practice and support quality improvement initiatives.

2 | METHODS

The current study represents a sub-group analysis of older Australian inpatients, from the international cross-sectional *One Million Global Peripheral Intravenous Catheter (OMG PIVC)* Study, which has been described in detail elsewhere.[3] Patients in rural, regional and metropolitan Australian hospitals, with a PIVC *in situ* on the day of the study, were eligible for inclusion. Data were collected between June 1, 2014 and July 31, 2015. Hospitals took part on a voluntary basis, with 82 Australian hospitals enrolled in the all-ages study. Capacity was determined locally, with the option of contributing data from anywhere between one ward and the entire institution. Ethical approval was originally granted from the Griffith University Human Research Ethics Committee (NRS/34/13/HREC), with all participating sites requiring local ethics committee approval prior to participation in the study.

The parent study involved nurses and doctors with prior experience in PIVC assessment to review PIVCs using a standardised data collection form. Clinicians assessed the PIVC insertion site and accessed hospital records to collect data related to PIVC insertion, concurrent medications and IV fluid orders. The case report form (CRF) used included variables such as catheter insertion characteristics (date and time, reason, location, profession of inserter, anatomical site of placement and how long it had been *in situ*), catheter type (gauge, brand and product), insertion site assessment for adverse symptoms/signs (pain/tenderness, local or extending redness, swelling, purulence, palpable hard vein, induration, blistering, other rash and extravasation) and dressing type and integrity, whether used in the preceding 24 hours, and information related to the intravenous (IV) therapy (types of IV fluids and medications, flushing solutions). Idle PIVCs were defined as those that were not being used for blood sampling or IV therapy in the preceding 24 hours (or since insertion, if shorter). In addition, patients were given the option of assessing their current PIVC experience on a Likert scale of 0–10 (ranging from 0 = worst possible, to 10 = best possible).[3]

Our outcomes of interest for this subgroup analysis were the characteristics of and risk factors for PIVC related complications in patients greater than 65 years of age who were enrolled in the original study. We report our findings as per the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[20]

2.1 | Statistical analysis

Patient and PIVC characteristics were investigated using descriptive statistics in the first instance, and associations with binary outcomes of interest were further investigated with univariate and multivariable logistic regression analysis as appropriate. Estimates of the risk for PIVC failure or phlebitis are presented as odd ratios (OR), and associated 95% confidence intervals (95% CI), both crude and adjusted, estimated are presented. The multivariable model was adjusted for all of the independent variables assessed (age, sex, reason for PIVC, PIVC size, PIVC site, inserter, insertion location and dressing type). In a sensitivity analysis, we additionally performed stepwise logistic regression, whereby variables that did not meet significance in the initial multivariable model (i.e., $p > 0.05$) were dropped from subsequent models.

All data management was performed using SAS (version 9.4), and all analysis were performed using the R language for statistical computing (R Core Team, 2017) and Stata® v13.0 (StataCorp®, Texas, USA).

3 | RESULTS

Overall, 68/82 patients enrolled in Australian hospitals were aged ≥65 on the day of the study. We assessed 2179 individual PIVCs across 2041 patients. Mean age of patients aged ≥65 years included in this study was 78 years (standard deviation 8.0 years), and 45% ($n = 985$) were female (Table 1). Most PIVCs were captured within the state of New South Wales (NSW; 58%, $n = 1257$), followed by Victoria (19%, $n = 422$). Hospitals ranged from large metropolitan tertiary referral centres, to private hospitals, to smaller rural facilities.

Among the 2179 PIVCs used, 43% ($n = 932$) were inserted by doctors, 24% ($n = 517$) by nurses with 29% ($n = 624$) having no documented information for inserter. Most were inserted in the ward (40%, $n = 866$) or the ED (25%, $n = 548$). The most common PIVC position was the wrist and hand (42%, $n = 901$), followed by the antecubital fossa (29%, $n = 624$). Only 27% ($n = 586$) of PIVCs were placed in the recommended position of the forearm. The majority of PIVCs (74%, $n = 1605$) were 20–22 gauge, and nearly all (97%, $n = 2104$) were covered with an appropriate transparent dressing (Table 1). Median duration that the PIVC had been in place was 1.7 days (IQR 0.83–2.04 days, range 0.1–32.88 days).

The primary indication for PIVC insertion was for IV medications (58%, $n = 1252$) of which 12% were for IV antibiotics ($n = 270$); this was followed by IV fluids (22%, $n = 478$), and 16% ($n = 356$) were for 'other' reasons (e.g., blood-collection). However, only 74% ($n = 1617$) had been used in the preceding 24 hours, suggesting that a quarter may have been idle (Table 1).

Regarding complications and burden related to the PIVC, 18.0% (393/2179) of the devices were observed to

TABLE 1 Characteristics of older adults and peripheral vascular access devices

	Women (n = 985)	Men (n = 1,194)	Combined (N = 2,179)
Age (years), mean (SD)	79 (8.4)	77 (7.6)	78 (8.0)
Reason for PIVC, *n* (%)			
IV fluids	221 (22)	259 (22)	480 (22)
IV meds	572 (58)	685 (57)	1,257 (58)
Other	161 (16)	195 (16)	356 (16)
Resuscitation	31 (3)	55 (5)	86 (4)
Site, *n* (%)			
Wrist or hand	441 (45)	465 (39)	906 (42)
Antecubital fossa	294 (30)	330 (28)	624 (29)
Forearm	222 (23)	365 (31)	587 (27)
Head/neck/other	17 (2)	20 (2)	37 (2)
Upper arm	8 (1)	14 (1)	22 (1)
Size, *n* (%)			
24–26 G	16 (2)	6 (1)	22 (1)
14–18 G	111 (11)	209 (18)	320 (15)
20–22 G	755 (77)	856 (72)	1,611 (74)
Not known	101 (11)	123 (10)	224 (10)
Dressing type, *n* (%)			
Sterile gauze	5 (1)	6 (1)	11 (1)
Tape only	3 (0)	6 (1)	9 (0)
Transparent	949 (97)	1,115 (97)	2,104 (97)
Unknown	19 (2)	27 (2)	46 (2)
PIVC inserted by, *n* (%)			
IV team	17 (2)	12 (1)	29 (1)
Nurse	225 (23)	293 (25)	518 (24)
Medical officer	429 (43)	508 (43)	937 (43)
Technician	34 (3)	33 (3)	67 (3)
Not documented	280 (28)	348 (29)	628 (29)
PIVC inserted in, *n* (%)			
Ambulance/EMS	33 (3)	35 (3)	68 (3)
Emergency Department	271 (28)	281 (24)	552 (25)
Ward	388 (39)	479 (40)	867 (40)
ICU/CCU	23 (2)	65 (5)	88 (4)
Operating Theatre	120 (12)	135 (11)	255 (12)
Radiology Department	14 (1)	15 (1)	29 (1)
Not documented	136 (14)	184 (15)	320 (15)
PIVC not used within 24hrs, *n* (%)	731 (74)	886 (74)	1617 (74)

Abbreviations: CCU, coronary Care Unit; EMS, Emergency Medical Services; G, gauge; ICU, Intensive Care Unit; IV, intravenous; OT, operating theatre.

be exhibit signs of complications (Table 2) with 154 (7.1%) exhibiting signs of phlebitis (such as local redness, tenderness, swelling; see Table 3). In total, 82.0% were symptom free.

3.1 | Risk factors for PIVC failure and Phlebitis

Overall, 18% (393/2179) showed clinical signs related to their PIVC, and 7% (154) had evidence of phlebitis (redness, pain and/or swelling[3]). For both univariate and adjusted analysis, age was not an independent risk factor for PIVC failure in this cohort of older patients (aged ≥65 years) (Table 2). Both infusing IV medications (aOR 1.74, 95% CI 1.28–2.38, $p < 0.001$) and inserting the PIVC in a non-upper limb vein (aOR 3.40 compared to forearm [reference site], 95% CI 1.62–7.17, $p < 0.001$) were independently associated with PIVC failure (Table 2). When multivariable stepwise logistic regression was employed, adjusting for both PIVC reason and site, PIVC use for IV medications (aOR 1.76, 95% CI 1.3–2.38, $p < 0.001$) and antecubital fossa (aOR 1.58, CI 1.18–2.11, $p = 0.002$) and 'other/head/foot' PIVC sites (aOR 3.77, CI 1.87–7.59, $p < 0.001$) remained independently associated with PIVC failure.

Increase in age was inversely associated with symptoms of phlebitis, with a trend towards reduced likelihood of phlebitis symptoms with advancing age (adjustment for all independent variables: $p = 0.05$ for trend [Table 2]; adjusted for age, site, PIVC reason and dressing [stepwise logistic regression]: $p = 0.035$ for trend). Only infusing intravenous medications increased the likelihood of developing symptoms of phlebitis (aOR 1.61, 95% CI 1.01–2.57, $p = 0.05$; Table 2); the findings were relatively unchanged when adjusted only for age, site, PIVC reason and dressing (aOR 1.53, CI 0.98–2.4, $p = 0.06$).

3.2 | Patient experience

Among the 1575 patients (79%) who rated their PIVC experience, using the Likert scale 0–10 (where 10 = 'best possible'), the median score was 8 (IQR 6–10). Just over 1 in 10 (11%, $n = 175$) scored the experience <5. In univariate analysis, lower likelihood of a high (>8) score was noted in those within the highest quartile age (>84 years) (OR 7.34, $p = 0.03$) and those with clinical symptoms/signs related to their PIVC (OR 0.49, $p < 0.001$). In multivariable analysis, both factors maintained independent associations with lower likelihood of giving a high Likert score (Table 4).

TABLE 2 Risk factors for PIVC failure

Risk factor	Failure, n/N (%)	crude Odds Ratio (95% CI)	adj Odds Ratio (95% CI)[b]	adj *p*-value
Age group (years)				
65–74	153/866 (18)	1.0 (ref)	1.0 (ref)	
75–84	154/831 (19)	1.06 (0.83, 1.36)	1.03 (0.80, 1.34)	
85–94	77/450 (17)	0.96 (0.71, 1.30)	0.85 (0.62, 1.17)	
95+	9/32 (28)	1.82 (0.83, 4.02)	1.86 (0.68, 1.07)	0.7[a]
Women	189/985 (19)	1.0 (ref)	1.0 (ref)	
Men	204/1,204 (17)	0.87 (0.70, 1.08)	0.85 (0.68, 1.07)	0.2
Reason for PIVC, *n* (%)				
IV fluids	63/480 (13)	1.0 (ref)	1.0 (ref)	
IV medication	257/1,257 (21)	1.70 (1.26, 2.29)	1.78 (1.31, 2.41)	<0.001
Resuscitation	13/86 (15)	1.18 (0.62, 2.25)	1.32 (0.68, 2.57)	0.4
Other	60/356 (17)	1.34 (0.91, 1.97)	1.27 (0.86, 1.88)	0.2
PIVC size				
20-22G	280/1,611 (17)	1.0 (ref)	1.0 (ref)	
24-26G	3/22 (14)	0.75 (0.22, 2.55)	0.88 (0.25, 3.08)	0.8
14-18G	60/322 (19)	1.09 (0.80, 1.48)	1.23 (0.88, 1.72)	0.2
Unknown	50/224 (22)	1.37 (0.97, 1.92)	1.13 (0.78, 1.63)	0.5
PIVC site (%)				
Forearm	95/587 (16)	1.0 (ref)	1.0 (ref)	
Antecubital fossa	145/627 (23)	1.56 (1.17, 2.08)	1.48 (1.10, 1.99)	0.01
Wrist or hand	134/906 (15)	0.90 (0.68, 1.20)	0.90 (0.67, 1.21)	0.5
Other / head/foot	15/37 (41)	3.53 (1.77, 7.05)	3.34 (1.59, 7.01)	0.001
Upper arm	4/22 (18)	1.15 (0.38, 3.48)	1.30 (0.42, 4.03)	0.6
PIVC inserted by (%)				
IV team	2/29 (7)	1.0 (ref)	1.0 (ref)	
Nurse	82/518 (16)	2.54 (0.59, 10.88)	2.52 (0.57, 11.13)	0.2
Medical officer	159/937 (17)	2.76 (0.65, 11.72)	2.81 (0.64,12.24)	0.2
Technician	7/67 (11)	1.57 (0.31, 8.09)	2.82 (0.38, 21.13)	0.3
Not documented	143/628 (23)	3.98 (0.94, 16.94)	3.36 (0.76, 14.87)	0.1
PIVC inserted in (%)				
Ambulance/EMS	6/68 (9)	1.0 (ref)	1.0 (ref)	
ED	102/552 (19)	2.34 (0.99, 5.56)	2.13 (0.50, 9.08)	0.3
Ward	149/867 (17)	2.14 (0.91, 5.05)	2.17 (0.51, 9.26)	0.3
ICU/CCU	9/88 (10)	1.18 (0.40, 3.48)	1.21 (0.25, 6.00)	0.8
OT	35/255 (14)	1.64 (0.66, 4.09)	1.50 (0.34, 6.68)	0.6
Radiology	6/29 (21)	2.70 (0.79, 9.21)	2.27 (0.51, 10.22)	0.3
Not documented	86/320 (27)	3.80 (1.59, 9.10)	3.22 (0.75, 13.77)	0.1
Dressing (%)				
Transparent	377/2,113 (18)	1.0 (ref)	1.0 (ref)	
Tape	1/9 (11)	0.58 (0.07, 4.68)	0.59 (0.07, 4.76)	0.6
Sterile gauze	1/11 (9)	0.47 (0.06, 3.66)	0.72 (0.09, 5.99)	0.8
Unknown	14/46 (30)	2.01 (1.06, 3.81)	1.48 (0.74, 2.96)	0.3

Abbreviations: CCU, coronary Care Unit; EMS, Emergency Medical Services; G, gauge; ICU, Intensive Care Unit; IV, intravenous; OT, operating theatre.

[a]*p* value for trend.

[b]Adjusted: age, sex, reason for PIVC, PIVC size, PIVC site, inserter, insertion location and dressing type.

TABLE 3 Risk factors for Phlebitis

Risk factor	Failure, n/N (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)[b]	Adjusted *p*-value
Age group (years)				
65–74	69/866 (8)	1.0 (ref)	1.0 (ref)	
75–84	62/831 (8)	0.93 (0.65,1.33)	0.89 (0.62, 1.29)	
85–94	22/450 (5)	0.62 (0.37,1.02)	0.51 (0.31, 0.85)	
95+	1/32 (3)	0.39 (0.05,2.91)	0.33 (0.04, 2.51)	0.05[a]
Women	70/985 (7)	1.0 (ref)	1.0 (ref)	
Men	84/1,194 (7)	0.99 (0.71,1.37)	0.93 (0.66, 1.30)	0.7
Reason for PIVC, *n* (%)				
IV fluids	26/480 (5)	1.0 (ref)	1.0 (ref)	
IV medication	101/1,257 (8)	1.53 (0.98, 2.38)	1.53 (0.98, 2.40)	0.06
Resuscitation	7/86 (8)	1.55 (0.65, 3.69)	1.76 (0.72, 4.29)	0.2
Other	20/356 (6)	1.04 (0.57, 1.89)	0.94 (0.51, 1.72)	0.8
PIVC size				
20-22G	120/1,611 (7)	1.0 (ref)	1.0 (ref)	
24-26G	1/22 (5)	0.59 (0.08, 4.44)	0.84 (0.11, 6.48)	0.9
14-18G	18/322 (6)	0.74 (0.44, 1.23)	0.85 (0.49, 1.45)	0.5
Unknown	15/224 (7)	0.89 (0.51, 1.55)	0.94 (0.53, 1.66)	0.8
PIVC Site (%)				
Forearm	46/587 (8)	1.0 (ref)	1.0 (ref)	
Antecubital fossa	54/627 (9)	1.11 (0.74, 1.67)	1.00 (0.65, 1.54)	1.0
Wrist or hand	49/906 (5)	0.67 (0.44, 1.02)	0.65 (0.42, 1.00)	0.05
Other/head/foot	3/37 (8)	1.04 (0.31, 3.51)	1.42 (0.4,5.04)	0.6
Upper arm	2/22 (9)	1.18 (0.27, 5.19)	1.23 (0.27, 5.6)	0.8
PIVC inserted by (%)				
IV team	1/29 (4)	1.0 (ref)	1.0 (ref)	
Nurse	36/518 (7)	2.09 (0.28, 15.82)	1.82 (0.23, 14.15)	0.6
Medical officer	65/937 (7)	2.09 (0.28, 15.59)	2.07 (0.27, 15.84)	0.5
Technician	2/67 (3)	0.86 (0.08, 9.89)	0.52 (0.03, 10.00)	0.7
Not documented	50/628 (8)	2.42 (0.32, 18.18)	1.96 (0.25, 15.32)	0.5
PIVC inserted in (%)				
Ambulance/EMS	3/68 (4)	1.0 (ref)	1.0 (ref)	
ED	45/552 (8)	1.92 (0.58, 6.36)	0.67 (0.11, 4.18)	0.7
Ward	60/867 (7)	1.61 (0.49, 5.28)	0.55 (0.09, 3.43)	0.5
ICU/CCU	4/88 (4)	1.03 (0.22, 4.77)	0.34 (0.04, 2.67)	0.3
OT	10/255 (4)	0.88 (0.24, 3.31)	0.29 (0.04, 2.01)	0.2
Radiology	2/29 (7)	1.60 (0.25, 10.15)	0.60 (0.06, 5.61)	0.655
Not documented	30/320 (9)	2.24 (0.66, 7.57)	0.84 (0.13, 5.27)	0.850
Dressing (%)				
Transparent	154/2,113 (7)	1.0 (ref)	1.0 (ref)	
Tape	0/9 (0)	NE	NE	
Sterile gauze	0/11 (0)	NE	NE	

Abbreviations: CCU, coronary Care Unit; EMS, Emergency Medical Services; G, gauge; ICU, Intensive Care Unit; IV, intravenous; OT, operating theatre.

[a]*p* value for trend.

[b]Adjusted: age, sex, reason for PIVC, PIVC size, PIVC site, inserter, insertion location, and dressing type.

TABLE 4 Adjusted analysis of 'high' experience score (Likert rating >8). $N = 1565$

Variable	OR	95% CI	*p*-value
Age in highest quartile	0.71	0.54–0.94	0.02
Clinical symptoms/signs	0.48	0.36–0.65	<0.001

Those who did not/were not able to respond to the experience questions were older (80.5 versus 76.5 years, $p < 0.001$) and were less likely to have PIVC inserted by a doctor; however, there was no difference between responders and non-responders in terms of Australian state, PIVC location, or clinical signs/symptoms.

4 | DISCUSSION

In this secondary analysis of Australian data from the prospective, cross-sectional, international OMG study, we identified that almost 1 in 5 older Australian hospital patients with a PIVC had symptoms and/or signs related to their PIVC. Almost one third of PIVC insertions had no documented inserter, and one in every 4 PIVCs assessed were idle on the day of assessment. These findings indicate that there is substantial room for improvement in the use of PIVCs in an older Australian inpatient population. Reassuringly, overall complication rates were not high, at least in this sample, however caution and routine surveillance of the PIVC may be helpful if infusing medications, given the association we noted between medication infusion and PIVC failure. Our findings also indicate that where possible, PIVCs should not be placed in non-conventional positions in this cohort, due to an association with increased cannula failure.

We included a simple and brief patient experience measure, and while few were dissatisfied, the oldest respondents were less likely to rate their PIVC experience very highly. Only three quarters of patients contributed to this assessment, and those who were unable to partake (due to illness or cognitive impairment) may be even more vulnerable. Furthermore, we note that a Likert scale only allows for a limited snapshot of the patient experience, and further research exploring the patient experience of cannulation and PIVC management is needed (and planned).

The deficits identified suggest that clinicians inserting and caring for PIVCs should be encouraged and facilitated to adopt evidence-based PIVC insertion and maintenance bundles to reduce the prevalence of PIVC complications.[21,22] The launch of the Management of Peripheral Intravenous Catheters Clinical Care Standard in May of 2021 is a promising step in the right direction.[4] It includes ten quality statements, and indicators for local monitoring, which can serve as a guide to clinicians and institutions towards improving and ensuring quality of PIVC care. These range from assessment of access needs to partnering with patients, to choice of device and site, to maximising first insertion success, as well as review for ongoing need. These standards aim to "support the delivery of evidence-based clinical care and promote shared decision-making between patients, carers and clinicians".[4] Box 1 summarises the Quality Statements from the Clinical Care Standard. The Clinical Care Standard also highlights a number of steps to reduce PIVC-related complications: avoidance of unnecessary PIVCs, ensuring medications and fluids are suitable for peripheral administration, clinician competence, use of standard precautions (hand hygiene/aseptic technique) for insertion and access, avoiding the side of arteriovenous fistula or axillary lymph node clearance, placing in a stable non-flexion area, securing and considering extension tubing, applying sterile semipermeable transparent dressings, and removing when not needed or if complications arise.[4] While the standards are not prescriptive in terms of 'acceptable' rates for each of the included recommendations, the indicators included can support health services to "monitor how well they are implementing...care...and support local quality improvement activity".[4] We suggest that where low rates of compliance with care standards are identified, this should prompt a search for barriers and facilitators to best practice, and a cycle of audit including intervention and reassessment.

Complications and difficulties associated with PIVCs among all adults are well-described.[3,21,22] In the French ADVANCED study of intravascular devices in adults within the intensive care unit, the incidence rate of complications was 60.9 per 1000 catheter days, the commonest of these being dysfunction, and this more commonly seen in PIVCs than arterial or central lines.[23] Overall failure rates of up to 50% have been described in the literature.[24] Our observed rate of phlebitis is lower than that described in a Serbian study of adults (all ages), where phlebitis was noted in 44% of PIVCs amongst 368 patients.[7] The authors note that access to chlorhexidine, transparent film dressing, and integrated PIVC systems, may be more restricted in developing countries such as Serbia, which may partly explain the higher rates of phlebitis observed by that group. We note that rates of phlebitis in our study were relatively low, but higher than the target of <5% set by the Infusion Nurse's Society.[7] Phlebitis was inversely associated with increasing age in the group of older people we studied. Both young and old extremes of age have been associated with increased risk of catheter failure in the literature.[25] A recent study by the AVATAR group in Queensland, including data from

BOX 1 Summary of Quality Statements from the Management of Peripheral Intravenous Catheters Clinical Care Standard[4] (available at Management of Peripheral Intravenous Catheters Clinical Care Standard (safetyandquality.gov.au)

1. Assess intravenous access needs
2. Inform and partner with patients
3. Ensure competency
4. Choose the right insertion site and PIVC
5. Maximise first insertion success
6. Insert and secure
7. Document decisions and care
8. Routine use: inspect, access and flush
9. Review ongoing need
10. Remove safely and replace if needed

almost 12,000 patients (all ages), noted a slight inverse association between increasing age and risk of phlebitis (HR 0.99, 95% CI 0.98–0.99), with a similar 'risk reduction' in overall PIVC failure, although the clinical significance of such a small reduction is unclear.[25] While we do know that ageing is associated with changes in immune response,[26] it is unclear if this might mediate the risk of phlebitis in the context of IVC insertion and remains a question for future research.

Although the older person's PIVC experience may be different to that among other adults,[14] PIVC studies specific to older patients have been limited. Few, if any, have investigated the patient burden associated with PIVCs, although some have explored particular aspects of PIVC burden. A Turkish study identified a number of factors that were associated with reduced first-attempt IVC insertion success rates in 472 older people, including anticipated difficulty of the procedure rated by the nurse, previous history of a difficult intravenous cannulation, use of a non-upper extremity site for cannulation, nurse-inserter experience and vein non-palpability.[27] Similar risk factors, as well as vein width <3 mm diameter, have been associated with cumulative risk of difficult IV access in a study of over 3000 adults.[18] Finally, as with all aspects of care, the intervention offered should ideally be aligned to patient values and preferences, and it is unclear as to what extent older people are offered alternatives and engaged in shared decision-making in the placement of PIVCs, despite the potential burdens associated with these.

Strengths of the present study include the reasonably large numbers, the case assessment methodology and the inclusion of patients from a variety of hospital types. Nonetheless, we acknowledge that our findings must be interpreted in the light of limitations. Our cross-sectional design did not allow follow-up for further complications or failure. Patient-reported outcome measures were limited, as above, but at least attempted to capture the patient lived experience, although at a basic level. Included hospitals were not randomly selected and may not be representative of all sites. Reasons for non-participation amongst sites that initially registered but later withdrew included local workload constraints and/or difficulties in applying for or obtaining local approvals.[3] These results cannot necessarily be extrapolated to non-hospital or non-Australian settings. Importantly, our data were derived from 2014–2015, but there is little published evidence so far to indicate that practices or outcomes have improved dramatically during the intervening period. A recent Australian study reporting outcomes among patients over the period 2008–2020 reported a failure rate of over 1 in 3, and phlebitis in 12%.[25] Nonetheless, we are hopeful that the recent publication of the Clinical Care Standard[4] will empower clinicians and healthcare organisations to assess and improve practice, and more up-to-date data will be welcomed.

5 | CONCLUSIONS

While our secondary analysis has provided some insight into the burden of cannulation in older adults, moving forward, research should and will focus on the longitudinal inpatient journey across hospital admission, the costs associated with PIVC-related harm and failure, and the patient lived experience. Local institutions will also now be able to assess their performance against the national standards, which will hopefully better inform targeted quality improvement initiatives. Armed with these data, we can optimise the patient experience and minimise iatrogenic harm associated with PIVCs in our older inpatients.

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CONFLICTS OF INTEREST

No conflicts of interest declared.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study may be available on request from the corresponding author and

subject to additional approval from the original approving Human Research Ethics Committee.

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