

Original Research

Multicentre Prospective Cohort Study of Continuous Antibiotic Infusion via Peripheral Intravenous Cannula in the Hospital in the Home Setting

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Importance

Continuous intravenous (IV) antibiotic infusion via peripheral intravenous cannula (PIVC) is utilised in some Hospital in the Home (HITH) services, but current Australian guidelines advise against this practice due to concerns about device failure and complication risk.

Objective

To evaluate the safety, efficacy, and patient experience of continuous IV antibiotic therapy delivered via PIVC in Australian HITH services.

Design

Multicentre prospective observational cohort study.

Setting

Four Australian hospitals with established HITH services.

Participants

Adults (≥ 18 years) receiving anticipated short-term (< 14 days) continuous IV antibiotic infusion via PIVC. Patients with central or midline catheters, intermittent dosing, or < 12 -hour infusions were excluded.

Exposure

Continuous 12–24 hour IV antibiotic administration using an elastomeric pump.

Outcomes

Primary outcomes were the frequency and reasons for PIVC failure (unplanned removal due to complication). Secondary outcomes included complication types, predictors of failure, PIVC dwell time, guideline adherence, and patient satisfaction.

Results

309 patients were included (461 PIVCs; 1,776 catheter-days). Overall PIVC failure rate was 9.98% (46/461; 95% CI 7.40–13.09%), or 25.901 failures per 1,000 catheter-days. No PIVC-related bacteraemia or local infection occurred. Dislodgement (2.82%), phlebitis and pain (each 2.39%) were the most common causes of failure. Higher final Visual Infusion Phlebitis (VIP) score predicted failure (OR 1.89 per point; 95% CI 1.06–3.18; $p=0.018$). Charlson Comorbidity Index was the only independent predictor of failure (HR 1.26, 95% CI 1.02–1.56; $p=0.030$). Clinically indicated PIVC replacement was associated

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with a reduced PIVC failure rate (IRR 0.26, 95% CI 0.13-0.48; $p < 0.001$). Patient satisfaction was high (mean 9.6/10).

Conclusion

Continuous PIVC antibiotic infusion in HITH is safe, effective, and associated with excellent patient experience. The findings support clinically indicated PIVC replacement guided by VIP score assessment and may inform guideline updates for short-course therapy in HITH settings.

Trial Registration: ACTRN12625000384459

KEY POINTS

QUESTION

What is the safety, efficacy, and patient experience of continuous IV antibiotic infusion therapy delivered via Peripheral Intravenous Cannula (PIVC) in Australian HITH services?

FINDINGS

We observed a 9.98% device failure rate, markedly lower than previously reported general PIVC failure rates of 36-69%, with no PIVC-related infections and high patient satisfaction. Results supported clinically indicated rather than routine time-based PIVC replacement.

MEANING

These findings provide evidence to reconsider the current Australian guideline position that continuous IV antibiotic infusions for patients at home, should only be infused via a central venous access device, showing that continuous antibiotic infusions via PIVC (when used for short duration), may be safe in well-resourced HITH settings.

INTRODUCTION

Hospital in the Home (HITH) offers a safe and cost-effective alternative to inpatient care, with equivalent or superior clinical outcomes.¹⁻⁴ Continuous intravenous (IV) antibiotic therapy is commonly delivered in HITH for conditions such as cellulitis, pneumonia and urinary tract infections,^{5, 6} using venous access devices, including peripheral intravenous cannulas (PIVCs), midline catheters or peripherally inserted central catheters (PICCs).⁷⁻⁹

In the home-care setting, continuous antibiotic infusion via PIVC offers practical advantages, including once-daily nursing, ease of insertion, lower invasiveness (superficial versus deep vein), with reduced risk of central venous access device (CVAD)-related complications and costs.¹⁰ PIVC infusions are common in hospitals, and patients may identify subjective symptoms more rapidly than routine staff assessment.¹¹ Longer-length PIVC may reduce phlebitis and dislodgment risk, and enhanced supervision (e.g. specialised nurses and virtual care technology) may further improve monitoring and safety.^{12,13}

Some Australian HITH services routinely use PIVCs for 12-24 hour antibiotic infusions, when short treatment du-

ration is anticipated (typically < 7 days, up to 14 days), with single-centre studies supporting efficacy, safety, and patient satisfaction.^{5,14,15} Current Australian guidelines, however, state that PIVCs are “generally not recommended for continuous infusion” due to risks of device failure and extravasation.¹⁶ This recommendation is largely based on reported general PIVC complication rates of up to 69%.¹⁷ More recent data shows a substantially lower complication rate of 36.4%, suggesting improved PIVC care practice.¹⁸

Many guidelines also recommend routine PIVC replacement every 72 hours,^{16,19} with clinically indicated PIVC replacement restricted to facilities that meet specific safety, surveillance and documentation standards.²⁰ Evidence from Cochrane¹⁹ and an Australian HITH randomised controlled trial²¹ indicates no difference in complication rates between routine and clinically indicated replacement, with reduced costs and less patient discomfort for the latter.

Despite known use, evidence evaluating continuous antibiotic infusion via PIVC in HITH remains limited. No multicentre Australian study has evaluated PIVC failure rates or patient experience in this context, hence there is a need for data to inform practice and guideline alignment.

This study prospectively evaluates safety and efficacy of continuous antibiotic infusion via PIVC across four Australian HITH services. We hypothesised that PIVC failure rate would be low and patient satisfaction high, comparable to or better than reported outcomes for published PICC and general PIVC use. The primary aim was to determine overall PIVC failure rate and reasons for removal. The secondary aims were to 1) measure patient satisfaction, 2) compare failure rates with published benchmarks, and 3) identify independent predictors of PIVC failure, including the association between Visual Infusion Phlebitis (VIP) score (Appendix A) and PIVC removal.

METHODS

STUDY DESIGN

Multicentre, prospective observational cohort study evaluating safety, efficacy and patient satisfaction of continuous 12-24 hour IV antibiotic infusions administered via PIVC in Australian HITH services. Ethics approval was obtained from the ACT Health Human Research Ethics Committee [2024.LRE.00240, 2024/ETH02165] and study was registered with the Australian New Zealand Clinical Trials Registry [ACTRN12625000384459]. Written informed consent was obtained from all participants. Recruitment and data collection occurred March-September 2025. Consecutive pa-

tient enrolment and standardised data collection minimised selection and observer bias.

HOSPITAL SETTING

The study was conducted across HITH services at four public, principal referral and teaching hospitals: Bankstown-Lidcombe (NSW), Canberra (ACT), Townsville University (QLD), and Rockhampton (QLD). Medical governance was provided by hospital-employed clinicians at all sites. Nursing delivery models varied: Canberra and Rockhampton employed hospital-based multidisciplinary teams; Townsville University and Bankstown-Lidcombe partner with private or community nursing services, respectively. At Bankstown-Lidcombe, PIVC management is hospital-based; other sites manage PIVCs in the home or hospital. At all sites, PIVC insertion is predominantly landmark-guided. Canberra Hospital HITH operates a dedicated Intravenous Access Team (IVAT) with specialist nurses who insert PIVCs under aseptic technique and ultrasound guidance, using long PIVCs (45–64mm vs 19–32mm short PIVCs), predominantly for patients with difficult venous access. All sites have pharmacist involvement in infusor management; Canberra and Rockhampton have dedicated HITH clinical pharmacists.

Antibiotic infusors were sourced from a commercial, sterile manufacturing facility (Baxter Healthcare or Slade Health) or prepared on-site by trained nurses or pharmacists. All compounded infusors were prepared using validated protocols governing sterility, dilution, solvent selection, reservoir volume, and drug stability.²² Antibiotic selection for continuous elastomeric infusion was guided by *Australian Therapeutic Guidelines (ATG): Ambulatory Antimicrobial Therapy*¹⁶ and the Baxter Compounding App,²² ensuring only antibiotics with established stability, thermal tolerance, and compatibility for elastomeric delivery were used.

PARTICIPANTS AND RECRUITMENT

Eligible patients were aged ≥ 18 years and anticipated to require only short-term (< 14 days) IV antibiotic therapy, with an antibiotic appropriate for continuous infusion via PIVC. Exclusion criteria were: use of a CVAD or midline catheter, short infusions (< 12 hours) or intermittent bolus dosing. Patients receiving vancomycin were excluded due to high phlebitis risk.^{17,22,23} Flucloxacillin is generally not recommended for continuous infusion via PIVC due to phlebitis risk,²² however, two patients receiving flucloxacillin were included due to initial clinical necessity. Daily admission lists were screened by HITH staff; eligible patients were approached for enrolment and consent before data collection.

SAMPLE SIZE

A minimum sample size of 300 participants was calculated to provide precise estimates of failure rates using Clopper–Pearson exact 95% confidence intervals (Appendix B). Assuming a 10% PIVC failure rate, the expected confidence interval was reduced from 12.7% ($n=100$) to 7.2% ($n=300$).

Recruitment ceased once the target sample size was reached.

DATA COLLECTION

Prospective data collection included patient demographics, comorbidities, treatment indications, antibiotic regimens, and PIVC insertion characteristics (insertor role, anatomical site, gauge, length, dressing type). Daily PIVC assessments by trained HITH nurses included the VIP score²⁴ (Appendix A) until PIVC removal, with reason for removal recorded. Upon completion of IV therapy, patients were invited to complete an anonymous patient satisfaction survey (Appendix C).

CLINICAL OUTCOMES

The primary outcome was overall PIVC failure, defined as unplanned PIVC removal due to complications (infiltration, dislodgement, phlebitis, pain, thrombus, leaking, occlusion, local infection, or bacteraemia). The PIVC failure rate was unplanned removals divided by total PIVC insertions. Planned removal was at treatment completion or electively without complication.

All sites followed routine 72-hour PIVC replacement for short PIVCs, with extension permitted at clinical discretion. Bankstown-Lidcombe directed early removal at VIP score ≥ 1 ; other sites used VIP score ≥ 2 . All sites removed PIVC early if clinical complications were evident²³; longer aseptically inserted PIVCs could remain until clinically indicated removal.

Secondary outcomes included patient satisfaction, type-specific complication rates, predictors of PIVC failure, PIVC dwell time and adherence to replacement guideline recommendations.¹⁶

PATIENT SATISFACTION SURVEY ANALYSIS

At treatment completion, a survey containing three 11-point Likert items and five binary (Yes/No) questions assessed patient satisfaction. Numerical rating scale responses (0–10) and categorical responses (as proportions with exact binomial 95% Confidence Intervals (CIs) were reported. Free-text comments were analysed thematically.

STATISTICAL ANALYSIS

Continuous variables were reported as mean $\pm$ standard deviation (SD) or median (interquartile range; IQR), and categorical variables as counts and percentages. Between-site comparisons used Pearson's chi-squared or Fisher's exact tests for categorical variables, and Kruskal–Wallis or Wilcoxon rank-sum tests for continuous variables. PIVC failure rates were expressed as proportions with exact binomial 95% CIs; failure incidence was calculated per 1,000 catheter-days with Poisson 95% CIs. VIP score associations with failure were examined by logistic regression (odds ratios, ORs).

Predictors of PIVC failure were examined using Cox proportional hazards models. Variables with $p \leq 0.20$ in uni-

variate analysis were included in the multivariable model: Charlson Comorbidity Index (CCI), hospital site, anatomical insertion site, inserter role, PIVC length category (Short: 19–32 mm vs. Long: 45–64 mm), and antibiotic type (grouped as cefazolin [reference], piperacillin-tazobactam, and other). Results were reported as hazard ratios (HRs) with 95% CIs. Quasi-Poisson regression compared failure incidence among failed PIVCs (excluding PIVCs routinely removed at 72 hours) between guideline-recommended (≤ 3 days) and extended (> 3 days) dwell and between total treatment time (≤ 7 vs. > 7 days), using catheter days as an offset to estimate Incidence Rate Ratios (IRR). The unit of analysis was the individual PIVC; each was treated as an independent observation from insertion. Patients with more than one eligible HITH admission during the study period could contribute multiple episodes. All analyses were conducted in R (version 4.3.2; R Core Team, Vienna, Austria); two-sided p -value < 0.05 was considered statistically significant.

Height and BMI were unavailable for Rockhampton participants ($n=74$) and were excluded from multivariable analyses. All other missing data were $< 1.2\%$ and were not imputed.²⁵

RESULTS

STUDY POPULATION

337 patients were screened across four HITH services. Seventeen declined, and 10 were missed due to operational constraints (e.g. after-hours presentations), leaving 310 enrolled. One patient was excluded due to transfer from HITH within 12 hours, leaving 309 patients included for analysis (Figure 1), contributing 461 PIVCs over 1,776 catheter-days. Recruitment differed significantly by site ($p=0.004$): Canberra (33.7%, $n=104$), Rockhampton (23.9%, $n=74$), Bankstown-Lidcombe (22.3%, $n=69$) and Townsville (20.1%, $n=62$).

PATIENT DEMOGRAPHICS AND TREATMENT CHARACTERISTICS

Mean patient age was 60 years (SD 17.80), and 62.78% were male ($n=194$). The median CCI was 1 (IQR 0–5) (Table 1). The most common treatment indication was cellulitis (67.96%, $n=210$), followed by bone and joint infections (8.74%, $n=27$). Cefazolin was most frequently prescribed (78.64%, $n=243$). The median total treatment time, equivalent to the HITH admission length of stay, was 5 days (IQR 3–7). All patients were discharged following clinical improvement; no readmissions due to PIVC complications were identified.

PIVC CHARACTERISTICS

PIVC insertors included regular nurses (51.20%, $n=235$), doctors (26.80%, $n=123$) and IVAT nurses (16.34%, $n=75$), with 5.66% unclassified. Long PIVCs accounted for 15.47% (70/461). Median PIVC dwell time was 4 days (IQR 3–5) (Table S1). Most patients (94.50%, $n=292$) required only 1–2

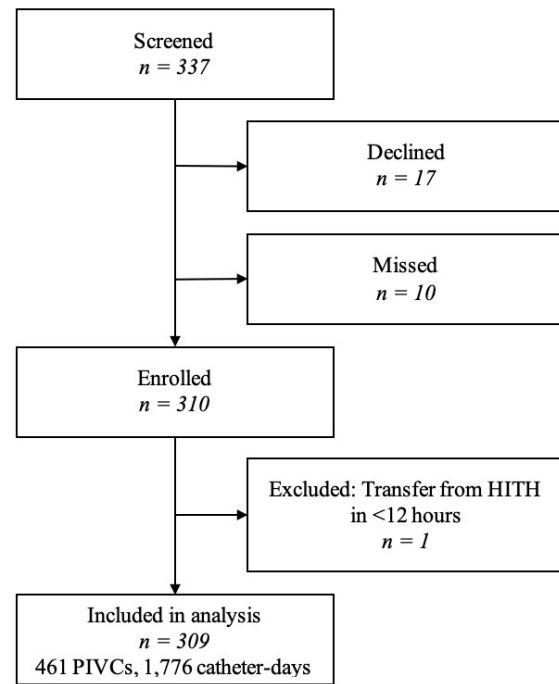


Figure 1. Study flow diagram showing participant screening, enrollment, exclusion and final analysis cohort.

PIVCs. The majority of ultrasound-guided insertions occurred at Canberra Hospital (78/100, 78%), reflecting ready access to the dedicated IVAT (Table S1). Insertion technique was not a significant predictor of PIVC failure (HR 0.61, 95% CI 0.29–1.29, $p=0.195$) (Table S5).

PRIMARY OUTCOMES

PIVC FAILURE

The overall PIVC failure rate was 9.98% (46/461 PIVCs, 95% CI 7.40–13.09%), corresponding to an incidence of 25.90 failures per 1,000 catheter-days. Despite significant differences in recruitment across sites ($p=0.004$), site was not a significant predictor of PIVC failure in either univariate or multivariable analysis (Tables S5, S6). The most common causes of PIVC failure were dislodgement (2.82%), phlebitis (2.39%) and pain (2.39%). No PIVC-related bacteraemia or local infection occurred (Table 2).

All 46 PIVC failures were minor and self-limiting. Mechanical complications (dislodgement, occlusion, leaking, infiltration; $n=28$) were more common than inflammatory complications (phlebitis, pain; $n=22$). No failure resulted in hospital readmission, CVAD escalation, or significant treatment interruption. The single superficial thrombus resolved without sequelae.

SECONDARY OUTCOMES

PATIENT SATISFACTION

249 surveys were completed (80.6% response rate). Overall patient satisfaction was 9.6/10 (mean, SD 1.0) (Table S2).

Table 1. Patient Demographics and Clinical Treatment Characteristics

Characteristic	Overall, n= 309	Bankstown n= 69	Canberra n= 104	Rockhampton n= 74	Townsville n= 62	p-value [§]
Age (years), mean (SD)	60.28 (17.80)	54.94 (19.10)	59.88 (18.27)	61.98 (15.71)	64.39 (16.51)	0.015
Sex, n (%)						0.22
Female	115 (37.22)	22 (31.88)	47 (45.19)	20 (32.26)	26 (35.14)	
Male	194 (62.78)	47 (68.12)	57 (54.81)	42 (67.74)	48 (64.87)	
BMI (kg/m ²), mean (SD)	33.22 (10.35)	32.64 (9.34)	33.95 (11.15)	NA (NA)	32.83 (10.33)	
CCI, median (IQR)	1 (0, 3)	1 (0, 2)	1.5 (0.5, 2.5)	2 (0, 3)	1 (1, 3)	
Grouped Comorbidities, n (%)						
Cardiovascular ¹	79 (25.57)	15 (21.74)	28 (26.92)	17 (27.42)	19 (25.68)	0.86
Endocrine/Metabolic ²	116 (37.54)	24 (34.78)	40 (38.46)	27 (43.55)	25 (33.78)	0.65
Renal/Nephrology ³	13 (4.21)	3 (4.35)	3 (2.89)	5 (8.07)	2 (2.70)	0.39
Respiratory ⁴	53 (17.15)	5 (7.25)	24 (23.08)	13 (20.97)	11 (14.87)	0.041
Neurological ⁵	3 (0.97)	0 (0.00)	1 (0.96)	1 (1.61)	1 (1.35)	0.89
Gastrointestinal/Hepatic ⁶	30 (9.71)	5 (7.25)	13 (12.50)	9 (14.52)	3 (4.05)	0.13
Malignancy ⁷	30 (9.71)	5 (7.25)	13 (12.50)	9 (14.52)	3 (4.05)	<0.001
Musculoskeletal ⁸	35 (11.33)	3 (4.35)	12 (11.54)	8 (12.90)	12 (16.22)	0.15
Immunological/Rheumatological ⁹	11 (3.56)	2 (2.90)	8 (7.69)	1 (1.61)	0 (0.00)	0.033
Other ¹⁰	58 (18.77)	20 (28.99)	35 (33.65)	0 (0.00)	3 (4.05)	<0.001
Treatment Indication, n (%)						0.009
Cellulitis	210 (67.96)	51 (73.91)	57 (54.81)	43 (69.36)	59 (79.73)	
Bone & Joint Infection ¹¹	27 (8.74)	4 (5.80)	15 (14.42)	6 (9.68)	2 (2.70)	
Other Specific Infections ¹²	16 (5.18)	4 (5.80)	7 (6.73)	2 (3.23)	3 (4.05)	
Respiratory Infection ¹³	12 (3.88)	0 (0.00)	10 (9.62)	1 (1.61)	1 (1.35)	
Urinary Tract Infection	11 (3.56)	0 (0.00)	5 (4.81)	3 (4.84)	3 (4.05)	
Abscess ¹⁴	10 (3.24)	3 (4.35)	3 (2.89)	3 (4.84)	1 (1.35)	
Wound-Related Infection ¹⁵	10 (3.24)	2 (2.90)	3 (2.89)	2 (3.23)	3 (4.05)	
Other Skin & Soft Tissue Infection ¹⁶	8 (2.59)	5 (7.25)	2 (1.92)	1 (1.61)	0 (0.00)	
Bacteraemia / Sepsis	5 (1.62)	0 (0.00)	2 (1.92)	1 (1.61)	2 (2.70)	
Antibiotic Type, n (%)						<0.001
Cefazolin	243 (78.64)	56 (81.16)	81 (77.89)	42 (67.74)	64 (86.49)	
Piperacillin/tazobactam	39 (12.62)	13 (18.84)	7 (6.73)	12 (19.36)	7 (9.46)	
Benzympenicillin	19 (6.15)	0 (0.00)	14 (13.46)	2 (3.23)	3 (4.05)	
Ceftazidime	4 (1.29)	0 (0.00)	2 (1.92)	2 (3.23)	0 (0.00)	
Cefepime	2 (0.65)	0 (0.00)	0 (0.00)	2 (3.23)	0 (0.00)	
Flucloxacillin	2 (0.65)	0 (0.00)	0 (0.00)	2 (3.23)	0 (0.00)	
Number of PIVCs per patient, median (IQR)	1.0 (1.0-2.0)	2.0 (1.0, 2.0)	1.0 (1.0, 2.0)	1.0 (1.0, 1.0)	1.0 (1.0, 1.0)	<0.001
Total Treatment time (days), median (IQR)	5.0 (3.0-7.0)	6.0 (5.0, 8.0)	6.0 (4.0, 8.0)	4.0 (3.0, 6.0)	3.0 (2.0, 3.0)	<0.001

§ site-level subgroup analyses may be underpowered

* BMI was not recorded at Townsville University Hospital

1. Hypertension, Myocardial Infarction (MI), Heart Failure, Peripheral Vascular Disease (PVD), Atrial Fibrillation (AF).

2. Diabetes Mellitus (DM), Obesity, Hyperlipidaemia.

3. Chronic Kidney Disease (CKD).

4. Chronic Obstructive Pulmonary Disease (COPD), Asthma.

5. Cerebrovascular Accident (CVA)/Transient Ischemic Attack (TIA), Dementia, Hemiplegia.

6. Gastroesophageal Reflux Disease (GERD), Peptic Ulcer Disease (PUD), Chronic Liver Disease (CLD).

7. Malignant Tumour, Leukemia, Lymphoma.

8. Osteoarthritis (OA).

9. Acquired Immunodeficiency Syndrome (AIDS), Connective Tissue Disease (CTD).

10. Other uncategorized comorbidities.

11. Arthritis (septic), infection (joint), osteomyelitis, prosthetic infection.

12. Mastitis, mastoiditis, melioidosis, ocular syphilis, otitis externa, parotitis, ppm (infected), quinsy, sinusitis.

13. Bronchiectasis, pneumonia.

14. Abscess, collection.

15. Diabetic foot, haematoma, necrotic, ulcer, wound.

16. Bursitis, impetigo, panniculitis, paronychia, tenosynovitis.

Abbreviations: BMI, body mass index; CCI, Charlson Comorbidity Index

Table 2. PIVC Failure, Complication Types and Incidence

PIVC Complication	Events (n)	Failure Rate (%) ¹	Incidence Rate per 1,000 catheter-days ²
Overall PIVC Failure	46	9.98 (7.40-13.09)	25.90 (18.96-34.55)
Complication Types			
Dislodgement	13	2.82 (1.51-4.77)	7.32 (3.90-12.52)
Phlebitis	11	2.39 (1.20-4.23)	6.19 (3.09-11.08)
Pain	11	2.39 (1.20-4.23)	6.19 (3.09-11.08)
Infiltration/Extravasation	8	1.74 (0.75-3.39)	4.51 (1.95-8.88)
Occluded	4	0.87 (0.24-2.21)	2.25 (0.61-5.77)
Leaking	3	0.65 (0.13-1.89)	1.69 (0.35-4.94)
Superficial Thrombus	1	0.22 (0.01-1.20)	0.56 (0.01-3.14)
PIVC Site Infection	0	0.00 (0.00-0.80)	0.00 (0.00-2.08)
Bacteraemia	0	0.00 (0.00-0.80)	0.00 (0.00-2.08)

1. % (95% CI)

2. Number of events per 1,000 catheter days (95% CI)

Most patients felt safe receiving treatment at home (98.3%) and would recommend HITH PIVC antibiotic infusion to others (99.1%) (Table S3). Satisfaction did not differ between patients with (mean 9.7, SD 0.73) and without (mean 9.6, SD 0.75; $p=0.65$) PIVC failure. Few patients contacted HITH regarding device concerns (8.2%), and 3.1% of respondents would have preferred hospital admission (Table S3). Of 425 free-text comments, 82.1% were positive, most addressing service quality (29.9%) and comfort and convenience (19.059%) (Table S4).

PREDICTORS OF PIVC FAILURE

Higher final VIP scores were associated with increased likelihood of PIVC removal; each 1-point VIP increase raised the odds of failure (OR 1.89; 95% CI 1.06–3.18; $p=0.018$).

In univariate analysis, forearm insertion site had significantly lower failure risk than antecubital fossa (HR 0.47, 95% CI 0.23-0.94, $p=0.03$). IVAT nurse insertion had lower failure risk than doctors (univariate HR 0.19, 95% CI 0.05-0.68, $p=0.011$). Longer cannulas had lower failure risk than short cannulas (univariate HR 0.32, 95% CI 0.11-0.94, $p=0.037$). Higher CCI trended toward increased failure risk (univariate HR 1.21, 95% CI 0.99-1.47, $p=0.065$). Hospital site, age, insertion technique, PIVC gauge, BMI, sex and treatment indication were not significant predictors of PIVC failure (Table S5).

In multivariable analysis, CCI was the only independent predictor of increased PIVC failure (HR 1.26, 95% CI 1.02-1.56, $p=0.03$), other factors lost significance (Figure 2).

IMPACT OF GUIDELINE ADHERENCE

Among failed PIVCs, those with extended dwell (>3 days) had significantly lower failure incidence than those replaced within ≤3 days (IRR 0.26, 95% CI 0.13–0.48, $p<0.001$) (Figure 3). Treatment duration >7 days demonstrated a non-significant trend toward lower failure incidence compared with ≤7 days (IRR 0.58, 95% CI 0.30–1.05, $p=0.08$).

DISCUSSION

SUMMARY OF MAIN FINDINGS

In this first multicentre prospective study to evaluate short-term continuous antibiotic infusion via PIVC in Australian HITH services, we observed a 9.98% device failure rate, markedly lower than previously reported general PIVC failure rates of 36-69%, with no PIVC-related infections and high patient satisfaction. Patient comorbidity was the strongest independent predictor of PIVC failure. Clinically indicated PIVC replacement guided by VIP score assessment appears safe.

SAFETY AND EFFICACY OF PIVCS IN HITH

Our data shows that PIVCs used for continuous antibiotic infusion in HITH have a 9.98% failure rate, which is substantially lower than national¹⁷ and meta-analytic¹⁸ estimates for general PIVC use. Phlebitis occurred at 6.19 per 1,000 catheter days,¹⁸ over sixfold lower than previously reported. Dislodgement, pain and local infection rates were notably lower than published PIVC complication rates.¹⁸ Importantly, all PIVC failures were clinically minor and self-limiting, requiring only device replacement without further intervention. These findings suggest that the HITH setting, characterised by specialised nursing, with daily VIP score monitoring and informed patients, may represent a lower-risk setting for PIVC complications.

Compared to PICCs, our thrombus rate for PIVCs (0.56 per 1,000 catheter-days) was comparable (PICCs: 0.54 per 1,000 catheter-days), but minor complications exceeded those in PICC literature (dislodgement 0.68, phlebitis 1.11, pain 1.48, leakage 0.36 per 1,000 catheter-days).²⁵ However, in comparison to a Michigan multicentre Outpatient Antimicrobial Therapy (OPAT) study,²⁶ where midlines and PICCs in situ for < 14 days of antibiotic therapy demonstrated major complication plus failure rates of 12% and 22% respectively, our 9.98% overall PIVC failure rate is

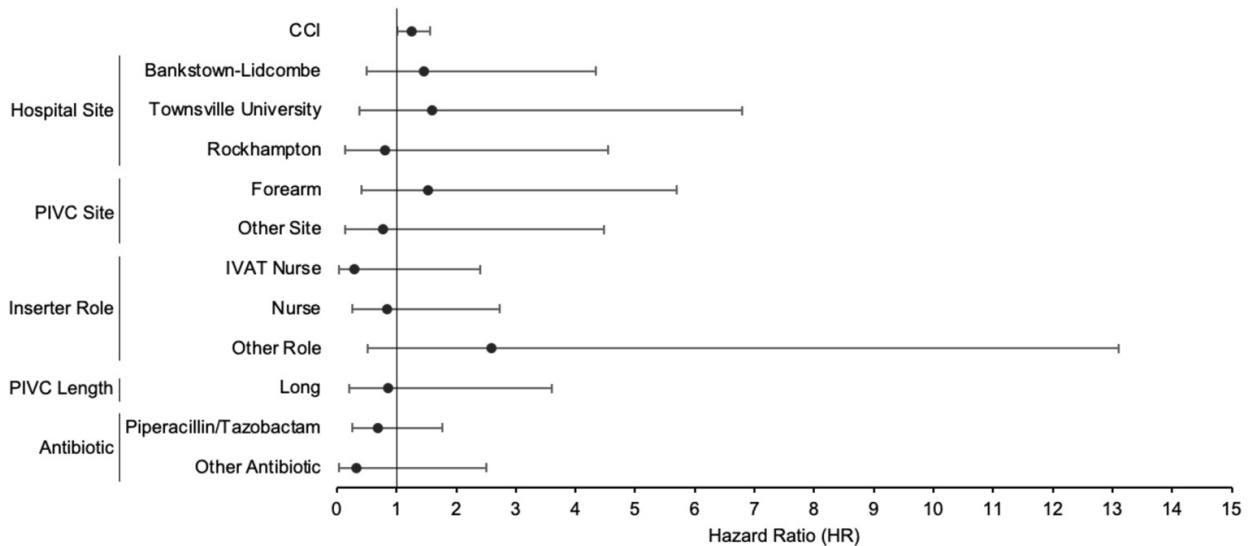


Figure 2. Forest plot of multivariable predictors of PIVC failure. Adjusted hazard ratios (HR) with 95% confidence intervals from the Cox proportional hazards model. Charlson Comorbidity Index (CCI) was the only independent predictor of failure (HR 1.26; 95% CI 1.02-1.56, $p=0.03$). Reference categories: Canberra hospital site, doctor inserter, short catheter, and cefazolin antibiotic. Abbreviations: CCI, Charlson Comorbidity Index, IVAT, intravenous access team.

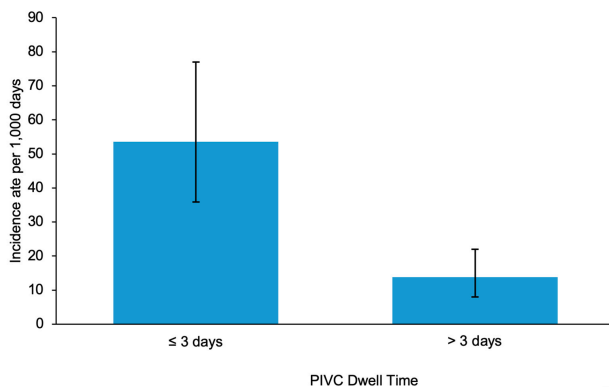


Figure 3. PIVC failure incidence by dwell time. Incidence rates of PIVC failure per 1,000 catheter-days for guideline-recommended dwell (≤ 3 days) vs extended use (> 3 days). Error bars indicate 95% confidence intervals. Analysis restricted to PIVCs that experienced failure. Extended dwell was associated with lower failure incidence (IRR 0.26; 95% CI 0.13-0.47; $p<0.001$).

favourable. Several factors may explain these differences. Paje et al. evaluated longer, more invasive devices (midlines and PICCs); may have included other known irritant antibiotics such as flucloxacillin, despite excluding vancomycin; and was conducted in a US outpatient setting with different nursing and vascular access practices than Australian admitted HITH services. This favourable difference, combined with ease of insertion, reduced invasiveness and lower cost, makes PIVC use for *short-duration* therapy in HITH a viable alternative.^{10,27}

PATIENT SATISFACTION

Patient satisfaction was high (mean 9.6/10), exceeding typical reports for general PIVC use, and comparable to PICC satisfaction rates.¹⁰ Notably, satisfaction remained high even among patients who experienced PIVC failure, suggesting the benefits of home-based care (e.g. comfort, convenience, continuity of usual activities), along with responsive HITH nursing support, mitigating the impact of device complications. Short treatment duration (most < 7 days) and low number of PIVCs per admission (typically 1-2) likely contributed to this positive experience.

PIVC MANAGEMENT AND GUIDELINE ALIGNMENT

The ATG recommend PIVC replacement every 72 hours,¹⁶ and ACSQHC standards allow clinically indicated replacement only in services with robust monitoring systems.^{16,17} In our cohort, PIVCs with dwell times > 72 hours had lower failure rates than those removed ≤ 72 hours, suggesting failures occur predominantly early and that routine time-based replacement may remove well-functioning catheters unnecessarily. The trend toward lower failure among patients treated for > 7 days also reflects survivorship bias: catheters prone to fail are removed early, whilst those that survive the initial higher-risk period tend to continue functioning.

Higher final VIP scores were associated with increased odds of removal, underscoring the value of diligent clinical assessment as an early signal of catheter deterioration, supporting clinically indicated rather than arbitrary time-based replacement. These results align with a HITH randomised controlled trial that found no difference between routine 72-96 hour and clinically indicated PIVC replacement.²¹ Collectively, our data supports clinically indicated

PIVC replacement as a preferable approach to routine PIVC replacement every 3 days in the HITH context.

PATIENT RISK AND INDEPENDENT PREDICTORS OF FAILURE

CCI was the only independent predictor of PIVC failure, indicating patient comorbidity is a stronger determinant of PIVC survival than insertion or device characteristics. This highlights an opportunity in HITH, to target patients with higher CCI for closer monitoring or non-PIVC venous access.

Several factors were strongly predictive in univariate analysis, namely, forearm insertion site, IVAT nurse inserters and longer catheters, but lost statistical significance in the multivariable analysis. This likely reflects confounding and collinearity; for example, more experienced inserters may preferentially choose optimal sites and longer catheters for patients with challenging access. Nonetheless, the univariate findings are consistent with previous evidence that increased intravascular catheter length improves stability and reduces dislodgement risk.^{12,13,28}

STRENGTHS AND LIMITATIONS

Key strengths include the multicentre, prospective study design, robust sample size and collection of both clinical and patient-reported outcomes. Despite significant variation in recruitment volumes, nursing delivery models and PIVC insertion practices, no significant site-level differences in failure risk were observed in univariate or multivariable analyses, supporting generalisability of the findings across similar Australian HITH services.

Limitations include the observational design, which precludes causal inferences, and potential residual confounding despite multivariable adjustment. Variations in local practice and monitoring protocols across sites may have influenced outcomes. Site-level variability in VIP score interpretation was not formally assessed and may have influenced phlebitis-related removal rates. Some subgroup analyses may be underpowered, and results may not generalise to paediatric populations, more resource-limited HITH services, or substantially different case-mixes.

FUTURE RESEARCH

Future research could compare once-daily IV cefazolin plus probenecid with continuous cefazolin infusion, evaluate increased or earlier oral antibiotic use, and investigate the impact of PIVC catheter length, insertion technique and routine ultrasound guidance on complication rates.^{29,30} Cost-effectiveness analyses would help guide best-practice recommendations. Patient or carer self-administration of IV antibiotics has shown safety and efficacy internationally and warrants future evaluation in Australian HITH. Further studies should also evaluate PIVC outcomes with a broader range of continuously infused antibiotics in the HITH setting.²²

CONCLUSION

Continuous antibiotic infusion via PIVC in HITH, for short durations, is safe and effective, with excellent patient experience. The findings also support clinically indicated PIVC replacement guided by VIP score assessment and reconsideration of guidelines that currently discourage PIVC use for continuous antibiotic infusions in HITH.

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DATA SHARING STATEMENT

The study data can be accessed by contacting the corresponding author and all authors had full access to all the data (including statistical reports and tables) related to the study

CONFLICT OF INTEREST STATEMENT

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REFERENCES

1. Melo MI, Prata AP, Reis Santos M. Hospital-at-home vs. Hospitalization, the cost-effective model: a systematic review of literature. *Millenium - Journal of Education, Technologies, and Health*. 2023;2(22):e31118. doi:[10.29352/mill0222.31118](https://doi.org/10.29352/mill0222.31118)
2. Edgar K, Iliffe S, Doll HA, et al. Admission avoidance hospital at home. *Cochrane Database of Systematic Reviews*. 2024;(3). doi:[10.1002/14651858.CD007491.pub3](https://doi.org/10.1002/14651858.CD007491.pub3)
3. Caplan GA, Sulaiman NS, Mangin DA, Aimonino Ricauda N, Wilson AD, Barclay L. A meta-analysis of "hospital in the home." *Med J Aust*. 2012;197(9):512-519. doi:[10.5694/mja12.10480](https://doi.org/10.5694/mja12.10480)
4. Lai YF, Ko SQ. Time to shift the research agenda for Hospital at Home from effectiveness to implementation. *Cochrane Database Syst Rev*. 2024;3(3):Ed000165. doi:[10.1002/14651858.Ed000165](https://doi.org/10.1002/14651858.Ed000165)
5. Ryan D, Miller J, Campbell J. Cannula complications using elastomeric infusers in Hospital in the Home. *JAC Antimicrob Resist*. 2020;2(3):dlaa033. doi:[10.1093/jacamr/dlaa033](https://doi.org/10.1093/jacamr/dlaa033)
6. Marsh N, Larsen E, Tapp S, Sommerville M, Mihala G, Rickard CM. Management of Hospital In The Home (HITH) Peripherally Inserted Central Catheters: A Retrospective Cohort Study. *Home Health Care Management & Practice*. 2019;32(1):34-39. doi:[10.1177/1084822319873334](https://doi.org/10.1177/1084822319873334)
7. Hatcher J, Costelloe C, Cele R, et al. Factors associated with successful completion of outpatient parenteral antibiotic therapy (OPAT): A 10-year review from a large West London service. *International Journal of Antimicrobial Agents*. 2019;54(2):207-214. doi:[10.1016/j.ijantimicag.2019.04.008](https://doi.org/10.1016/j.ijantimicag.2019.04.008)
8. Browning S, Loewenthal MR, Frelander I, Dobson PM, Schneider K, Davis JS. Safety of prolonged outpatient courses of intravenous antibiotics: a prospective cohort study. *Clinical Microbiology and Infection*. 2022;28(6):832-837. doi:[10.1016/j.cmi.2021.12.020](https://doi.org/10.1016/j.cmi.2021.12.020)
9. Wolie ZT, Roberts JA, Gilchrist M, McCarthy K, Sime FB. Current practices and challenges of outpatient parenteral antimicrobial therapy: a narrative review. *J Antimicrob Chemother*. 2024;79(9):2083-2102. doi:[10.1093/jac/dkae177](https://doi.org/10.1093/jac/dkae177)
10. Periard D, Monney P, Waeber G, et al. Randomized controlled trial of peripherally inserted central catheters vs. peripheral catheters for middle duration in-hospital intravenous therapy. *Journal of Thrombosis and Haemostasis*. 2008;6(8):1281-1288. doi:[10.1111/j.1538-7836.2008.03053.x](https://doi.org/10.1111/j.1538-7836.2008.03053.x)
11. Cooke M, Ullman AJ, Ray-Barruel G, Wallis M, Corley A, Rickard CM. Not "just" an intravenous line: Consumer perspectives on peripheral intravenous cannulation (PIVC). An international cross-sectional survey of 25 countries. *PLOS ONE*. 2018;13(2):e0193436. doi:[10.1371/journal.pone.0193436](https://doi.org/10.1371/journal.pone.0193436)
12. Marsh N, Larsen EN, Takashima M, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. *International Journal of Nursing Studies*. 2021;124:104095. doi:[10.1016/j.ijnurstu.2021.104095](https://doi.org/10.1016/j.ijnurstu.2021.104095)
13. Pandurangadu AV, Tucker J, Brackney AR, Bahl A. Ultrasound-guided intravenous catheter survival impacted by amount of catheter residing in the vein. *Emergency Medicine Journal*. 2018;35(9):550. doi:[10.1136/emered-2017-206803](https://doi.org/10.1136/emered-2017-206803)
14. Chan H, Joseph S, Tran F, Dotel R, Ngian VJJ, Ong BS. Safety and efficacy of continuous cefazolin infusion via peripheral intravenous catheter (PIVC) for outpatient therapy: a brief report. *JAC Antimicrob Resist*. 2025;7(5):dlaf169. doi:[10.1093/jacamr/dlaf169](https://doi.org/10.1093/jacamr/dlaf169)
15. Pedersen MG, Jensen-Fangel S, Olesen HV, Tambe SD, Petersen E. Outpatient parenteral antimicrobial therapy (OPAT) in patients with cystic fibrosis. *BMC Infect Dis*. 2015;15:290. doi:[10.1186/s12879-015-1019-4](https://doi.org/10.1186/s12879-015-1019-4)
16. Ambulatory Antimicrobial therapy. Melbourne. March 2025. Accessed November 11, 2025. https://app.tg.org.au/viewTopic?etgAccess=true&guidelinePage=Antibiotic&topicfile=bartonella-infections&guidelinename=auto§ionId=c_ABG_Ambulatory-antimicrobial-therapy_topic_10#c_ABG_Ambulatory-antimicrobial-therapy_topic_10
17. Management of Peripheral Intravenous Catheters Clinical Care Standard. Australian Commission on Safety and Quality in Health Care. May 2021. Accessed November 11, 2025. <https://www.safetyandquality.gov.au/publications-and-resources/resource-library/management-peripheral-intravenous-catheters-clinical-care-standard-2021>

18. Marsh N, Larsen EN, Ullman AJ, et al. Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. *International Journal of Nursing Studies*. 2024;151:104673. doi:[10.1016/j.ijnurstu.2023.104673](https://doi.org/10.1016/j.ijnurstu.2023.104673)
19. Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database of Systematic Reviews*. 2019;(1). doi:[10.1002/14651858.CD007798.pub5](https://doi.org/10.1002/14651858.CD007798.pub5)
20. Care ACoSaQiH. Management of Peripheral Intravenous Catheters Clinical Care Standard. Australian Commission on Safety and Quality in Health Care. 2025. Accessed November 5, 2025. <https://www.safetyandquality.gov.au/standards/clinical-care-standards/management-peripheral-intravenous-catheters-clinical-care-standard/quality-statements/remove-safely-and-replace-if-needed>
21. Van Donk P, Rickard CM, McGrail MR, Doolan G. Routine replacement versus clinical monitoring of peripheral intravenous catheters in a regional hospital in the home program: A randomized controlled trial. *Infect Control Hosp Epidemiol*. 2009;30(9):915-917. doi:[10.1086/599776](https://doi.org/10.1086/599776)
22. Baxter Healthcare. *Baxter Compounding App-Antibiotic Drug Suitability for PIVC*. Baxter Healthcare; 2022.
23. Canberra Health Services. *Peripheral Intravenous Cannula (PIVC) and Midline Catheters – The Insertion and Management of Adults and Children (Not Neonates)*.; 2025.
24. Jackson A. Infection control--a battle in vein: infusion phlebitis. *Nurs Times*. 1998;94(4):68-71.
25. Yeatts SD, Martin RH. What is missing from my missing data plan? *Stroke*. 2015;46(6):e130-2. doi:[10.1161/strokeaha.115.007984](https://doi.org/10.1161/strokeaha.115.007984)
26. Wen J, Xiong S, Tu Z, et al. Which is the safer option for adult patients between peripherally inserted central catheters and midline catheters: a meta-analysis. *Infection Control & Hospital Epidemiology*. 2025;46(1):27-34. doi:[10.1017/ice.2024.190](https://doi.org/10.1017/ice.2024.190)
27. Paje D, Walzl E, Heath M, et al. Midline vs Peripherally Inserted Central Catheter for Outpatient Parenteral Antimicrobial Therapy. *JAMA Intern Med*. 2025;185(1):83-91. doi:[10.1001/jamainternmed.2024.5984](https://doi.org/10.1001/jamainternmed.2024.5984)
28. Meto E, Cabout E, Rosay H, et al. Cost comparison of four venous catheters: Short peripheral catheter, Long peripheral line, Midline, and PICC for peripheral infusion. *J Vasc Access*. 2025;26(3):966-974. doi:[10.1177/11297298241258257](https://doi.org/10.1177/11297298241258257)
29. Marsh N, Webster J, Larsen E, Cooke M, Mihala G, Rickard CM. Observational Study of Peripheral Intravenous Catheter Outcomes in Adult Hospitalized Patients: A Multivariable Analysis of Peripheral Intravenous Catheter Failure. *Journal of Hospital Medicine*. 2018;13(2):83-89. doi:[10.12788/jhm.2867](https://doi.org/10.12788/jhm.2867)
30. Dibia U, Kulasegaran T, Muller V, Chapman P, Hay K. Probenecid and Cefazolin use in Treatment of Cellulitis in Hospital in the Home. *Internal Medicine Journal*. 2018;48(S5):9-10. doi:[10.1111/imj.2_13827](https://doi.org/10.1111/imj.2_13827)

SUPPLEMENTARY MATERIALS

Supporting Information

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