

Preventing peripheral intravenous catheter failure in hospitalised adults through multimodal intervention (PREBACP study): a multicentre, cluster-randomised, controlled trial

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Background

Two billion peripheral intravenous catheters (PIVCs) are inserted each year in hospitalised patients worldwide. Approximately, **one in two PIVCs fail** before completion of intravenous therapy, either due to phlebitis, extravasation, obstruction, accidental removal or infections.

Methods



Design

a multicentre, cluster-randomised, controlled trial.

7 public hospitals in Spain. The clusters had at least 70% permanent staff.

Participants



Data were collected from adult patients with one or more PIVCs at the start of intravenous therapy.

Procedures



Randomisation

Groups were randomly assigned (1:1) to either the multimodal intervention group or the control group.



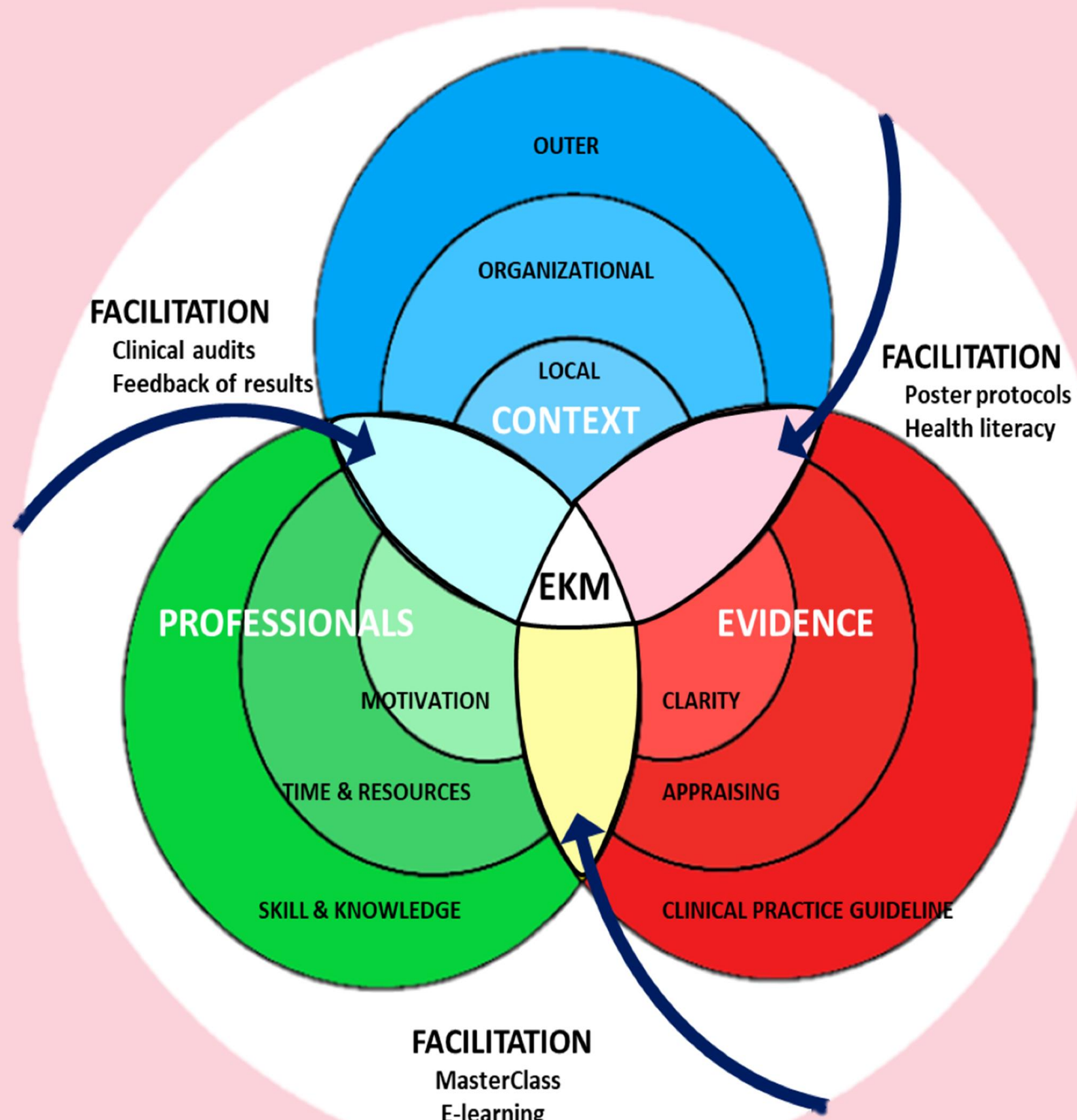
Analysis

The primary outcome was PIVC failure at 12 months. Analysis was by modified intention-to-treat.

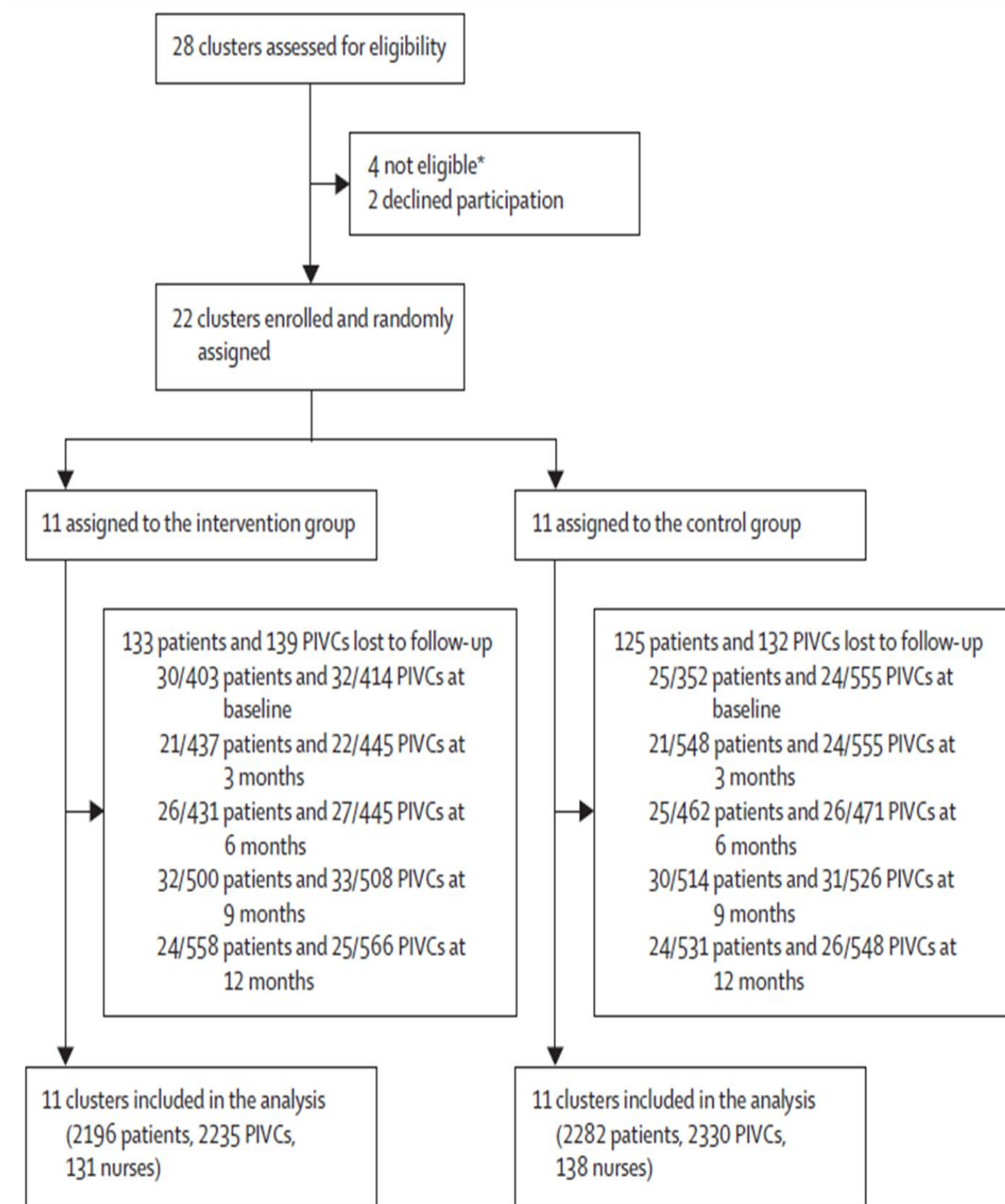
Aims

Our objective was to determine **the efficacy and costs of a multimodal intervention to reduce PIVC failure** among hospitalised patients.

Intervention



Findings



	Baseline		12 months	
	Intervention group (n=11)	Control group (n=11)	Intervention group (n=11)	Control group (n=11)
Total patient admissions	33.91 (17.29)	29.72 (10.73)	48.55 (25.79)	46.09 (16.16)
Patient age, years	70 (68-73)	70 (68-74)	69 (65-70)	70 (65-73)
Female patients	39.1% (12.11)	41.03% (9.63)	51.07% (12.04)	43.37% (13.08)
Male patients	60.9% (12.11)	58.97% (9.63)	48.93% (12.04)	56.63% (13.08)
Patients with one or more comorbidities	93.58% (6.37)	92.75% (4.75)	90.88% (6.49)	90.93% (9.22)
Patients with cognitive impairment	14.46% (9.23)	32.21% (18.01)	22.08% (10.06)	32.19% (18.89)
Patients prescribed antibiotics	37.41% (12.84)	34.62% (15.97)	35.74% (16.69)	37.24% (14.22)
Total nurses	11.91 (1.92)	12.55 (1.69)	12.09 (2.07)	12.27 (2.28)
Female nurses	84.42% (11.58)	83.45% (17.58)	84.29% (10.92)	81.82% (18.10)
Male nurses	15.58% (11.58)	16.55% (17.58)	15.71% (10.92)	18.18 (18.10)
Nurse age, years	41 (37-43)	41 (38-43)	41 (37-43)	41 (38-43)
Years employed as a nurse	17 (14-19)	17 (15-19)	17 (14-19)	17 (15-19)

Data are mean (SD) or median (IQR). PIVC=peripheral intravenous catheter.

Table 1: Characteristics of hospital wards at baseline and at 12 months

	Baseline		12 months	
	Intervention group (n=11)	Control group (n=11)	Intervention group (n=11)	Control group (n=11)
Primary outcome: modified intention-to-treat analysis				
PIVC failures	45.30% (1.97)	44.85% (3.02)	0.45% (-1.81 to 2.72)	0.69
Relative risk (95% CI)	..	..	..	..
Primary outcome: excluding dislodgement				
PIVC failures	40.28% (4.23)	41.09% (4.54)	-0.80% (-4.70 to 3.10)	0.67
Relative risk (95% CI)	..	..	..	..
PIVC outcomes				
Total PIVCs	34.73 (17.89)	30.64 (11.13)	4.09 (-9.16 to 17.34)	0.53
PIVC dwell time, h	85 (55-115)	90 (60-120)	-3.12 (-12.96 to 6.48)	0.49
Phlebitis	13.43% (4.37)	14.11% (3.39)	-0.68% (-4.16 to 2.80)	0.69
Extravasation	19.62% (3.54)	20.70% (2.89)	-1.08% (-3.96 to 1.80)	0.44
Obstruction	7.23% (3.02)	5.91% (3.53)	1.32% (-1.60 to 4.24)	0.36
Dislodgement	5.02% (4.36)	3.76% (3.15)	1.25% (-2.13 to 4.63)	0.45
Catheter-related bloodstream infection	0.65% (1.28)	0	0.65% (-0.16 to 1.45)	0.11
Two or more PIVCs in situ per patient	1.94% (3.24)	2.65% (3.39)	-0.71% (-3.66 to 2.24)	0.62
Unnecessary PIVC	10.48% (9.25)	8.96% (8.85)	1.52% (-6.54 to 9.57)	0.70
Multimodal intervention content and dosage				
Poster with recommendations	..	..	..	5*
Video protocols	..	..	..	3*
e-learning, completed courses	..	..	..	33†
Website visits	..	..	..	NA†
Face-to-face training	..	..	..	05
Feedback of results, h	..	..	..	16.09 (2.02)
Number of internal facilitators	..	..	..	536 (0.67)
Adherence to clinical practice guidelines recommendations				
Recommendations completed	63.86% (12.57)	57.71% (11.00)	6.14% (-4.43 to 16.57)	0.24
Patient knowledge related to PIVC	57.35% (23.30)	45.28% (16.50)	12.08% (-5.88 to 30.03)	0.18
PIVC adequacy and insertion	54.66% (12.03)	54.91% (15.01)	-0.24% (-12.34 to 11.86)	0.97
PIVC inserted in forearm	42.69% (13.21)	38.68% (13.38)	4.02% (-7.81 to 15.84)	0.49
PIVC inserted with 20-22 gauge	82.08% (18.82)	81.53% (12.36)	0.55% (-13.61 to 14.71)	0.94
Visual inspection of insertion site	49.39% (30.77)	38.77% (17.80)	10.62% (-11.74 to 32.98)	0.33
Transparent dressing	92.22% (19.04)	86.12% (23.97)	6.10% (-13.15 to 25.35)	0.52
Optimal dressing status	57.17% (23.67)	45.56% (18.34)	11.61% (-7.22 to 30.44)	0.21
Management of PIVC flushing	79.46% (12.02)	82.70% (8.95)	-3.24% (-12.67 to 6.18)	0.48
Record of PIVC care	56.75% (40.81)	59.95% (42.03)	-5.80% (-31.05 to 42.64)	0.75
PIVCs with all recommendations completed	7.18% (10.12)	3.90% (5.92)	3.28% (-4.10 to 10.65)	0.34
PIVC Care Questionnaire score	3.31 (0.23)	3.23 (0.14)	0.08 (-0.09 to 0.25)	0.34
General asepsis and cutaneous antisepsis	3.31 (0.23)	3.23 (0.14)	0.08 (-0.09 to 0.25)	0.34
Insertion of PIVC	3.13 (0.17)	3.04 (0.12)	0.09 (-0.04 to 0.21)	0.17
Care of PIVC	3.08 (0.10)	3.00 (0.19)	0.08 (-0.06 to 0.22)	0.25
General principles of PIVC management	3.22 (0.11)	3.16 (0.12)	0.06 (-0.04 to 0.16)	0.23
Strategies of PIVC removal	3.35 (0.14)	3.23 (0.16)	0.12 (-0.01 to 0.25)	0.070
Record of PIVC	3.21 (0.18)	3.21 (0.22)	0.00 (-0.19 to 0.18)	0.97
Patient education	2.92 (0.19)	2.88 (0.35)	0.04 (-0.21 to 0.29)	0.73
Professional education	2.28 (0.40)	2.20 (0.49)	0.08 (-0.32 to 0.48)	0.68

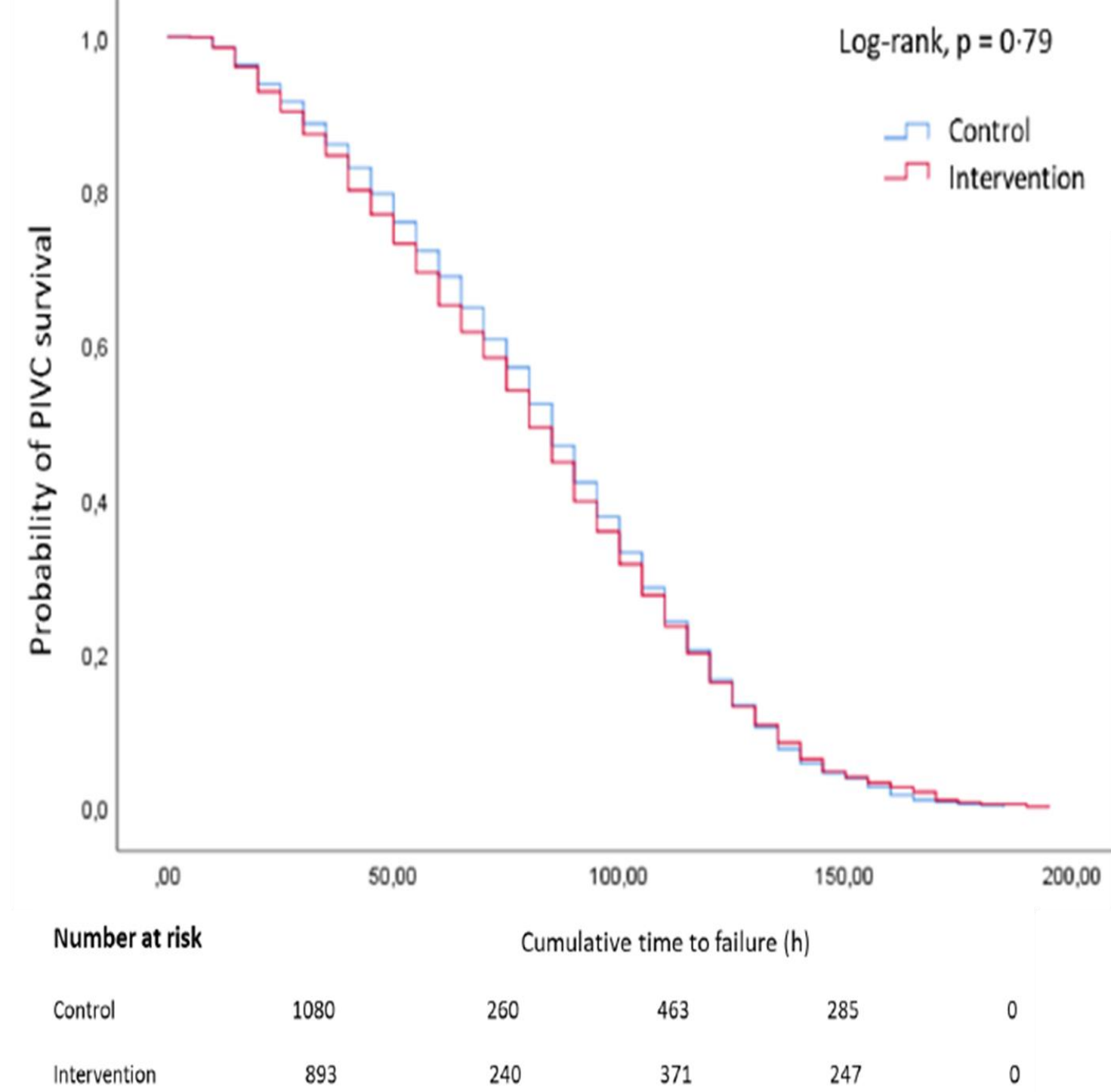
Data are mean (SD) or median (IQR) except where otherwise stated. n represents the number of clusters in each group. HR=hazard ratio. PIVC=peripheral intravenous catheter. *Totals per hospital ward. †Total number of nurses completing the e-learning courses across all intervention wards. ‡The website was available and functioning correctly, but it was not possible to determine the number of visits for each cluster; the total number of visits was 963. §Face-to-face training was offered between month 1 and month 2 of the intervention; there was no teaching programme at 12 months.

Table 2: Effect of process outcomes on hospital ward characteristics at 12 months

	Intervention group (n=2235)	Control group (n=2330)	Mean difference (95% CI)	p value
Cost of staff time for PIVC insertion*†	€3.00	€3.00	..	..
Costs associated with PIVC first insertion and replacement	€7.31 (2.59)	€7.62 (2.61)	-€0.31 (-0.46 to -0.16)	<0.0001
Initial PIVC, dressing, add-on devices, and staff time‡	€5.22 (0.23)	€5.21 (0.21)	€0.01 (0.00 to 0.03)	0.015
PIVC replacement, dressing, add-on devices, and staff time	€2.09 (2.56)	€2.41 (2.60)	-€0.32 (-0.47 to -0.17)	<0.0001
Costs associated with treatment of complications	€9.35 (190.88)	€33.27 (389.29)	-€23.91 (-41.82 to -6.01)	0.0090
Treatment of PIVC-related primary bloodstream infections	€4.24 (147.85)	€21.00 (342.19)	-€16.76 (-32.17 to -1.35)	0.033
Treatment of PIVC non-infectious complications	€5.12 (120.91)	€12.27 (187.00)	-€7.16 (-16.33 to 2.03)	0.13
Total costs associated with insertion and removal PIVC	€16.67 (191.05)	€40.89 (389.55)	-€24.22 (-42.14 to -6.30)	0.0080
Costs of facilitation*‡	€4.72	..	..	..
Total costs	€21.39 (191.05)	€40.89 (389.55)	-€19.50 (-37.20 to -1.80)	0.033

Data are mean (SD) except where otherwise stated. n represents the number of PIVCs in each group. *SDs not available because costs were calculated on the basis of weighted mean times. †Mean calculated on the basis of weighted average times during catheter insertion (9 min per catheter inserted). ‡Mean calculated on the basis of weighted average times (each hospital ward in intervention group employed 48 h for the trial; 1 h equates to €20).

Table 3: Economic evaluation of resources required at 12 months



Conclusions

The multimodal intervention **reduced PIVC failure, thus avoiding potentially serious complications** for hospitalised patients. The PREBACP findings enabled a deeper understanding of decision-making, knowledge mobilisation and awareness of routine clinical practice.

