

Budget impact analysis of Midline, Short Peripheral and PICC catheters for peripheral intravenous infusions

E. METO¹, H. ROSAY², S. F. ESPINASSE³, AS. LOT³, M. EL HAJJAM³, S. GNAMIEN CLERMONT³, R. LAUNOIS¹

¹Réseau d'Évaluation en Économie de la Santé, Paris, France ; ²Centre Léon Bérard, Centre de lutte contre le cancer, Lyon, France ; ³Hôpital Ambroise Paré (AP-HP), Boulogne-Billancourt, France

INTRODUCTION

30 million catheters are used every year, including **short peripheral cannulas (SPCs), midlines and peripherally inserted central catheters (PICCs)**.

The use of midline catheters for patients requiring a peripheral intravenous infusion is sometimes limited by their cost.

However, their **economic impact relative to SPCs and PICCs has not been fully assessed**.

Objective: Estimate and compare the actual cost of using Midline & SPC & PICC for treatment duration of 7, 14, 21 days

Structure of the study

- Economic assessment : Budget impact analysis
- Perspective : Hospital
- Decision modelling : Decision trees
- Time horizon : Cross section
- Comparators (devices) : SCP, Midline, PICC
- Length of treatment : 7, 14, 21 days

METHOD

1) In silico decision tree modeling

- The clinical pathway varies based on the number of **insertion attempts, duration of nursing supervision, frequency of dressing repairs, frequencies of mechanical complications** (dislodgement, occlusion, infiltration, phlebitis, thrombosis) and **systemic complications** (infection, pulmonary embolism)
- **The cost of each pathway is estimated by summing the event costs, weighted by their probability of events**
- **The cost of catheter use is estimated by summing the weighted costs of all possible patient pathways.**

2) Probability of events

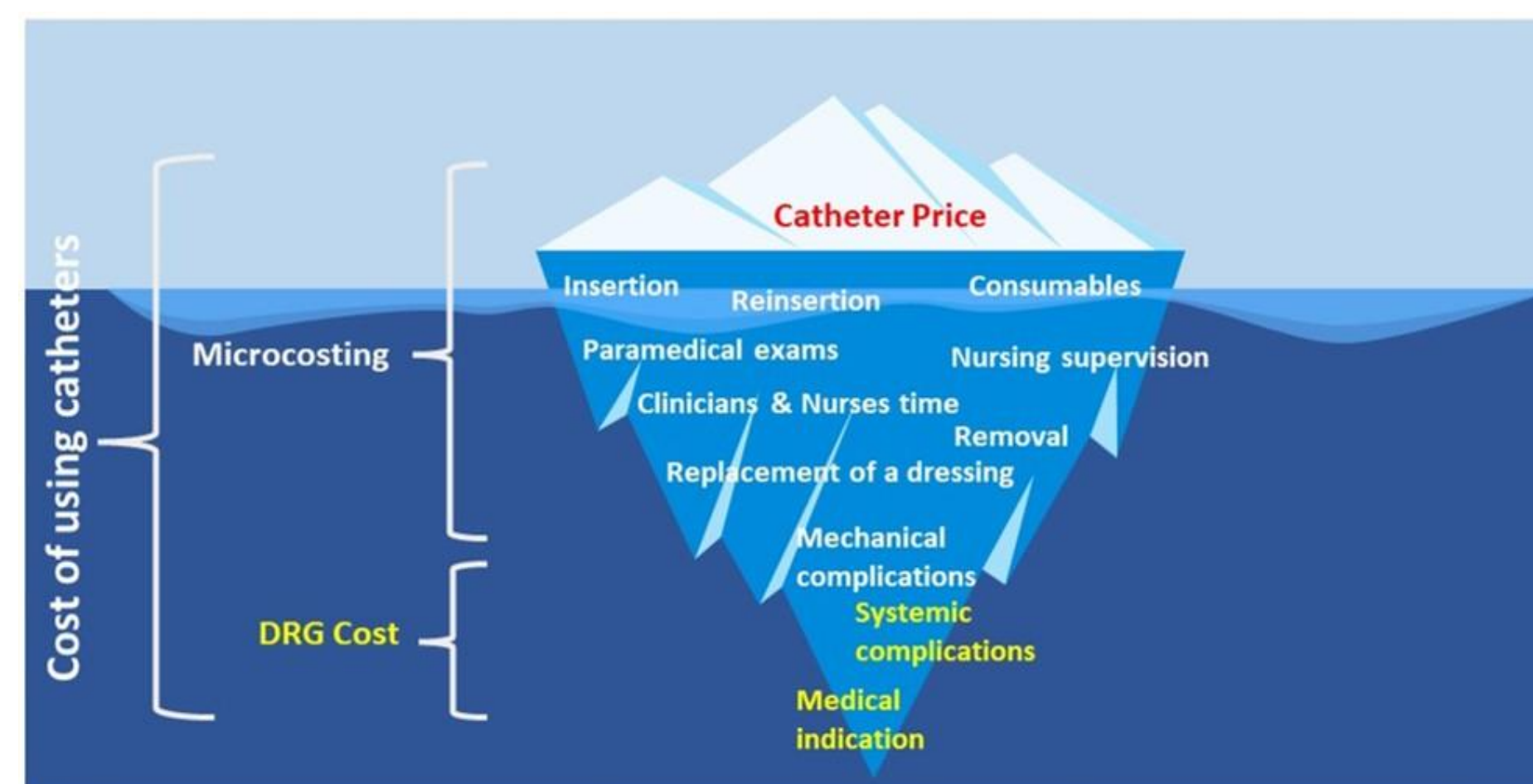
Review of the literature, validated by an expert clinician

Unit costs	SPC ⁽²⁾	MIDLINE	PICC
Successful insertion	73%	89% ⁽¹⁾	90% ⁽¹⁾
Bloodstream infection	2.2%	0.34% ⁽³⁾	1.8% ⁽⁴⁾
Pulmonary embolism	0%	1.65% ⁽¹⁾	1.62% ⁽¹⁾
Dislodgement	17.5%	3.79% ⁽³⁾	1.5% ⁽⁵⁾
Infiltration	14.2%	0.6% ⁽³⁾	0%
Occlusion	9.2%	2.24% ⁽³⁾	5.8% ⁽⁴⁾
Thrombosis	0%	1.38% ⁽³⁾	2.4% ⁽⁶⁾
Phlebitis	22.7%	0%	0%

3) Cost valuation

- **Micro-costing study (Ambroise Paré hospital) :**
 - Expenses observed at **all stages of catheter care**
 - Expenses related to **mechanical complications** (involving a new insertion)
- **French National Hospital Cost Study :**
 - Expenses related to the care of **systemic complications** : Diagnosis Related Group (DRGs)
 - Expenses related to the **indication** : DRG of peritonitis (7 days) ; DRG of cystic fibrosis (14 days) ; DRG of meningitis (21 days)

Cost valuation of catheter



Unit costs per catheter stage of care

Unit costs	SPC	MIDLINE	PICC
Microcosting			
Insertion	7€	114€	160€
Réinsertion	4€	101€	144€
Nursing supervision	5€	5€	5€
Dressing repair	-	18€	178€
Removal	2€	2€	3€
National Hospital Cost			
Systemic complication	1 802€	1 217€	1 468€

RESULTS

Cost comparison for 7 days treatment : Midline vs SPC

Unit costs	Estimated Cost Per Patient		Incremental Cost
	MIDLINE	SPC	
Microcosting	186€	145€	+41€
Consumables	19€	24€	-5€
Device	76€	4€	72€
Medical & nursing time	49€	50€	-1€
Paramedical exams	29€	0.15€	29€
Mechanical complications	12€	66€	-54€
National Hospital Cost	3703€	3784€	-81€
Indication : peritonitis	3679€	3679€	0€
Systemic complications	24€	105€	-81€
Total per patient	3890€	3929€	-39€

Cost comparison for 14 days treatment : Midline vs SPC vs PICC

Unit costs	Estimated Cost Per Patient			Incremental Cost	
	MIDLINE	SPC	PICC	MID VS SPC	MID VS PICC
Microcosting	244 €	269 €	320 €	-25 €	-76 €
Consumables	33 €	41 €	33 €	-8 €	0 €
Device	76 €	13 €	97 €	63 €	-21 €
Medical & nursing time	93 €	100 €	105 €	-7 €	-12 €
Paramedical exams	30 €	4 €	63 €	26 €	-33 €
Mechanical complications	12 €	111 €	22 €	-99 €	-10 €
National Hospital Cost	10799€	10949€	10825€	-150€	-26€
Indication : cystic fibrosis	10775€	10775€	10775€	0€	0€
Systemic complications	24€	174€	50€	-150€	-26€
Total per patient	11044€	11218€	11146€	-175€	-102€

Cost comparison for 21 days treatment : Midline vs PICC

Unit costs	Estimated Cost Per Patient		Incremental Cost
	MIDLINE	PICC	
Microcosting	319€	388€	-68€
Consumables	46 €	46 €	0 €
Device	76 €	97 €	-21 €
Medical & nursing time	145 €	150 €	-5 €
Paramedical exams	30 €	64 €	-34 €
Mechanical complications	23 €	31 €	-8 €
National Hospital Cost	9310€	9336€	-26€
Indication : meningitis	9286€	9286€	0€
Systemic complications	24€	50€	-81€
Total per patient	3890€	3929€	-94€

CONCLUSIONS

Saving per patient with Midline

Midline vs SPC (7 days) : 39€ - Midline vs SPC (14 days) : 175€

Midline vs PICC (14 days) : 102€ - Midline vs PICC (21 days) : 94€

Sensitivity analysis

Microcosting was conducted in a center using fluoroscopy for PICC placement : more costly than ECG-guided placement methods. However, ECG-guided placements also favor midlines. Future studies should generalize these findings across various hospitals.

REFERENCES

- ¹Bahl A, Karabon P, Chu D. Comparison of Venous Thrombosis Complications in Midlines Versus Peripherally Inserted Central Catheters: Are Midlines the Safer Option? Clin Appl Thromb Hemost 2019;25:
- ²Helm RE, Klausner JD, Klemperer JD, Flint LM, Huang E. Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing 2015;38:189–203.
- ³Chopra V, Kaatz S, Swaminathan L, Boldenow T, Snyder A, Burris R, et al. Variation in use and outcomes related to midline catheters: results from a multicentre pilot study. BMJ Qual Saf 2019;28:714–20.
- ⁴Swaminathan L, Flanders S, Horowitz J, Zhang Q, O'Malley M, Chopra V. Safety and Outcomes of Midline Catheters vs Peripherally Inserted Central Catheters for Patients With Short-term Indications: A Multicenter Study. JAMA Intern Med 2022;182:50.
- ⁵Piredda A, Radice D, Zencovich C, Cerri M, Aventino L, Naccarato F, et al. Safe use of Peripherally Inserted Central Catheters for chemotherapy of solid malignancies in adult patients: A 1-year monocentric, prospectively-assessed, unselected cohort of 482 patients. J Vasc Access 2020;11
- ⁶Balsorano P, Virgili G, Villa G, Pittiruti M, Romagnoli S, De Gaudio AR, et al. Peripherally inserted central catheter-related thrombosis rate in modern vascular access era—when insertion technique matters: A systematic review and meta-analysis. J Vasc Access 2019;21:45–54.