Supplementary Material

Appendix 1: Searching strategies for CPGs on PICC-related thrombosis prevention in patients

Cochrane Library search performed on 8 August 2024

#	Query
1	MeSH descriptor: [Practice Guideline] explode all trees
2	MeSH descriptor: [Consensus] explode all trees
3	MeSH descriptor: [Practice Patterns, Nurses'] explode all trees
4	MeSH descriptor: [Practice Patterns, Physicians'] explode all trees
5	(practice guideline*):ti,ab,kw OR (clinical guideline*):ti,ab,kw OR (consensus):ti,ab,kw OR (practice pattern*):ti,ab,kw OR (best practice*):ti,ab,kw
6	1 OR 2 OR 3 OR 4 OR 5
7	MeSH descriptor: [Venous Thrombosis] explode all trees
8	MeSH descriptor: [Venous Thromboembolism] explode all trees
9	MeSH descriptor: [Upper Extremity Deep Vein Thrombosis] explode all trees
10	(venous thrombo* OR vein thrombo* OR catheter related thrombo* OR CRT OR VTE OR UEDVT):ti,ab,kw
11	7 OR 8 OR 9 OR 10
12	MeSH descriptor: [Catheterization, Peripheral] explode all trees
13	(peripherally inserted central catheter*):ti,ab,kw OR (PICC*):ti,ab,kw
14	12 OR 13
15	6 AND 11 AND 14

PubMed search performed on 8 August 2024

#	Query
1	Search:(((("Practice Guidelines as Topic"Mesh]) OR "Practice Guideline" [Publication Type]) OR "Consensus"[Mesh])OR"Practice Patterns, Nurses'"[Mesh]) OR "Practice Patterns, Physicians'[Mesh]
2	Search: ((((practice guideline*[Title/Abstract]) OR (clinical guideline*[Title/Abstract])) OR (consensus[Title/Abstract])) OR (practice pattern*[Title/Abstract])) OR (best practice*[Title/Abstract])
3	1 OR 2
4	Search: (("Venous Thrombosis"[Mesh]) OR "Venous Thromboembolism"[Mesh]) OR "Upper Extremity Deep Vein Thrombosis"[Mesh]
5	Search: (((((venous thrombo*[Title/Abstract]) OR (vein thrombo*[Title/Abstract])) OR (catheter related thrombo*[Title/Abstract])) OR (CRT[Title/Abstract])) OR (VTE[Title/Abstract])) OR (UEDVT[Title/Abstract])
6	4 OR 5
7	Search: "Catheterization, Peripheral"[Mesh]
8	Search: (peripherally inserted central catheter*[Title/Abstract]) OR (PICC*[Title/Abstract])
9	7 OR 8
10	3 AND 6 AND 9

EMBASE search performed on 8 August 2024

#	Query
1	'practice guideline'/exp OR 'consensus'/exp OR 'nursing practice'/exp OR 'clinical practice'/exp
2	'practice guideline*':ab,ti OR 'clinical guideline*':ab,ti OR consensus:ab,ti OR 'clinical practice':ab,ti OR 'best practice*':ab,ti OR 'nursing practice':ab,ti
3	1 OR 2
4	'vein thrombosis'/exp OR 'venous thromboembolism'/exp OR 'catheter thrombosis'/exp
5	'venous thrombo*':ab,ti OR 'vein thrombo*':ab,ti OR 'catheter related thrombo*':ab,ti OR crt:ab,ti OR vte:ab,ti OR 'upper extremity deep vein thrombosis':ab,ti OR uedvt:ab,ti
6	4 OR 5
7	'peripherally inserted central venous catheter'/exp
8	'peripherally inserted central catheter*':ab,ti OR picc*:ab,ti
9	7 OR 8
10	3 AND 6 AND 9

CINAHL search performed on 8 August 2024

#	Query
1	(MH "Practice Guidelines") OR (MH "Consensus")
2	TI (practice guideline* OR clinical guideline* OR consensus OR clinical practice OR best practice* OR nursing practice) OR AB (practice guideline* OR clinical guideline* OR consensus OR clinical practice OR best practice* OR nursing practice)
3	1 OR 2
4	(MH "Venous Thromboembolism") OR (MH "Venous Thrombosis") OR (MH "Catheter-Related Thrombosis") OR (MH "Upper Extremity Deep Vein Thrombosis")
5	TI (venous thrombo* OR vein thrombo* OR catheter related thrombo* OR CRT OR VTE OR UEDVT) OR AB (venous thrombo* OR vein thrombo* OR catheter related thrombo* OR CRT OR VTE OR UEDVT)
6	4 OR 5
7	(MH "Peripherally Inserted Central Catheters")
8	TI (peripherally inserted central catheter* OR PICC*) OR AB (peripherally inserted central catheter* OR PICC*)
9	7 OR 8
10	3 AND 6 AND 9

CNKI search performed on 8 August 2024

#	Query
1	(主题: '静脉血栓栓塞症'+'深静脉血栓'+'导管相关性血栓') AND (主题: '外周穿刺中心静脉导管'+'外周中心静脉导管置管'+'中心静脉通路装置'+'PICC') AND (主题: '指南'+'共识')
2	Language=中文
3	1 AND 2

WanFang search performed on 8 August 2024

#	Query
1	题名或关键词:(静脉血栓栓塞症 or 深静脉血栓 or 导管相关性血栓) and 题名或关键词: (外周穿刺中心静脉导管 or 外周中心静脉导管置管 or 中心静脉通路装置 or PICC) and 题名或关键词: (指南 or 共识)
2	语言：中文
3	1 AND 2

Appendix 2: Excluded studies and reason

	Author (year)	Title	Reason(s) for exclusion
1	Bierman S. (2016)	AAGBI safe vascular access guidelines II	This is an interpretation of a guideline on PICC-related thrombosis, not a guideline.
2	Brewer C. (2012)	Reducing upper extremity deep vein thrombosis when inserting PICCs	This is a less normative summary of evidence on reducing PICC-associated thrombosis, not a guideline.
3	Delluc A, et al. (2015)	Catheter-related thrombosis: Unresolved issues	This is a review summarizing the unresolved issues of catheter-related thrombosis, not a guideline.
4	International Society on Thrombosis and Haemostasis, ISTH (2014)	Catheter-associated deep vein thrombosis of the upper extremity in cancer patients: guidance from the SSC of the ISTH	Provides guidance for the prevention of catheter-related thrombosis in cancer patients, not a guideline.
5	Evans RS, et al. (2013)	Reduction of peripherally inserted central catheter-associated DVT	This is a single-center study of catheter-versus-PICC-associated thrombosis, not prevention, and is not a guideline.
6	J A Capdevila (2016)	2016 Expert consensus document on prevention, diagnosis and treatment of short-term peripheral venous catheter-related infections in adult	The consensus focuses on indications for intravenous catheter placement, catheter maintenance and registration, and diagnosis and treatment of catheter-related infections. It was excluded due to the absence of content dealing with catheter-related thrombosis.
7	Macmillan T, et al. (2018)	SecurAcath for Securing Peripherally Inserted Central Catheters: A NICE Medical Technology Guidance	The article is one among the series of NICE Medical Technology Guidance summaries. It is not a guideline.
8	Maynard G. (2014)	Upper extremity deep vein thrombosis: A	This is a review of catheter-related deep venous

		call to arms	thrombosis of the upper extremity, not a guideline.
9	Meyer M B (2011)	Managing Peripherally Inserted Central Catheter Thrombosis Risk: A Guide for Clinical Best Practice	This is a retrospective study of PICC-associated thrombosis. It is not a guideline.
10	Infusion Nursing Society, INS (2021)	Infusion Therapy Standards of Practice, 8th Edition	An updated version is available.
11	American Society of Anesthesiologists, ASA (2019)	Practice Guidelines for Central Venous Access 2020: An Updated Report by the American Society of Anesthesiologists Task Force on Central Venous Access.	This recommendation for prevention of catheter-related infections and mechanical trauma or injury does not address catheter-related thrombosis.
12	ASCO (2019)	Venous Thromboembolism Prophylaxis and Treatment in Patients With Cancer: ASCO Clinical Practice Guideline Update	For Venous Thromboembolism Prophylaxis and Treatment in Patients With Cancer, catheter-related thrombosis was not involved.
13	American Society of Anesthesiologists, ASA (2018)	American Society of Hematology 2018 guidelines for management of venous thromboembolism: prophylaxis for hospitalized and nonhospitalized medical patients	This article mainly focuses on the drug prevention of VTE in hospitalized and non-hospitalized medical patients, and does not involve the content of catheter-related thrombosis.
14	International Initiative on Thrombosis and Cancer, ITAC-CME (2013)	International clinical practice guidelines for the treatment and prophylaxis of thrombosis associated with central venous catheters in patients with cancer	An updated version is available.
15	National Institute for Health and Care Excellence,NICE (2020)	Venous thromboembolic diseases: diagnosis, management and thrombophilia testing	The diagnosis and management of VTE are not concerned with the prevention of catheter-associated thrombosis.
16	American Society of	American Society of Hematology 2018	The diagnosis of VTE is described only, but

	Anesthesiologists, ASA (2018)	guidelines for management of venous thromboembolism: diagnosis of venous thromboembolism	catheter-related thrombosis is not mentioned.
17	American Society of Anesthesiologists, ASA (2019)	American Society of Hematology 2019 guidelines for management of venous thromboembolism: prevention of venous thromboembolism in surgical hospitalized patients	For prevention of vte in hospitalized patients surgeons not involved catheter-related thrombosis.
18	Chinese Society of Clinical Oncology, CSCO (2019)	Tumor related prevention and treatment guidelines for venous thromboembolism (2019 edition)	Prophylaxis of catheter-related thrombosis was not covered.
19	Fu QN, et al. (2020)	Clinical Practice Recommendation of Chinese Expert Consensus on Venous Thrombosis associated with Infusion catheterization	This article is a guide interpretation.
20	Clinical Practice Guidelines (Canadian Medical Association) (2020)	Central venous catheter-related deep vein thrombosis	This article provides guidance for the prevention of catheter-related thrombosis and is not a guideline .

Appendix 3: Definitions of AGREE II domains

Domain 1 - Scope and Purpose: This domain is concerned with the overall aim(s) of the guideline, the specific health question(s) it attempts to address, and the target population(s) that the guideline focusses on (items 1-3).

Domain 2 - Stakeholder Involvement: This domain focuses on the extent to which the guideline was developed by the appropriate stakeholders and consequently, how well the guideline represents the views of its' intended users (items 4-6).

Domain 3 - Rigour of Development: This domain relates to the processes used to gather and synthesize evidence that underpins the guideline, the methods used to formulate recommendations, and the process for updating the guideline (items 7-14).

Domain 4 - Clarity of Presentation: This domain focusses on the language, structure, and format of the guideline (items 15-17).

Domain 5 - Applicability: This domain pertains to the likely barriers and facilitators to guideline implementation, strategies to improve and monitor guideline uptake, and the resource implications of applying the guideline (item 18-21).

Domain 6 - Editorial Independence: This domain is concerned with the formulation of recommendations not being unduly biased with competing for interest, such as funding, personal gain or ghost writing (items 22-23).

Overall assessment: This is a rating of the overall quality of the guideline, based on the judgement of guideline appraisers, and dictates whether the appraiser would recommend the use of the guideline in practice.

Appendix 4: Summary of sources where CPGs were obtained

CPG Document	Link to document
ASCO 2013	https://guidelines.ebmportal.com/central-venous-catheter-care-patient-cancer-american-society-clinical-oncology-clinical-practice
ASH 2021	https://www-ncbi-nlm-nih-gov-443.webvpn.cams.cn/pmc/articles/PMC7903232/pdf/advancesADV2020003442C.pdf
INS 2021	https://www-embase-com-443.webvpn.cams.cn/search/results?subaction=viewrecord&id=L633948335&from=export
CCC-IUA 2020	https://link.cnki.net/doi/10.19538/j.cjps.issn1005-2208.2020.04.03
CMA 2018	https://oss.wanfangdata.com.cn/file/download/perio_zhyx201836002.aspx
IITC-CNA 2022	https://rs.yiigle.com/cmaid/1410887
ITAC-CME 2013	https://linkinghub-elsevier-com-s.webvpn.cams.cn/retrieve/pii/S1538-7836(22)05263-1
ESMO 2015	https://linkinghub-elsevier-com-s.webvpn.cams.cn/retrieve/pii/S0923-7534(19)47179-2
ISCCM 2020	https://www-ncbi-nlm-nih-gov-443.webvpn.cams.cn/pmc/articles/PMC7085816/pdf/ijccm-24-S6.pdf

CPGs, clinical practice guidelines; ASCO, American Society of Clinical Oncology; ASH, American Society of Hematology; INS, Infusion Nursing Society; CCC-IUA, Chinese Chapter Congress of the International Union of Angiology; CMA, China Medical Association; IITC-CNA, Intravenous Infusion Therapy Committee of Chinese Nursing Association; ITAC-CME, International Initiative on Thrombosis and Cancer; ESMO, European Society for Medical Oncology; ISCCM, Indian Society of Critical Care Medicine.

Appendix 5: AGREE II scaled item scores of CPGs for PICC-related thrombosis prevention in patients

Section	Item	ASCO 2013		ASH 2021		INS 2024		CCC-IUA 2020		CMA 2018		IITC-CNA 2022		ITAC-CME 2022		ESMO 2015		ISCCM 2020	
		A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
Scope and Purpose	1	7	7	7	7	7	7	6	7	7	7	7	7	7	7	5	6	7	7
	2	7	7	7	7	7	7	6	5	7	7	6	6	6	7	6	6	6	5
	3	7	7	7	7	7	7	7	7	6	7	6	6	7	7	7	7	7	7
Stakeholder Involvemen	4	7	5	7	7	7	7	7	7	7	7	5	5	7	7	7	7	7	7
	5	5	4	5	6	2	1	2	1	2	2	1	2	5	5	2	2	2	2
	6	7	7	7	7	7	7	6	7	7	6	7	7	7	7	5	4	7	7
Rigour of Development	7	5	6	5	4	7	7	2	1	7	7	7	7	7	7	2	1	7	7
	8	6	6	2	2	2	1	2	4	4	2	1	2	5	6	2	3	2	1
	9	2	1	7	7	6	5	2	2	7	7	7	7	7	7	7	7	5	6
	10	6	5	7	7	7	7	3	4	7	7	7	7	7	7	6	6	6	6
	11	6	5	7	7	7	7	6	6	7	7	6	6	7	7	7	7	7	7
	12	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	13	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	14	7	7	6	4	7	7	2	1	7	7	1	1	5	6	2	1	2	1
Clarity of Presentation	15	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	16	6	7	7	6	6	7	7	7	7	7	6	7	7	6	7	7	7	7
	17	6	5	7	7	7	7	7	6	6	5	5	6	7	7	7	6	7	6
Applicability	18	7	7	5	6	7	7	4	3	4	3	4	3	4	3	3	4	3	4
	19	4	3	7	7	7	7	2	2	7	7	5	6	6	7	2	2	7	7
	20	7	7	7	7	4	5	6	6	6	5	4	5	7	7	6	6	6	5
	21	2	2	7	7	5	6	2	4	2	4	2	2	2	2	2	3	7	7
Editorial Independence	22	7	7	7	6	6	6	7	7	6	5	7	7	6	6	7	7	7	7
	23	7	7	7	7	7	7	5	6	7	7	6	6	7	7	7	7	7	7
Overall Assessment	OA1	6	6	6	6	6	7	4	4	6	6	5	5	6	6	4	5	6	6
	OA2	Yes	Yes	Yes	Yes	Yes	Yes	Yes*	Yes*	Yes	Yes	Yes*	Yes*	Yes	Yes	Yes*	Yes*	Yes	Yes

*Recommended with modifications.

Appendix 6: Specific recommendations across all CPGs that informed in Table 4

Recommendations identified in Table 4	**Corresponding recommendation from each of the included CPGs**
1. Identify Patient risk factors	*INS 2024:* ➓ Malignancy (type of cancer, tumor size, and characteristics), diabetes mellitus, obesity, chemotherapy administration, thrombophilia (eg, Factor V Leiden, protein C deficiency, protein S deficiency), critical illness, and personal and family history of thrombosis. (I) ➓ Other risk factors include SARS-CoV 2 virus infection (COVID-19), patient age (but varies widely per study and population risks), pregnancy, elevated triglycerides, elevated low-density protein, ethnicity (higher risk reported in Black or African Americans), reduced functional capacity (as measured by Eastern Oncology Cooperative Group [ECOG] scoring), readmission to the hospital shortly after central vascular access device (CVAD) insertion, inadequate hydration and nutrition, non-O blood types, and blood transfusions. (I) *CCC-IUA 2020:* ➓ Patients with catheterization are often in special disease-related states, and these states are highly overlapping with high risk factors for venous thrombosis, such as surgery, malignant tumors, and prolonged bed rest. (WG) ➓ Malignant tumor patient is one of the important people use infusion catheter, malignant tumor. The risk of VTE is significantly increased in patients with malignant tumors, and the risk may be increased by chemotherapy and surgery. (WG)
2.Identify catheter related risk factors	
➓ **Catheter diameter selection**	*INS 2024:* ➓ Use the smallest diameter, least number of lumens possible to deliver the required infusion therapy. (I) ➓ In a meta-analysis of PICC-related outcomes, optimal insertion techniques and use of single-lumen, smaller diameter PICCs reduced PICC-related DVT risk to a rate comparable to other CVADs. (I) ➓ Measure the catheter-to-vessel ratio prior to insertion; ensure no more than 45% ratio. (II)

	CCC-IUA 2020: ❿ On the premise of meeting the treatment needs, the infusion device with the smallest external diameter, the least number of lumen and the least trauma should be selected. (WG)
❿ **Catheter tip position**	*INS 2024:* ❿ Position the tip of a CVAD in the lower third of the superior vena cava (SVC) or upper third of the right atrium (RA) at or near the cavoatrial junction (CAJ) for adults and children. For lower body insertion sites, position the CVAD tip in the inferior vena cava (IVC) above the level of the diaphragm. (A/P) ❿ For lower body insertion sites, position the CVAD tip in the inferior vena cava (IVC) above the level of the diaphragm. (IV) *CCC-IUA 2020:* ❿ Under the same circumstances, the risk of thrombosis is lower if the catheter tip is located in the subclavian vein than in the proximal part of the basilic vein. (WG) ❿ *ITAC-CME 2022:* ❿ Catheters should be inserted on the right side, in the jugular vein, and the distal extremity of the central catheter should be located at the junction of the superior vena cava and the right atrium (Grade 1B). *ISCCM 2020:* ❿ We recommend IJ and SCV catheter tip should be placed in the lower one-third of the SVC near the SVC/RA junction (A, 2).
3. Identify operator risk factors	*INS 2024:* ❿ Use a bundled approach for PICC insertion, including systematic ultrasound evaluation and identification of optimal area for placement, insertion methods that reduce vascular trauma, optimal tip placement verification, optimal catheter-to-vein ratio, and use of smallest diameter/fewest number of lumens. (II) ❿ Consider tunneling PICCs. A single-center, randomized, controlled, nonblinded, prospective trial demonstrated tunneled PICCs had a lower incidence of venous thrombosis and lower costs of catheter maintenance compared to nontunneled PICCs. (III)

	➓ Reduce thrombotic risk with arterial catheter insertion and management through use of ultrasound for accurate insertion, optimization of the catheter entry angle and length within the artery, catheter securement and stabilization, and frequent monitoring of circulatory status. (V) ➓ The use of electrocardiography to confirm appropriate PICC tip positioning has been associated with reduced thrombotic risk. (III) *CCC-IUA 2020:* ➓ Repeated puncture and withdrawal of catheter during catheterization can aggravate intimal injury and increase the risk of thrombosis. (WG) ➓ Non-standard rushed, sealing tube operation can increase the thrombotic wind duct loss risk. (WG) *ISCCM 2020:* ➓ We recommend that a mechanism should be in place to assess knowledge and compliance with guidelines of all the personnel involved in care related to CVC (A, 1)
4. Risk assessment of patients with PICC	*INS 2024:* ➓ Evaluate the risk of CAT during the process of VAD selection with careful consideration of patient vasculature, urgency and type of treatment required, and patient preference and functional needs (including laterality). (I) *CMA 2018:* ➓ VTE risk assessment is recommended for patients with a central venous catheter (2B).
5. Consider use of a risk scoring system	
➓ **Using Caprini Risk Assessment Model**	*INS 2024:* ➓ The Caprini Risk Assessment Model may have predictive value for PICC-related thrombosis, especially in high-risk patients. The Caprini score, however, was found to have moderate sensitivity and low specificity, possibly leading to overdiagnosis. (IV)
➓ **Using Michigan Risk Score**	*INS 2024:* ➓ Machine learning predictive techniques using genotypes may assist in identifying patients at high risk for PICC-related thrombosis. (IV)

❿ **Using Khorana score model**	*CMA 2018:* ❿ VTE risk assessment using the Khorana score model is recommended for outpatient patients with malignancies receiving chemotherapy. (1B)
6. Monitor for signs and symptoms	
❿ **Measuring arm circumference**	*INS 2024:* ❿ Monitor for signs, symptoms, and potential consequences of CAT; recognize that CA-DVT often does not produce overt signs and symptoms. Clinical signs and symptoms are related to obstruction of venous blood flow and may include, but are not limited to, pain/edema/erythema in the extremity, shoulder, neck, or chest, and engorged peripheral veins of the extremity. (IV) ❿ Measure baseline circumference of the extremity with a PICC or a midline catheter upon insertion, noting location for future measurements to ensure consistent measurement. Assess circumference when edema or signs and symptoms of DVT present, noting the location and characteristics of edema. A 3-cm increase in mid-arm circumference in adults with PICCs was associated with CA-DVT. (IV) ❿ Recognize post-thrombotic syndrome as a potential long-term consequence of CA-DVT characterized by chronic pain, swelling, and skin changes. (II)
7. Pharmacologic preventative measures for PICC-related thrombosis	
❿ **guided by individual patient risk**	*INS 2024:* ❿ Recommendations for prophylactic anticoagulation for CA-DVT prevention have not been established for all patient populations but should be guided by individual patient risk. (I) a. VTE prophylaxis is recommended during cancer treatment requiring CVAD insertion and has not been associated with a risk of major bleeding. (I) b. The role of pharmacologic VTE prophylaxis is unclear in pediatric patients but has been associated with decreased CAT risk without increased bleeding risk in specific pediatric populations. (II)
❿ **Not to use as preference**	*ASCO 2013:* ❿ The use of systemic anticoagulation (war-farin, low–molecular weight heparin [LMWH], or unfractionated heparin) has not been shown to decrease the incidence of catheter- associated thrombosis, and therefore, routine prophylaxis with anti- coagulants is not recommended for patients with cancer with CVCs. (WG)

	ASH 2021: ❿ For patients with cancer and a central venous catheter (CVC), the ASH guideline panel suggests not using parenteral thromboprophylaxis (conditional recommendation, low certainty in the evidence of effects ⊕⊕OO). ❿ For patients with cancer and a CVC, the ASH guideline panel suggests not using oral thromboprophylaxis (conditional recommendation, low certainty in the evidence of effects ⊕⊕OO). *CMA 2018:* ❿ Routine pharmacologic prophylaxis is not recommended for low-risk patients (2B). *ITAC-CME 2022:* ❿ Use of anticoagulation for routine prophylaxis of catheter-related thrombosis is not recommended (Grade 1A).
❿ **Use LMWH or LDUH as preference**	*CMA 2018:* ❿ Medium and high risk patients without anticoagulation taboo, suggest using LMWH or LDUH (2 B).
8. Non-pharmacological preventative measures for PICC-related thrombosis	
❿ **handgrip exercise**	*INS 2024:* Consider upper extremity exercise to reduce venous stasis; handgrip exercise using an elastic ball 3 or 6 times per day for 3 weeks was associated with a lower incidence of ultrasound-confirmed CA-DVT in patients with cancer who had a PICC. Further research is needed to identify postinsertion nursing interventions that reduce thrombotic risk (III). *CCC-IUA 2020:* ❿ When conditions permit, the use of nonpharmacological measures for thromboprophylaxis is encouraged, including early mobilization of the catheterization limb, normal daily activities, appropriate limb exercise, and adequate hydration. (WG) *IITC-CNA 2022:*

	❿ Physical prophylaxis can be used to reduce thrombosis, and the use of non-pharmacological measures to prevent thrombosis is encouraged when conditions permit (V, B).
❿ **flushing with saline as preference**	*ASCO 2013:* ❿ Routine flushing with saline of the CVC to prevent fibrin buildup is recommended. (WG) *ESMO 2015:* ❿ Intermittent flushing with heparin is a standard practice in the maintenance of CVC patency. However, when compared with 0.9% normal saline flushing, no differences in thrombosis rates were found (I, C)
❿ **providing appropriate and adequate nursing care**	*ISCCM 2020:* ❿ We suggest providing appropriate and adequate nursing care to improve CVC-related outcomes. (B, 2) *CCC-IUA 2020:* ❿ For patients with high risk of thrombosis, it is still necessary to take corresponding preventive measures against VTE risk. (WG) *IITC-CNA 2022:* ❿ The principles of aseptic operation should be strictly adhered to during puncture and maintenance to reduce the chance of central venous catheter infection (II, A).
9. Diagnose and confirm PICC-related thrombosis	
❿ **Doppler ultrasound as preference**	*INS 2024:* ❿ Diagnose and confirm CA-DVT using color-flow Doppler ultrasound by the presence of at least 2 of the following: an echogenic mass in the venous structure assessed; noncompressibility of the vein, abnormal color Doppler vein pattern, and/or vein filling defect. Venography with contrast injection may also be used to assess more proximal veins (eg, brachiocephalic) that are obscured by the clavicle or ribs. (II) *CC-IUA 2020:* ❿ Doppler ultrasound is the first choice, which can indicate the location and range of CRT. (WG)

	ESMO 2015: ❿ Although venography is considered the gold standard for the diagnosis of CRT, Doppler ultrasound is usually carried out (III, A). *ISCCM 2020:* ❿ We suggest that ultrasound guidance can be used for early identification of mechanical complication (B, 2). *IITC-CNA 2022:* ❿ The occurrence of catheter-related venous thrombosis can be assessed by observation, measurement and questioning of the patient's complaints and by colour Doppler imaging methods (I, A).
❿ **Not to routine use Doppler ultrasound**	*IITC-CNA 2022:* ❿ Based on the available evidence, the use of Doppler ultrasound to screen all patients for catheter-related venous thrombosis is not recommended (IV, D).
10. Remove the PICC against	
❿ **Do not remove catheter unless necessary**	*INS 2024:* ❿ Evaluate the need and appropriateness of PICC exchange. PICC exchange was independently associ- ated with a twofold greater risk of thrombosis in a retrospective study. However, this risk may have been influenced by the fact that patients who experienced exchanges were more likely to have had multilumen PICCs. (IV) ❿ Do not remove a CVAD in the presence of CA-DVT when the catheter is correctly positioned, functional, and necessary for infusion therapy. The decision to remove a CVAD should be made based on the individual patient's characteristics, symptoms, and imaging. (I) ❿ Carefully consider the need to retain or remove an implanted port at the conclusion of chemotherapy, evaluating the patient risks and need for further therapy. (V) *ISCCM 2020:* ❿ We recommend prompt removal of CVC when it is not essential (A, 2).

	IITC-CNA 2022: ❿ Symptomatic thrombosis should be retained or the timing of extubation should be considered in the light of the degree of dependence on the catheter for treatment, the likelihood of re-establishing venous access, and the progression of the thrombus (II, B).
11. Treatment after diagnosis	
❿ **Anticoagulation therapy was given for at least 3 months after extubation**	*INS 2024:* ❿ Treat CA-DVT with anticoagulant medication for at least 3 months after diagnosis. For CVADs with a longer dwell time, continue the treatment for as long as the CVAD is in situ; unfractionated heparin infusion or catheter-directed thrombolysis may be of benefit to patients with severe symptoms. (IV) *ITAC-CME 2022:* ❿ For the treatment of symptomatic catheter-related thrombosis in patients with cancer, anticoagulant treatment is recommended for a minimum of 3 months; in this setting, LMWHs are suggested. Direct comparisons between LMWHs and VKAs have not been made in this setting (guidance). *IITC-CNA 2022:* ❿ When catheter removal is warranted, it should be preceded by routine anticoagulation according to the occurrence of thrombus and ultrasound screening for thrombus before removal (IV, B)
❿ **further assessed for appropriate interventions**	*IITC-CNA 2022:* ❿ After thrombosis has occurred, the patient's risk factors for catheter-related venous thrombosis should be further assessed for appropriate interventions (I, A).
12. Medical personnel training	
❿ **Establishing education and training systems**	*CCC-IUA 2020:* ❿ Standardized placement, use and maintenance of catheters and professional nursing teams are important prerequisites to reduce catheter-related complications, including thrombosis. (WG)

	ISCCM 2020: ⑩ We recommend that a healthcare education and training program should be in place wherever CVCs are inserted and maintained for overall quality improvement (A, 1)
⑩ **Establishing Credentialing process**	*INS 2024:* ⑩ Ensure that the selected VAD is inserted by staff with specific training, using vascular visualization. (II) *ISCCM 2020:* ⑩ We suggest providing appropriate and adequate nursing care to improve CVC-related outcomes (B, 2)

CVADs, Central Venous Access Devices; CA-DVT, catheter-associated deep vein thrombosis; CPGs, clinical practice guidelines; ASCO, American Society of Clinical Oncology; ASH, American Society of Hematology; INS, Infusion Nursing Society; CCC-IUA, Chinese Chapter Congress of the International Union of Angiology; CMA, China Medical Association; IITC-CNA, Intravenous Infusion Therapy Committee of Chinese Nursing Association; ITAC-CME, International Initiative on Thrombosis and Cancer; ESMO, European Society for Medical Oncology; ISCCM, Indian Society of Critical Care Medicine.

Appendix 7: Evidence level systems used across CPGs

Evidence Levels	CPG Working Group
ASCO 2013/ CCC-IUA 2020	
WG	Recommendations based on expert opinion/consensus by the working group.
ASH 2021	
strong	-For patients: most individuals in this situation would want the recommended course of action, and only a small proportion would not.
	-For clinicians: most individuals should follow the recommended course of action. Formal decision aids are not likely to be needed to help individual patients make decisions consistent with their values and preferences.
	-For policy makers: the recommendation can be adopted as policy in most situations. Adherence to this recommendation according to the guideline could be used as a quality criterion or performance indicator.
	-For researchers: the recommendation is supported by credible research or other convincing judgments that make additional research unlikely to alter the recommendation. On occasion, a strong recommendation is based on low or very low certainty in the evidence. In such instances, further research may provide important information that alters the recommendations.
conditional	-For patients: the majority of individuals in this situation would want the suggested course of action, but many would not. Decision aids may be useful in helping patients to make decisions consistent with their individual risks, values, and preferences.
	-For clinicians: recognize that different choices will be appropriate for individual patients and that you must help each patient arrive at a management decision consistent with their values and preferences. Decision aids may be useful in helping individuals to make decisions consistent with their individual risks, values, and preferences.
	-For policy makers: policymaking will require substantial debate and involvement of various stakeholders. Performance measures about the suggested course of action should focus on whether an appropriate decision-making process is duly documented.
	-For researchers: this recommendation is likely to be strengthened (for future updates or adaptation) by additional research. An evaluation of the conditions and criteria (and the related judgments, research evidence, and additional considerations) that determined the conditional (rather than strong) recommendation will help to identify possible research gaps.

INS 2024	
I	Meta-analysis, systematic literature review, guideline based on randomized controlled trials (RCTs), or at least 3 well-designed RCTs.
II	Two well-designed RCTs, 2 or more well-designed, multicenter clinical trials without randomization, or systematic literature review of varied prospective study designs.
III	One well-designed RCT, several well-designed clinical trials without randomization, or several studies with quasi-experimental designs focused on the same question. Includes 2 or more well-designed laboratory studies.
IV	Well-designed quasi-experimental study, case control study, cohort study, correlational study, time series study, systematic literature review of descriptive and qualitative studies, narrative literature review, or psychometric study. Includes 1 well-designed laboratory study.
V	Clinical article, clinical/professional book, consensus report, case report, guideline based on consensus, descriptive study, well-designed quality improvement project, theoretical basis, recommendations by accrediting bodies and professional organizations, or manufacturer recommendations for products or services. This also includes a standard of practice that is generally accepted but does not have a research basis (eg, patient identification).
A/P	Evidence from anatomy, physiology, and pathophysiology as understood at the time of writing.
Committee Consensus	Review of evidence, discussion, and committee agreement for a Practice Recommendation. Used when there is insufficient or low-quality evidence to draw a conclusion.
CMA 2018	
High (A)	Further research is very unlikely to change our confidence in the estimate of effect
Moderate (B)	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Low (C)	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low (D)	Any estimate of effect is very uncertain
Recommendation (1)	Interventions clearly have more benefits than harms
Suggestions (2)	Interventions may have more benefits than harms
Not suggestions	Interventions may do more harm than good or pros and cons of relationship is not clear

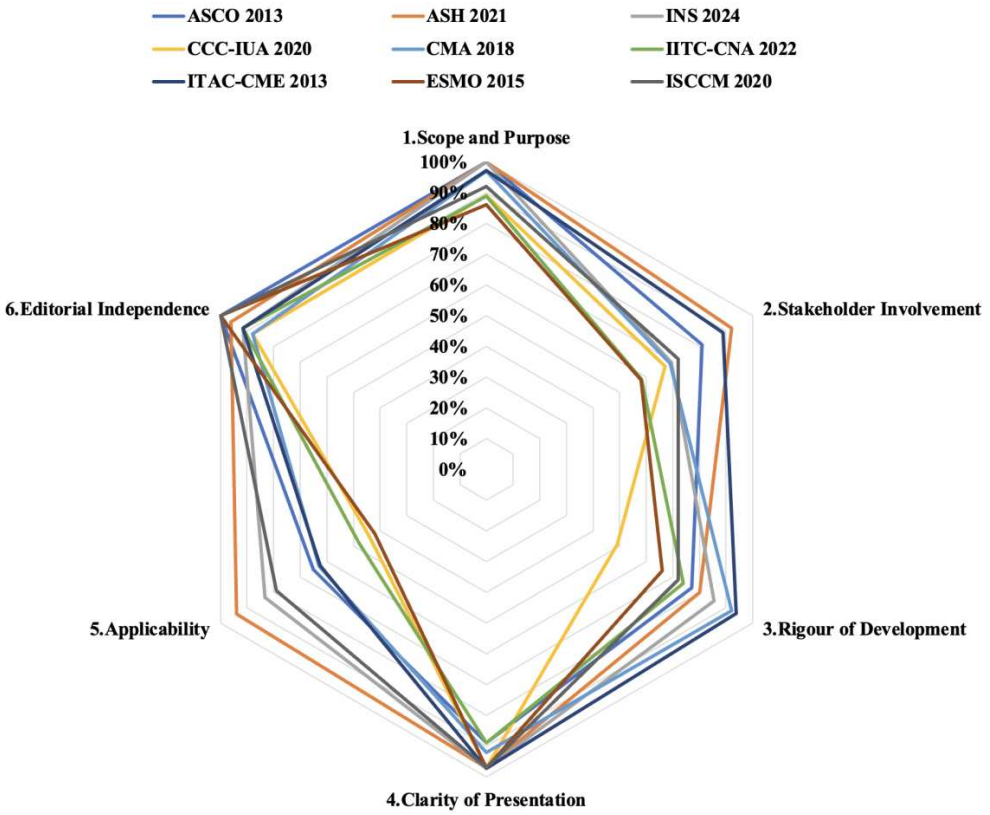
(2)	
Not recommended (1)	Interventions clearly do more harm than good
ITAC-CME 2022	
High (A)	further research is very unlikely to change our confidence in the estimate of effect
Moderate (B)	further research is likely to have an important impact on our confidence in the estimate of effect and could change the estimate
Low (C)	further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low (D)	any estimate of effect is very uncertain
Strong (Grade 1)	The panel is confident that the desirable effects of adherence to a recommendation outweigh the undesirable effects
Weak (Grade 2)	The panel concludes that the desirable effects of adherence to a recommendation probably outweigh the undesirable effects, but is not confident
Best clinical practice (Guidance)	In the absence of any clear scientific evidence and because of undetermined balance between desirable and undesirable effects, judgment was based on the professional experience and consensus of the international experts within the working group
IITC-CNA 2022	
I	Meta-analysis, systematic literature review, guideline based on randomized controlled trials (RCTs), or at least 3 well-designed RCTs.
II	Two well-designed RCTs, 2 or more well-designed, multicenter clinical trials without randomization, or systematic literature review of varied prospective study designs.
III	One well-designed RCT, several well-designed clinical trials without randomization, or several studies with quasi-experimental designs focused on the same question. Includes 2 or more well-designed laboratory studies.
IV	Well-designed quasi-experimental study, case control study, cohort study, correlational study, time series study, systematic literature review of descriptive and qualitative studies, narrative literature review, or psychometric study. Includes 1 well-designed laboratory study.
V	Clinical article, clinical/professional book, consensus report, case report, guideline based on consensus, descriptive study, well-designed quality improvement project, theoretical basis, recommendations by accrediting bodies and professional organizations, or manufacturer

	recommendations for products or services. This also includes a standard of practice that is generally accepted but does not have a research basis (eg, patient identification).
A	Evidence is highly effective and can be recommended to all clinical staff.
B	Evidence is valid and can be recommended to clinical staff.
C	the evidence is valid under certain conditions and the findings should be applied with caution.
D	Evidence validity is quite limited, valid only within a narrow range, and application is more restricted.
ESMO 2015	
I	Evidence from at least one large randomised controlled trial of good methodological quality (low potential for bias) or meta- analyses of well-conducted randomised trials without heterogeneity
II	Small randomised trials or large randomised trials with a suspicion of bias (lower methodological quality) or meta-analyses of such trials or of trials with demonstrated heterogeneity
III	Prospective cohort studies
IV	Retrospective cohort studies or case–control studies
V	Studies without control group, case reports, experts opinions
A	Strong evidence for efficacy with a substantial clinical benefit, strongly recommended
B	Strong or moderate evidence for efficacy but with a limited clinical benefit, generally recommended
C	Insufficient evidence for efficacy or benefit does not outweigh the risk or the disadvantages (adverse events, costs, ...), optional
D	Moderate evidence against efficacy or for adverse outcome, generally not recommended
E	Strong evidence against efficacy or for adverse outcome, never recommended
ISCCM 2020	
1	Evidence from ≥1 good quality and well-conducted randomized control trial(s) or meta-analysis of RCT's
2	Evidence from at least 1 RCT of moderate quality, or well-designed clinical trial without randomization; or from cohort or case-controlled studies
3	Evidence from descriptive studies, or reports of expert committees, or opinion of respected authorities based on clinical experience
Useful Practice	Not backed by sufficient evidence; however, a consensus reached by the working group, based on clinical experience and expertise

Point (UPP)	
Grade A	Strong recommendations to do (or not to do) where the benefits clearly outweigh the risk (or vice versa) for most, if not all patients
Grade B	Weak recommendations, where benefits and risk are more closely balanced or are more uncertain

CPGs, clinical practice guidelines; ASCO, American Society of Clinical Oncology; ASH, American Society of Hematology; INS, Infusion Nursing Society; CCC-IUA, Chinese Chapter Congress of the International Union of Angiology; CMA, China Medical Association; IITC-CNA, Intravenous Infusion Therapy Committee of Chinese Nursing Association; ITAC-CME, International Initiative on Thrombosis and Cancer; ESMO, European Society for Medical Oncology; ISCCM, Indian Society of Critical Care Medicine.

Supplementary Figure 1 The AGREE II domain scores of each guideline



CPGs, clinical practice guidelines; ASCO, American Society of Clinical Oncology; ASH, American Society of Hematology; INS, Infusion Nursing Society; CCC-IUA, Chinese Chapter Congress of the International Union of Angiology; CMA, China Medical Association; IITC-CNA, Intravenous Infusion Therapy Committee of Chinese Nursing Association; ITAC-CME, International Initiative on Thrombosis and Cancer; ESMO, European Society for Medical Oncology; ISCCM, Indian Society of Critical Care Medicine.