Bijlagen bij de richtlijn Centraal Veneuze Toegang

Inhoudsopgave

Module 1: Beeldvorming voorafgaand aan een centraal veneuze lijn

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Reference	Reason for exclusion
Ku MC, Song MG, Seo TS, Kang EY, Yong HS, Lee JW. Factors causing loss of normal Doppler waveform of the left internal jugular vein: evaluation on chest computed tomography. J Vasc Access. 2017 Sep 11;18(5):402-407. doi: 10.5301/jva.5000750. Epub 2017 Jul 19. PMID: 28731492.	wrong population; wrong design
Shenthar J, Padmanabhan D, Banavalikar B, Parvez J, Vallapil SP, Singha I, Tripathi V. Incidence, predictors, and gradation of upper extremity venous obstruction after transvenous pacemaker implantation. Indian Heart J. 2019 Mar-Apr;71(2):123-125. doi: 10.1016/j.ihj.2019.02.002. Epub 2019 Mar 14. PMID: 31280823; PMCID: PMC6620414.	Wrong design

Zoekverantwoording

Richtlijn: NVvH – Centraal veneuze toegang	
Uitgangsvraag: Welke patiëntkenmerken zijn geassocieerd met een slechte uitkomst (centraal of perifeer veneuze stenose)	
Database(s): Ovid/Medline, Embase	Datum: 9-3-2023
Periode: 2003-	Talen: nvt
Literatuurspecialist: Ingeborg van Dusseldorp	
BMI zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Voor deze vraag is gezocht met de volgende concepten: Centraal veneuze lijn EN (veneuze stenose, occlusie of thrombose) EN prognostisch model. De sleutelartikelen worden gevonden in de basisstrategie. Door het toevoegen van het prognostisch model wordt slechts 1 sleutelartikel gevonden: Tedla FM, Clerger G, Distant D, Salifu M. Prevalence of Central Vein Stenosis in Patients Referred for Vein Mapping. Clin J Am Soc Nephrol. 2018;13(7):1063-8.	

Zoekopbrengst

	EMBASE	OVID/MEDLINE	Ontdubbeld
SRs	19	13	25

RCTs	148	89	13
Observationele studies	354	278	402
Overig	37	38	31
Totaal			641

Zoekstrategie

Embase

No.	Query	Results
#23	#10 NOT #20 NOT #19 NOT #18 Overige	37
#22	#20 NOT #19 NOT #18 OBS	354
#21	#19 NOT #18 Clinical trials, RCT	148
#20	#10 AND (#16 OR #17)	508
#19	#10 AND #15	158
#18	#10 AND #14 SR	19
#17	'case control study'/de OR 'comparative study'/exp OR 'control group'/de OR 'controlled study'/de OR 'controlled clinical trial'/de OR 'crossover procedure'/de OR 'double blind procedure'/de OR 'phase 2 clinical trial'/de OR 'phase 3 clinical trial'/de OR 'phase 4 clinical trial'/de OR 'pretest posttest design'/de OR 'pretest posttest control group design'/de OR 'quasi experimental study'/de OR 'single blind procedure'/de OR 'triple blind procedure'/de OR (((control OR controlled) NEAR/6 trial):ti,ab,kw) OR (((control OR controlled) NEAR/6 (study OR studies)):ti,ab,kw) OR (((control OR controlled) NEAR/1 active):ti,ab,kw) OR 'open label*':ti,ab,kw OR (((double OR two OR three OR multi OR trial) NEAR/1 (arm OR arms)):ti,ab,kw) OR ((allocat* NEAR/10 (arm OR arms)):ti,ab,kw) OR placebo*:ti,ab,kw OR 'sham-control*':ti,ab,kw OR (((single OR double OR triple OR assessor) NEAR/1 (blind* OR masked)):ti,ab,kw) OR nonrandom*:ti,ab,kw OR 'non-random*':ti,ab,kw OR 'quasi-experiment*':ti,ab,kw OR crossover:ti,ab,kw OR 'cross over':ti,ab,kw OR 'parallel group*':ti,ab,kw OR 'factorial trial':ti,ab,kw OR ((phase NEAR/5 (study OR trial)):ti,ab,kw) OR ((case* NEAR/6 (matched OR control*)):ti,ab,kw) OR ((match* NEAR/6 (pair OR pairs OR cohort* OR control* OR group* OR healthy OR age OR sex OR gender OR patient* OR subject* OR participant*)):ti,ab,kw) OR ((propensity NEAR/6 (scor* OR match*)):ti,ab,kw) OR versus:ti OR vs:ti OR compar*:ti OR ((compar* NEAR/1 study):ti,ab,kw) OR (('major clinical study'/de OR 'clinical study'/de OR 'cohort analysis'/de OR 'observational study'/de OR 'cross-sectional study'/de OR 'multicenter study'/de OR 'correlational study'/de OR 'follow up'/de OR cohort*:ti,ab,kw OR 'follow up':ti,ab,kw OR followup:ti,ab,kw OR longitudinal*:ti,ab,kw OR prospective*:ti,ab,kw OR retrospective*:ti,ab,kw OR observational*:ti,ab,kw OR 'cross sectional*':ti,ab,kw OR cross?ectional*:ti,ab,kw OR multicent*:ti,ab,kw OR 'multi-cent*':ti,ab,kw OR consecutive*:ti,ab,kw) AND (group:ti,ab,kw OR groups:ti,ab,kw OR subgroup*:ti,ab,kw OR versus:ti,ab,kw OR vs:ti,ab,kw OR compar*:ti,ab,kw OR 'odds ratio*':ab OR 'relative odds':ab OR 'risk ratio*':ab OR 'relative risk*':ab OR 'rate ratio':ab OR aor:ab OR arr:ab OR rrr:ab OR ((('or' OR 'rr') NEAR/6 ci):ab)))	13900841
#16	'major clinical study'/de OR 'clinical study'/de OR 'case control study'/de OR 'family study'/de OR 'longitudinal study'/de OR 'retrospective study'/de OR 'prospective study'/de OR 'comparative study'/de OR 'cohort analysis'/de OR ((cohort NEAR/1 (study OR studies)):ab,ti) OR (('case control' NEAR/1 (study OR studies)):ab,ti) OR (('follow up' NEAR/1 (study OR studies)):ab,ti) OR (observational NEAR/1 (study OR studies)) OR ((epidemiologic NEAR/1 (study OR studies)):ab,ti) OR (('cross sectional' NEAR/1 (study OR studies)):ab,ti)	6767914
#15	'clinical trial'/exp OR 'randomization'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR 'placebo'/exp OR 'prospective study'/exp OR rct:ab,ti OR random*:ab,ti OR 'single blind':ab,ti OR	3302394

	'randomised controlled trial':ab,ti OR 'randomized controlled trial'/exp OR placebo*:ab,ti	
#14	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	733409
#13	#5 AND #12	4
#12	#6 AND #7	7794
#11	#5 AND #10	1
#10	#9 AND [1-1-2003]/sd NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal'/exp OR 'animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	558
#9	#6 AND #7 AND #8	905
#8	'area under the curve'/exp OR 'brier score'/exp OR 'computer prediction'/exp OR 'c statistic'/exp OR 'c statistics'/exp OR 'integrated discrimination improvement'/exp OR 'net reclassification improvement'/exp OR 'net reclassification index'/exp OR 'prediction'/exp OR 'predictive model'/exp OR 'predictive modeling'/exp OR 'predictive validity'/exp OR 'predictive value'/exp OR 'regression analysis'/exp OR 'statistical model'/exp OR 'area under the curve':ti,ab,kw OR 'brier score*':ti,ab,kw OR 'c statistic*' OR 'computer prediction':ti,ab,kw OR 'decision curve anal*':ti,ab,kw OR (('net reclassification' NEAR/2 (improvement OR index)):ti,ab,kw) OR (((predict* OR statistical*) NEAR/3 (model* OR validity OR value)):ti,ab,kw) OR 'proportional hazards model*':ti,ab,kw OR 'r square*':ti,ab,kw OR regression:ti,ab,kw OR predict*:ti OR multivariate:ti,ab,kw OR multivariab*:ti,ab,kw	3152652
#7	'vein stenosis'/exp OR 'venous stenosis'/exp OR 'vein occlusion'/exp OR 'venous thromboembolism'/exp OR 'vein thrombosis'/exp OR 'venothrombo*':ti,ab,kw OR venoocclusi*:ti,ab,kw OR (((vein OR venous OR veno OR phlebo* OR vena) NEAR/3 (occlusi* OR obliterat* OR obstruct* OR interrupt* OR thromb*)):ti,ab,kw)	340486
#6	'central venous catheter'/exp OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device* OR lead*)):ti,ab,kw) OR 'peripherally inserted central venous catheter'/exp OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'implantable port system'/exp OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR hickman*:ti,ab,kw OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp OR ((central NEAR/3 cath*):ti,ab,kw)	58049
#5	#1 OR #2 OR #3 OR #4 sleutelartikelen	4
#4	'venous thrombosis associated with the placement of peripherally inserted central catheters'	1
#3	'venous obstruction after pacemaker implantation' AND korkeila	1
#2	'prevalence of central vein stenosis in patients referred for vein mapping'	1

#1	'subclavian vascular access stenosis in dialysis patients: natural history and risk factors'	1

Ovid/Medline

#	Searches	Results
17	7 not 14 not 13 not 12 Overige	38
16	14 not 13 not 12 OBS	278
15	13 not 12 Clinical trials, RCT	89
14	7 and (10 or 11)	367
13	7 and 9	95
12	7 and 8 SR	13
11	Case-control Studies/ or clinical trial, phase ii/ or clinical trial, phase iii/ or clinical trial, phase iv/ or comparative study/ or control groups/ or controlled before-after studies/ or controlled clinical trial/ or double-blind method/ or historically controlled study/ or matched-pair analysis/ or single-blind method/ or (((control or controlled) adj6 (study or studies or trial)) or (compar* adj (study or studies)) or ((control or controlled) adj1 active) or "open label*" or ((double or two or three or multi or trial) adj (arm or arms)) or (allocat* adj10 (arm or arms)) or placebo* or "sham-control*" or ((single or double or triple or assessor) adj1 (blind* or masked)) or nonrandom* or "non-random*" or "quasi-experiment*" or "parallel group*" or "factorial trial" or "pretest posttest" or (phase adj5 (study or trial)) or (case* adj6 (matched or control*)) or (match* adj6 (pair or pairs or cohort* or control* or group* or healthy or age or sex or gender or patient* or subject* or participant*)) or (propensity adj6 (scor* or match*))).ti,ab,kf. or (confounding adj6 adjust*).ti,ab. or (versus or vs or compar*).ti. or ((exp cohort studies/ or epidemiologic studies/ or multicenter study/ or observational study/ or seroepidemiologic studies/ or (cohort* or 'follow up' or followup or longitudinal* or prospective* or retrospective* or observational* or multicent* or 'multi-cent*' or consecutive*).ti,ab,kf.) and ((group or groups or subgroup* or versus or vs or compar*).ti,ab,kf. or ('odds ratio*' or 'relative odds' or 'risk ratio*' or 'relative risk*' or aor or arr or rrr).ab. or (("OR" or "RR") adj6 CI).ab.))	5373338
10	Epidemiologic studies/ or case control studies/ or exp cohort studies/ or Controlled Before-After Studies/ or Case control.tw. or cohort.tw. or Cohort analy$.tw. or (Follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or Longitudinal.tw. or Retrospective*.tw. or prospective*.tw. or consecutive*.tw. or Cross sectional.tw. or Cross-sectional studies/ or historically controlled study/ or interrupted time series analysis/ [Onder exp cohort studies vallen ook longitudinale, prospectieve en retrospectieve studies]	4383248
9	exp clinical trial/ or randomized controlled trial/ or exp clinical trials as topic/ or randomized controlled trials as topic/ or Random Allocation/ or Double-Blind Method/ or Single-Blind Method/ or (clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or multicenter study or clinical trial).pt. or random*.ti,ab. or (clinic* adj trial*).tw. or ((singl* or doubl* or treb* or tripl*) adj (blind$3 or mask$3)).tw. or Placebos/ or placebo*.tw.	2562305
8	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or	653639

	cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	
7	6 not ((exp animals/ or exp models, animal/) not humans/) not (letter/ or comment/ or editorial/)	418
6	limit 5 to yr="2003 -Current"	427
5	3 and 4	459
4	Area Under Curve/ or exp Forecasting/ or "Predictive Value of Tests"/ or exp Multivariate Analysis/ or exp Regression Analysis/ or exp Models, Statistical/ or area under the curve.ti,ab,kf. or brier score*.ti,ab,kf. or c statistic*.ti,ab,kf. or computer prediction.ti,ab,kf. or decision curve anal*.ti,ab,kf. or (net reclassification adj2 (improvement or index)).ti,ab,kf. or ((predict* or statistical*) adj3 (model* or validity or value)).ti,ab,kf. or proportional hazards model*.ti,ab,kf. or r square*.ti,ab,kf. or regression.ti,ab,kf. or predict*.ti. or multivaria*.ti,ab,kf.	2368868
3	1 and 2	3914
2	exp Venous Thrombosis/ or Venous Thromboembolism/ or venothrombo*.ti,ab,kf. or venoocclusi*.ti,ab,kf. or ((vein or venous or veno or phlebo* or vena) adj3 (occlusi* or obliterat* or obstruct* or interrupt* or thromb*)).ti,ab,kf.	136893
1	exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device* or lead*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or (tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or ((intravascular or intravenous or venous or vascular or cardiovascular) adj3 catheter*).ti. or cvc.ti,ab,kf. or (central adj3 line*).ti,ab,kf.	47623

Module 2: Echogeleiding

Evidence tabel

Systematic review(s) PICO 1
Niet van toepassing.

Systematic review(s) PICO 2

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Follow-up	Outcome measures and effect size	Comments
Tada (2022)	SR and meta-analysis of RCTs *Literature search up to the 29th of November 2021*. A: Aponte (2007) B: Bahl (2016) C: Bridey (2018) D: Costantino (2005) E: Glasin (2020) F: Ismailoglu (2015) G: Kerforne (2012) H: McCarthy (2016A) I: McCarthy (2016B)	Inclusion criteria SR: • Randomised controlled trials (RCTs), including cluster randomised controlled trials, cross-over trials, and quasi-RCTs, (RCTs in which participants are allocated based on data such as date of birth, date of recruitment, or medical record number). • All adult participants (≥18 years old) with any clinical characteristics, in any setting, who required a peripheral	Describe intervention: A: Ultrasound guidance. B: Ultrasound guidance. C: Ultrasound guidance. D: Ultrasound guidance. E: Ultrasound guidance. F: Ultrasound guidance. G: Ultrasound guidance. H: Ultrasound guidance. I: Ultrasound guidance.	Describe control: A: Landmark technique. B: Landmark technique. C: Landmark technique. D: Landmark technique. E: Landmark technique. F: Landmark technique. G: Landmark technique. H: Landmark technique. I: Landmark technique. J: Landmark technique. K: Landmark technique. L: Landmark technique. M: Landmark technique.	End-point of follow-up: A: No information. B: No information. C: No information. D: No information. E: No information. F: No information. G: No information. H: No information. I: No information.	**Results** See original publication.	Author's conclusion There is very low- and low-certainty evidence that, compared to the landmark method, ultrasound guidance may benefit difficult participants for increased first-pass and overall success of cannulation, with no difference detected in pain. There is moderate- and low certainty evidence that, compared to the landmark method, ultrasound guidance may benefit moderately difficult participants due to a small increased first-pass success of cannulation with no difference detected in pain. There is moderate- and high-certainty evidence that, compared to the landmark method, ultrasound guidance does not benefit easy participants: ultrasound guidance

	J: McCarthy (2016C) K: Nishizama (2020) L: Pappas (2006) M: River (2009) N: Skulec (2019) O: Stein (2009) P: Weiner (2013) <u>Study design</u>: A: RCT B: RCT C: RCT D: RCT E: RCT F: RCT G: RCT H: RCT I: RCT J: RCT K: RCT L: RCT M: RCT N: RCT O: RCT P: RCT <u>Setting and Country</u>: A: Operating room B: Emergency department C: ICU D: Emergency department	intravenous line, irrespective of the difficulty of cannulation. Exclusion criteria • Central lines, intraosseous lines, and peripherally inserted central lines; • children because the effect of ultrasound guidance would be different for them, due to smaller veins and extremities, and a possible lack of cooperation. *16 studies included* <u>Important patient characteristics at baseline</u>: <u>N</u> A: 35 B: 122 C: 114 D: 60 E: 90 F: 60 G: 60 H: 192 I: 401	J: Ultrasound guidance. K: Ultrasound guidance. L: Ultrasound guidance. M: Ultrasound guidance. N: Ultrasound guidance. O: Ultrasound guidance. P: Ultrasound guidance.	N: Landmark technique. O: Landmark technique. P: Landmark technique.	J: No information. K: No information. L: No information. M: No information. N: No information. O: No information. P: No information. <u>For how many participants were no complete outcome data available?</u> (intervention/control) A: None. B: None. C: None. D: None. E: None. F: None. G: None. H: None. I: None. J: None. K: None. L: None. M: None. N: None.		decreased the first-pass success of cannulation with no difference detected in overall success of cannulation and increased pain.

	E: Emergency department F: Emergency department G: ICU H: Emergency department I: Emergency department J: Emergency department K: ICU L: Operating room M: Emergency department N: Prehospital O: Emergency department P: Emergency department <u>Source of funding and conflicts of interest:</u> MT: declared that his institute received research grants from Nakatani Foundation (ongoing multicentre prospective cohort study for myocardial	J: 596 K: 60 L: 18 M: 47 N: 300 O: 59 P: 53 Groups comparable at baseline? Yes.			O: None. P: None.		

	infarction in the emergency department) and Radiometer America, Inc. (ongoing multicentre prospective cohort study of myocardial infarction in the emergency department). MT declared that he has received royalties from Japan Medical Journal as he coauthored a textbook about ultrasound-guided peripheral intravenous cannulation in emergency medicine. The textbook is about the technical issues of the review intervention. It explains the review intervention as one of various options and is						

	not intended to promote the review intervention. Japan Medical Journal has no role in this Cochrane Review and meta-analysis. NY: none known TM: none known CT: none known TF: has received financial paymentfor speaker's fees (Mitsubishi Tanabe Pharma Corporation), clinicaltrial consultancy (Mitsubishi Tanabe Pharma Corporation, Sony Electronics), scientific advisory board (Kyoto University Original), grant (Shionogi) and declares intellectual properties and patent-pending (2020-548587)						

	for smartphone CBT apps (Mitsubishi Tanabe Pharma Corporation). NW: his institution has received research funds from the Japanese Ministry of Health Labor and Welfare and the Japanese Ministry of Education, Science, and Technology.He has also received royalties from Sogensha and Akatsuki for writing a book and developing soNware about interventions for insomnia. This review is completely independent from the intention of these grants.						

Systematic review(s) PICO 3
Not applicable.

Randomized controlled trial(s) PICO 1

Study reference	Study characteristics	Patient characteristics [2]	Intervention (I)	Comparison / control (C) [3]	Follow-up	Outcome measures and effect size [4]	Comments
Airapetian (2013)	Type of study: Randomized controlled trial. Setting and country: Eight-bed medical ICU of a university hospital. Funding and conflicts of interest: Authors have no conflict of interest. No information regarding funding.	Inclusion criteria: • Need for jugular or femoral central cannula placement, as determined by the attending physician caring for the patient. Exclusion criteria: • The decision to place a subclavian catheter. N total at baseline: *Jugular vein* I: N = 21 C: N = 21 *Femoral vein* I: N = 15 C: N = 10 Important prognostic factors[2]: *age ± SD:* *I: 63 (15) years.* *C: 67 (16) years.*	Describe intervention (treatment/procedure/test): Ultrasound-guided technique.	Describe control (treatment/procedure/test): Landmark technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *Jugular vein* I: 21/21 (100%) C: 21/28 (75%) *Femoral vein* I: 15/15 (100%) C: 7/10 (70%) *All sites* I: 36/36 (100%) C: 28/38 (74.0%) **Complications** *Jugular vein* I: 0/21 (0%) C: 7/28 (25.0%) *Femoral vein* I: 0/15 (0%) C: 2/10 (20.0%) **Number of attempts** I: 1 times C: 3 (1) times	Author's conclusion: Ultrasound-guided cannulation of the internal jugular or femoral vein by inexperienced residents appears to be more reliable than the LM or UM methods and was associated with a lower mechanical complication rate among ICU patients.

		Sex: *I: Ratio 2.6* *C: Ratio 1.9* *BMI:* *I: 25 (6) kg/m²* *C: 28 (6) kg/m²* Groups comparable at baseline? Yes.				**Access time** I: 4 (2) minutes C: 8 (7) minutes **Catheter colonization** I: 9/36 (25.0%) C: 7/28 (18.0%)	
Benali (2022)	Type of study: Randomized controlled trial. Setting and country: No information. Funding and conflicts of interest: No information.	Inclusion criteria: • Patients 18 years or older requiring elective central venous catheterization after obtaining a written informed consent from the patient or trusted person. Exclusion criteria: • Vein thrombosis; • Major blood the coagulation disorders; • Cannulation site infection. N total at baseline: *Subclavian vein* Intervention: N = 35 Control: N = 35	Describe intervention (treatment/procedure/test): Ultrasound guidance	Describe control (treatment/procedure/test): Landmark technique	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate (overall)** I: 35/35 (100%) C: 30/35 (85.7%) **Success rate (obesitas)** I: 7/7 (100%) C: 1/4 (25.0%) **First attempt success rate (overall)** I: 29/35 (82.9%) C: 14/35 (40.0%) **Number of attempts (overall)** I: 1 (range 1 to 1) C: 2 (range 1 to 4) **Complications (overall)** *Arterial puncture*	Author's conclusion: According to our study, US guidance for SCV catheterization seems to be an interesting alternative to anatomical landmarks approaches.

		Important prognostic factors[2]: *age ± SD:* *I: 48 (20) years.* *C: 44 (18) years.* *BMI >30* *I: 7/35 (20%)* *C: 4/35 (11.4%)* *BMI <30* *I: 28/35 (80.0%)* *C: 31/35 (88.6%)* Groups comparable at baseline?				I: 0/35 (0%) C: 5/35 (14.3%) *Hematoma* I: 0/35 (0%) C: 9/35 (25.7%) *Pneumothorax* I: 0/35 (0%) C: 2/35 (5.7%) *Malposition* I: 2/35 (5.7%) C: 1/35 (2.9%)	
Dolu (2015)	Type of study: Randomized controlled trial. Setting and country: Medical faculty of Gaziantep University. Funding and conflicts of interest: The authors declare that they have no conflict of interest.	Inclusion criteria: • Patients who required elective cardiovascular surgery. Exclusion criteria: • No information. N total at baseline: *Jugularis vein* Intervention: N = 50 Control: N = 50 Important prognostic factors[2]: *age ± SD:* *I: 53.6 (5.8) years.* *C: 53.2 (9.10) years.*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Number of needles passes** I: 1.1 (0.5) needles C: 2.2 (1.6) needles **Duration of procedure in seconds** I: 109.4 (30.4) seconds C: 165.9 (91.5) seconds **Complications** *Arterial puncture* I: 0/50 (0%) C: 4/50 (8.0%)	Author's conclusion: The findings of this study indicate that internal jugular vein catheterization guided by real-time ultrasound results in a lower access time and a lower rate of attempts.

		BMI: *I: 25.7 (2.6) kg/m²* *C: 26.6 (3.7) kg/m²* Groups comparable at baseline? Yes.				*Hematoma* I:(1/50 (2.0%) C: 1/50 (2.0%) *Total* I: 1/50 (2.0%) C: 5/50 (10.0%)	
Ethesham (2020)	Type of study: Randomized controlled trial. Setting and country: Poona Hospital and Research Centre, Pune, India Funding and conflicts of interest: None declared.	Inclusion criteria: • Patients who underwent major surgeries under general anaesthesia requiring central venous pressure monitoring, rapid infusion of fluids for major surgery, drug administration, and inadequate peripheral access. Exclusion criteria: • Patients who had infection at the local site, bleeding diathesis/ coagulopathy. N total at baseline: *Internal jugular vein* Intervention: N = 45 Control: N = 45 Important prognostic factors[2]: *age ± SD:* *I: 47.3 (13.6) years.*	Describe intervention (treatment/procedure/test): Ultrasound-guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** I: 45/45 (100%) C: 43/45 (95.6%) **Complications** *Nil* I: 45/45 (100%) C: 33/45 (73.3%) *Hematoma* I: 0/45 (0%) C: 8/45 (17.8%) *Carotid artery puncture* I: 0/45 (0%) C: 4/45 (8.9%) **Mean time required for the procedure in minutes** I: 4.2 (0.4) minutes C: 4.7 (0.8) minutes	Author's conclusion: USG guided cannulation of IJV decreases access time, reduces attempts, and complication rates. USG guided technique may be preferred for cannulation of IJV.

		C: 46.4 (14.2) years. *Sex:* *I: 22/45 (48.9%) M* *C: 28/45 (62.2%) M* *BMI around 22 kg/m^2 in both groups.* Groups comparable at baseline? Yes.					
Faithi (2016)	Type of study: Randomized controlled trial. Setting and country: No information. Funding and conflicts of interest: This study was supported by the research deputy of Mashhad at the University of Medical Sciences	Inclusion criteria: • No information. Exclusion criteria: • Patients who had a right jugular vein cannulation for any reason, such as those who required hemodialysis N total at baseline: *Internal jugular vein* Intervention: N = 170 Control: N = 151 Important prognostic factors[2]: *age ± SD:* *I: 64.45 (11.29) years.* *C: 62.15 (9.76) years.* *Sex:*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *First attempt* I: 156/170 (91.8%) C: 140/151 (92.7%) *Second attempt* I: 8/170 (4.2%) C: 6/151 (4.0%) *Third attempt* I: 6/170 (3.6%) C: 5/151 (3.3%) **Time required for cannulation** I: 46.05 (12.7) seconds C: 45.56 (10.9) seconds	Author's conclusion: In our conditions, the use of an anatomical landmark-guided procedure was the preferred treatment method due to limited resources and a lack of adequate training.

		I: 103/170 M *C: 102/151 M* Groups comparable at baseline? Yes.					
Nazari (2015)	Type of study: Randomized controlled trial. Setting and country: No information. Funding and conflicts of interest: No information.	Inclusion criteria: • All patients who have had indications for central venous cannulation Exclusion criteria: • Patients with previous CVC within 15 days, anatomical deformity (such as neck surgery, malignancy and burns on the site), having emergency conditions and bleeding disorders. N total at baseline: *Internal jugular vein* Intervention: N = 168 Control: N = 168 Important prognostic factors[2]: *age ± SD:* *I: 54.8 (7.6) years.* *C: 49.9 (10.6) years.* *Sex:*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *From skin prep to successful aspiration (in seconds)* I: 132.52 (15.1) seconds. C: 169.2 (16.21) **Number of patients required more than one attempt** I: 22/168 (13.09%) C: 75/168 (44.6%) **Successful cannulation** *Mean number of attempts* I: 1.4 (0.42) C: 1.98 (0.61)	Author's conclusion: The results of our study showed that USG approach took lesser time, required lesser attempts, and had lower incidence of complications for cannulation of the internal jugular vein.

		I: 90/168 (53.5%) M *C: 87/168 (51.7%) M* Groups comparable at baseline? Yes.					
Oh (2014)	Type of study: Randomized controlled trial. Setting and country: Seoul National University Bundang Hospital. Funding and conflicts of interest: The authors declare that they have no competing interests	Inclusion criteria: • Patients between the age of 18 and 75 years (ASA physical status I–III), who required subclavian venous catheterization. Exclusion criteria: • Patients with chest deformities or significant coagulopathy. N total at baseline: *Subclavian* Intervention: N = 30 Control: N = 30 Important prognostic factors[2]: *age ± SD:* *I: 51 (14) years.* *C: 50 (16) years.* *Sex:* *I: 15/30 (50%) M* *C: 16/30 (53.3%) M*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** I: 26/30 (86.7%) C: 16/30 (53.3%) **Complications** I: 0/30 (0%) C: 0/30 (0%)	Author's conclusion: The proper placement of guidewire was less influenced by the direction of the guidewire J-tip with ultrasound-guided subclavian venous cannulation than with the landmark approach.

		Groups comparable at baseline? Yes.					
Palkhiwala (2020)	Type of study: Randomized controlled trial. Setting and country: No information. Funding and conflicts of interest: No information.	Inclusion criteria: • Adult patients with ASA Grade II and II posted for major surgeries; • Patients willing to enrol in the study; • Patients aged 18 years or older. Exclusion criteria: • Patients who do not give consent; • Skin inflammation at insertion site; • Altered coagulation profile (platelet count <50.000 per cu mm, INR > 1.5).; • Patients with known bleeding disorders; • Prior catheterization; • Subcutaneous emphysema; • Patients undergoing radiation therapy. N total at baseline: *Jugularis* Intervention: N = 30 Control: N = 30	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *First attempt* I: 28/30 (93.33%) C: 20.30 (66.67%) *Second attempt* I: 2/30 (6.67%) C: 7/30 (23.34%) *Third attempt* I: 0/30 (0%) C: 3/30 (10.0%) **Complications** *Total* I: 2/30 (6.67%) C: 9/30 (30.0%) *Hematoma* I: 1/30 (3.33%) C: 2/30 (6.67%) *Carotid artery puncture* I: 0/30 (0%) C: 3/30 (10.0%) *Pneumothorax* I: 0/30 (0%) C: 1/30 (3.3%)	Author's conclusion: We conclude that use of ultrasound makes cannulation of the IJV a much safer technique, especially in high-risk patients, and leaves almost none to minimal chances of any complications. With experience, expertise and under real-time vision, the contra-indications to a central line insertion are almost nullified

		Important prognostic factors[2]: *age ± SD:* *I: 53.1 (15.05) years.* *C: 50.1 (15.70) years.* *Sex:* *I: 20/30 (66.7%) M* *C: 22/30 (73.3%) M* Groups comparable at baseline? Yes.				*Double wall puncture* I: 1/30 (3.3%) C: 3/30 (10.0%) **Number of attempts** I: 1.06 (0.24) C: 1.43 (0.66) **Access time** I: 9.63 (1.85) seconds C: 19.30 (8.85) seconds	
Rando (2014)	Type of study: Randomized controlled trial. Setting and country: Intensive care unit and operating rooms of the military hospital in motevideo, Uruguay. Funding and conflicts of interest: None declared.	Inclusion criteria: • Critically ill patients or those that required surgery and a CVL. Exclusion criteria: • Patients under 18 years old; • Conscious but non-collaborative patients. N total at baseline: *Jugular vein* Intervention: N = 123 Control: N = 134 Important prognostic factors[2]: *age ± SD:* *Ranging from a mean of 55 to 62 years.*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate (overall)** I: 112/123 (91.0%) C: 105/134 (78.0%) **Success rate (difficult neck)** I: 42/46 (93.0%) C: 24/37 (65.0%) **Complications (overall)** I: 10/123 (8.1%) C: 20/134 (15.0%) **Multiple puncture (overall)** I: 48/123 (39.0%) C: 54/134 (40.0%)	Author's conclusion: Ultrasound reduces the incidence of complications when placement is performed by inexperienced operators. Centers with residents should emphasize the necessity of ultrasound for central line catheterization. Training in ultrasound might be of paramount importance in the effectiveness of the technique.

		BMI: *Ranging from 27.5 to 27.8 kg/m²* Groups comparable at baseline? Yes.					
Riaz (2015)	Type of study: Randomized controlled trial. Setting and country: Anaesthesia department. Funding and conflicts of interest: No information.	Inclusion criteria: • Adult patients who required intravenous jugular vein catheterization. Exclusion criteria: • Patients with local or systemic infection, known vascular abnormalities, untreated coagulopathy N total at baseline: *Jugularis* Intervention: N = 100 Control: N = 100 Important prognostic factors[2]: *age ± SD:* *I: 44.25 (14.43) years.* *C: 48.59 (14.57) years.* *Sex:* *I: 74/100 (74.0%) M* *C: 81/100 (81.0%) M*	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *First attempt* I: 99/100 (99.0%) C: 89/100 (89.0%) *Second attempt* I: 1/100 (1.0%) C: 7/100 (7.0%) **Complications** *Carotid artery puncture* I: 1/100 (1.0%) C: 9/100 (9.0%) *Irritation of brachial plexus* I: 0/100 (0%) C: 6/100 (6.0%) *Hematoma* I: 0/100 (0%) C: 7/100 (07.0%) *Hemothorax* I: 0/100 (0%) C: 0/100 (0%)	Author's conclusion: Access time, failure rate and procedure related complications are reduced when real-time ultrasonography is used to cannulate internal Jugular vein.

		Groups comparable at baseline? Yes.				*Pneumothorax* I: 0/100 (0%) C: 0/100 (0%) **Access time (in seconds)** I: 34.95 (11.47) seconds C: 146.59 (40.20) seconds	
Srinivasan (2017)	Type of study: Randomized controlled trial. Setting and country: Adult Gastroenterology and Liver Intensive Care Unit. Funding and conflicts of interest: There are no conflicts of interest. No funding.	Inclusion criteria: • Both surgical and medical gastroenterology patients in whom central venous lines were indicated as a part of their medical management. Exclusion criteria: • Patient/relatives refusal for central venous line placement, choice of alternate site for central venous cannulation (besides IJV), presence of thrombus within the jugular vein and infection at chosen site of catheter insertion. N total at baseline: *Jugularis* Intervention: N = 90	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *First attempt* I: 90//90 (100.0%) C: 60/80 (75.0%) *Second attempt* I: 0/90 (0%) C: 18/80 (22.5%) *Third attempt* I: 0/90 (0%) C: 2/80 (2.5%) **Complications** *Posterior wall puncture of internal jugular vein* I: 19/90 (21.0%) C: 37/80 (46.0%) *Inadvertent arterial puncture* I: 5/90 (5.5%) C: 8/80 (10.0%)	Author's conclusion: Real-time ultrasound-guided IJV cannulation significantly reduces but does not wholly eliminate the incidence of posterior venous wall penetrations. It also significantly reduces the incidence of inadvertent arterial punctures and number of attempts for successful cannulation.

		Control: N = 80 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 52.1 (14.2)* *C: 48.6 (15.7)* Groups comparable at baseline? Yes.				*Hematoma* I: 1/90 (1.1%) C: 11/80 (13.8%) *Pneumothorax* I: 0/90 (0%) C: 1/80 (1.3%)	
Subramony (2022)	<u>Type of study:</u> Randomized controlled trial. <u>Setting and country:</u> Urban tertiary care teaching hospital. <u>Funding and conflicts of interest:</u> No information.	<u>Inclusion criteria</u>: • Patients who required assessment of administration of vasoactive drugs or large volume fluid resuscitation or patients in which there was failure to obtain the necessary peripheral venous access. <u>Exclusion criteria</u>: • Patients with a high bleeding risk. This was defined by an international normalized ratio >2.5 or platelet count of <u>N total at baseline</u>: *Subclavian vein* Intervention: N = 44 Control: N = 41	<u>Describe intervention (treatment/procedure/test):</u> Ultrasound-guidance.	<u>Describe control (treatment/procedure/test):</u> Landmark technique.	<u>Length of follow-up</u>: No information. <u>Loss-to-follow-up</u>: None.	**Success rate** I: 35/44 (79.5%) C: 24/41 (58.5%)	<u>Author's conclusion:</u> Ultrasound-guided subclavian vein catheterization was found to be associated with a higher overall success rate compared with the landmark method with no significant difference with respect to complication rate in an ED setting.

		Important prognostic factors[2]: *age ± SD:* *No information* *Sex:* *No information* Groups comparable at baseline? No information.					
Vinayagam urugan (2021)	Type of study: Randomized cross-over clinical trial. Setting and country: Tertiary care University hospital. Funding and conflicts of interest: None.	Inclusion criteria: • Patients aged than 18 years of age undergoing elective or emergency surgery under general anesthesia. Exclusion criteria: • Patients who had distorted neck anatomy, previous neck surgeries, neck mass, torticollis, neck contracture and previous history of long term IJV catheterization. N total at baseline: *Jugularis* Intervention: N = 94 Control: N = 94	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate (overall)** I: 94/94 (100%) C: 94/94 (100%) **Success rate (first attempt)** I: 84/94 (89.34%) C: 75/94 (79.78%) **Complications** *Total* I: 4/94 (4.25%) C: 12/94 (12.76%) *Carotid artery puncture* I: 2/94 (2.12%) C: 2/94 (2.12%) *Hematoma* I: 2/94 (2.12%) C: 4/94 (4.25%)	Author's conclusion: In patients with non-distorted neck anatomy and a visible EJV, IJV catheterization using the EJV-based LM approach and standard US-guided technique yielded similar first attempt and overall success rates. Cannulation time was longer and complications occurred more frequently in the EJV-based LM compared to the standard US-guided technique.

		Important prognostic factors[2]: *age ± SD:* *I: 45.9 (14.32) years.* *C: 45.01 (15.35) years.* *Sex:* *I: 54/94/ (57.44%) M* *C: 61/94 (64.89%) M* Groups comparable at baseline? Yes.				*Mechanical complications (pneumothorax, hemothorax, hemomediastinum, cardic tamponade, nerve injury, catheter malposition)* I: 0/94 (0%) C: 0/94 (0%) **Cannulation time** I: 44.27 (5.28) seconds C: 58.11 (6.6) seconds.	
Wang (2020)	Type of study: Pilot RCT. Setting and country: ICU hospital. Funding and conflicts of interest: This study was funded by the grants from the Science and Technology Bureau of Jiaxing city, Zhejiang, China (No.2017AY33034 to J.M. Cai; and	Inclusion criteria: • : ICU inpatient, age > 18 years, and required subclavian vein puncture. Exclusion criteria: • Severe coagulation disorder (i.e., international normalized ratio [INR] > 3.5 or disseminated intravascular coagulation with active bleeding), platelet count (PLT) < 20,000/ mL,	Describe intervention (treatment/procedure/test): Ultrasound guidance.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: Loss-to-follow-up:	**Success rate** I: 88/96 (91.7%) C: 76/98 (77.6%) *First attempt success* I: 57/96 (59.4%) C: 48/98 (49.0%) **Complications** *Total* I: 7/96 (7.3%) C: 20/98 (20.4%) *Mispuncture of artery* I: 2/96 (2.1%)	Author's conclusion: Static ultrasoundguided subclavian vein puncture is superior to the traditional landmark-guided approach for critically ill patients in the ICU. It is suggested that static ultrasound-guided puncture techniques should be considered for subclavian vein puncture in the ICU.

	No.2020AD30082 to Q.Y. Wang).	bilateral pneumothorax, cardiopulmonary resuscitation, or emergency subclavian vein puncture. N total at baseline: *Subclavian* Intervention: N = 96 Control: N = 98 Important prognostic factors[2]: *age ± SD:* *I: 21.6 (8.7)* *C: 22.5 (8.3)* *Sex:* *I: 23/96 (24.0%) F* *C: 34/98 (34.7%) F* Groups comparable at baseline? Yes.				C: 14/98 (14.3%) *Hematoma* I: 0/96 (0%) C: 1/98 (1.0%) *Pneumothorax* I: 0/96 (0%) C: 2/98 (2.0%) **Number of punctures** I: 1.6 (1.0) C: 1.5 (0.7) **Puncture time** I: 50 (47) seconds C: 62 (53) seconds	
Zhang (2023)	Type of study: Randomized controlled trial. Setting and country: No information. Funding and conflicts of interest: The authors declare that they have no conflicts of interest.	Inclusion criteria: • No information. Exclusion criteria: • No information. N total at baseline: *Subclavian vein* Intervention: N = 30 Control: N = 30	Describe intervention (treatment/procedure/test): Ultrasound-guidance.	Describe control (treatment/procedure/test): Landmark technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**Success rate** *First attempt* I: 24/30 C: 20/30 *Total* I: 30/30 C: 30/30 **Complications** *Pneumothorax* I: 1/30	Author's conclusion: Te improved ultrasound-guided subclavian vein catheterization technique can greatly reduce the catheterization time and improve the success rate of puncture and catheterization. It can also reduce the occurrence of complications and damage to adjacent tissues. Te operation is simple, fast, and easy to master, and it has a high popularization clinical value.

		Important prognostic factors[2]: *age ± SD:* *I: <60 N = 4 / >60 N = 26* *C: <60 N =5 / >60 N = 25* *Sex:* *I: 27/30 M* *C: 22/30 M* Groups comparable at baseline? Yes.				C: 5/30 *Hematoncus* I: 2/30 C: 6/30 **Intubation time** I: 6.3333 minutes C: 11.3667 minutes	

Randomized controlled trial(s) PICO 2

Study reference	**Study characteristics**	**Patient characteristics [2]**	**Intervention (I)**	**Comparison / control (C) [3]**	**Follow-up**	**Outcome measures and effect size [4]**	**Comments**
Yalcinli (2022)	Type of study: Randomized controlled trial. Setting and country: An emergency department of an academic tertiary care hospital Funding and conflicts of interest: No conflicts of	Inclusion criteria: • Patients describing DVA history (>two trial histories during vascular access on a previous visit), with no visible or palpable veins on the upper extremity, and who were assessed to have a difficult procedure by the senior nurse (according to	Describe intervention (treatment/procedure/test): Ultrasound-guided placement.	Describe control (treatment/procedure/test): Landmark-based technique.	Length of follow-up: No information. Loss-to-follow-up: None.	**First attempt success** I: 71/90 (78.9%) C: 56/90 (62.2%) **Catheter-related interventions** I: 17/90 (18.9%) C: 17/90 (18.9%) **Duration of the procedure**	Author's conclusion: It was found that USG increases the success of the first attempt compared with the standard method and NIR in patients with DVA.

	interest declared. This article received no specific grant from any funding agency.	classification: easy-moderate-difficult) <u>Exclusion criteria</u>: • Patients who did not provide • consent, pregnant, <18 years of age, and urgent critical intervention needs were excluded <u>N total at baseline</u>: Intervention: N = 90 Control: N = 90 <u>Important prognostic factors</u>[2]: *age (median. IQR):* *I: 64 (49 to 77)* *C: 68.5 (51 to 76)* *Sex:* *I: 39/90 male* *C: 34/90 male* Groups comparable at baseline? Yes.				**(Median, IQR, 95% CI)** I: 107 (IQR 69 to 228, 95% CI 140 to 209) seconds C: 72 (IQR 47 to 134, 95% 86 to 128) seconds **Number of total attempts (Median, IQR, 95% CI)** I: 1.0 (IQR 1.0 to 1.0, 1.25 to 1.64) C: 1.0 (IQR 1.0 to 2.0, 95% CI 1.35 to 1.74)	

Risk of bias tabel

Study reference	Was the allocation sequence	Was the allocation	Blinding: Was knowledge of the allocated	Was loss to follow-up	Are reports of the study free of selective	Was the study apparently free of other problems	Overall risk of bias

(first author, publication year)	**adequately generated?** Definitely yes Probably yes Probably no Definitely no	**adequately concealed?** Definitely yes Probably yes Probably no Definitely no	**interventions adequately prevented?** **Were patients/healthcare providers/data collectors/assessors/data analysts blinded?** Definitely yes Probably yes Probably no Definitely no	**(missing outcome data) infrequent?** Definitely yes Probably yes Probably no Definitely no	**outcome reporting?** Definitely yes Probably yes Probably no Definitely no	**that could put it at a risk of bias?** Definitely yes Probably yes Probably no Definitely no	**If applicable/necessary, per outcome measure** **LOW** **Some concerns** **HIGH**
<u>PICO 1: Central venous catheters</u>							
Airapetian (2013)	Definitely yes. Reason: patients were randomly assigned to the three groups	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Benali (2022)	Definitely yes. Reason: Patients were randomly divided according to computer generated randomized table into two groups.	Definitely yes. Reason: Computer generated.	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Dolu (2015)	Definitely yes.	No information. Reason: -	No information. Reason: -	No loss to follow-up reported.	Definitely yes.	Probably yes.	Low.

	Reason: patients were randomly assigned to the groups.			Reason: -	Reason: All predefined outcomes were reported.	Reason: No other bias reported.	
Ethesham (2020)	Definitely yes. Reason: Randomly divided into two groups.	No information. Reason: -	Partly yes. Reason: The patients were blind (single blind study) to the study.	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Faithi (2016)	Definitely yes. Reason: patients were randomly assigned to either the control (anatomical landmark-guided) or experimental (ultrasound-guided) groups	Probably yes. Reason: based upon the order of their entrance to the operating room.	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Nazari (2015)	Definitely yes. Reason: From patients 340 cases were selected based on inclusion and exclusion criteria, 4 of them not participate to the study and other 336 cases allocated with a simple	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.

	random sampling method in 2 groups of intervention and control (168 cases in each groups).						
Oh (2014)	Definitely yes. Reason: Patients were randomly divided into a landmark group (n = 30) or an ultrasound group (n = 30).	No information. Reason: -	Definitely no. Reason: this in- vestigation was not-blinded because the catheterization could not be disguised; therefore, there was a possibility of a bias.	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Palkhiwala (2020)	Definitely yes. Reason: Randomly divided into two groups.	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Rando (2014)	Definitely yes. Reason: Randomization was performed through a computer random number generator	Definitely yes. Reason: placing the results in sheets inside closed enve- lopes, which were opened right before CVL placement.	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Riaz (2015)	Definitely yes. Reason: patients who required	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined	Probably yes. Reason: No other bias reported.	Low.

	internal jugular vein cannulation were randomly assigned.				outcomes were reported.		
Srinivasan (2017)	Definitely yes. Reason: Randomly divided into two groups.	Definitely yes. Reason: The allocation was concealed in an opaque-sealed envelope. The envelope was opened just before the central line (IJV line) placement	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Subramony (2022)	Definitely yes. Reason: Patients were randomized according to an odd or even numbering system found on the inside of the data packet. Odd numbers were randomized to the traditional method while even numbers were assigned to the ultrasoundguided group.	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Vinayagamurugan (2021)	Definitely yes.	Reason:	Partly yes.	No loss to follow-up reported.	Definitely yes.	Probably yes.	Low.

	Reason: Randomly divided into two groups.		Reason: Resident physician who performed the procedures were not blinded to study. However, patients and postoperative assessors of mechanical complications were blinded to study.	Reason: -	Reason: All predefined outcomes were reported.	Reason: No other bias reported.	
Wang (2020)	Definitely yes. Reason: Randomly divided into two groups.	Definitely yes. Reason: The allocation sequence, which was based on a random number table, was prepared by a third-party biostatistician in sequentially numbered sealed opaque envelopes.	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
Zhang (2023)	Definitely yes. Reason: Randomly divided into two groups.	No information. Reason: -	No information. Reason: -	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.
<u>PICO 2: Peripheral intravenous catheters</u>							
Yalcinli (2022)	Reason:	Reason:	Reason:	No loss to follow-up reported.	Definitely yes.	Probably yes.	Low.

				Reason: -	Reason: All predefined outcomes were reported.	Reason: No other bias reported.	
PICO 3: Peripherally inserted central catheters							
Wang (2016)	Reason:	Reason:	Reason:	No loss to follow-up reported. Reason: -	Definitely yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other bias reported.	Low.

Exclusie tabel

Author and year	Reason for exclusion
Anderssen (2022)	The included RCTs in this systematic review are already included in a more recent published systematic review which is included in this guideline.
Berlanga-Macis (2022)	Wrong study design.
Hansel (2023)	Wrong study population.
McCarthy (2016)	The RCT is already included in the systematic review of Tada (2022) which is included in this guideline.
Misiołek (2012)	The full-text version of this study is not available.
Oleti (2019)	Wrong study population.
Poulsen (2023)	The studies regarding adults are already included in the systematic review of Tada (2022). Poulsen (2023) includes three more studies about children, but children are beyond the scope of this review.
Sazdov (2017)	Study did not report results for the jugular vein, subclavian vein, and femoral vein separately.
Tran (2021)	The included RCTs in this systematic review are already included in a more recent published systematic review which is included in this guideline.
Wang (2016)	Wrong comparison for PICO 3.
Xia (2014)	The full-text version of this study is not available.
Xu (2013)	The full-text version of this study is not available.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: NVvH Centraal veneuze toegang	
Uitgangsvraag/modules: UV2 Wat is de waarde van echogeleid aanprikken van een centraal veneuze of perifere lijn?	
Database(s): Embase.com, Ovid/Medline	Datum: 7 februari 2024
Periode: vanaf 2012	Talen: geen restrictie
Literatuurspecialist: Alies Oost	Rayyan review: https://rayyan.ai/reviews/923533
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Deduplication: voor het ontdubbelen is gebruik gemaakt van http://dedupendnote.nl/	
Toelichting: Voor deze vraag is gezocht op de elementen: - centraal veneuze/ perifere lijn - echogeleid aanprikken De sleutelartikelen worden gevonden met deze search (PMID 23249991, 30032874 en 25656255)	
Te gebruiken voor richtlijntekst: In de databases Embase.com en Ovid/Medline is op 7 februari 2024 systematisch gezocht naar systematische reviews en RCTs over echogeleid aanprikken van een centraal veneuze of perifere lijn. De literatuurzoekactie leverde 752 unieke treffers op.	

Zoekopbrengst

	EMBASE	OVID/MEDLINE	Ontdubbeld
SR	103	88	125
RCT	495	340	627
Totaal	598	428	**752***

****in Rayyan***

Zoekstrategie

Embase.com

No.	Query	Results
#1	'central venous catheter'/exp OR 'central venous catheterization'/exp OR (((central* OR peripheral*) NEAR/3 (venous OR vein OR intravenous OR vascular) NEAR/3 (catheter* OR access OR line* OR device* OR cannulation)):ti,ab,kw) OR cvc:ti,ab,kw OR cvcs:ti,ab,kw OR pivc:ti,ab,kw OR pivcs:ti,ab,kw OR ((central NEAR/3 (cath* OR line*)):ti,ab,kw) OR 'peripherally inserted central venous catheter'/exp OR 'peripheral venous catheter'/exp OR ((peripheral* NEAR/3 (insert* OR catheter* OR line* OR infusion OR access OR cannulation)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR portacath:ti,ab,kw OR ((('venous access' OR 'central venous' OR cv OR implant* OR catheter*) NEAR/2 port*):ti,ab,kw) OR 'implantable port system'/exp OR ((implant* NEAR/2 venous NEAR/2 (device* OR port*)):ti,ab,kw) OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR hickman*:ti,ab,kw OR (((tunnel* OR cuffed) NEAR/3 (catheter* OR 'central catheter*' OR line* OR cvad*)):ti,ab,kw)	82913
#2	(((ultrasound OR ultrasonograph* OR ultrasonic OR echo* OR sonograph*) NEAR/3 (guidance OR guided)):ti,ab,kw) OR 'point of care ultrasound*':ti,ab,kw OR pocus:ti,ab,kw	87255
#3	('ultrasound'/exp/mj OR 'echography'/mj OR 'ultrasound scanner'/exp/mj) AND ('central venous catheter'/exp/mj OR 'central venous catheterization'/exp/mj OR 'peripherally inserted central venous catheter'/exp/mj OR 'peripheral venous catheter'/exp/mj OR 'peripheral vein'/exp/mj OR 'cannulation'/mj OR 'vascular access'/exp/mj OR 'vascular puncture (procedure)'/exp/mj)	1507
#4	(#1 AND #2 OR #3) NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal'/exp OR 'animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp) NOT (('adolescent'/exp OR 'child'/exp OR adolescent*:ti,ab,kw OR child*:ti,ab,kw OR schoolchild*:ti,ab,kw OR infant*:ti,ab,kw OR girl*:ti,ab,kw OR boy*:ti,ab,kw OR teen:ti,ab,kw OR teens:ti,ab,kw OR teenager*:ti,ab,kw OR youth*:ti,ab,kw OR pediatr*:ti,ab,kw OR paediatr*:ti,ab,kw OR puber*:ti,ab,kw) NOT ('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR adult*:ti,ab,kw OR man:ti,ab,kw OR men:ti,ab,kw OR woman:ti,ab,kw OR women:ti,ab,kw))	2184
#5	#4 AND [2012-2024]/py	1627
#6	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab	999373

	OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	
#7	'clinical trial'/exp OR 'randomization'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR 'placebo'/exp OR 'prospective study'/exp OR rct:ab,ti OR random*:ab,ti OR 'single blind':ab,ti OR 'randomised controlled trial':ab,ti OR 'randomized controlled trial'/exp OR placebo*:ab,ti	3963906
#8	#5 AND #6 - SR	103
#9	#5 AND #7 NOT #8 - RCT	495
#10	#8 OR #9	598
#11	23249991:ui OR 30032874:ui OR 25656255:ui - sleutelartikelen	3
#12	#10 AND #11 – sleutelartikelen worden gevonden	3

Ovid/Medline

#	Searches	Results
1	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or ((central* or peripheral*) adj3 (venous or vein or intravenous or vascular) adj3 (catheter* or access or line* or device* or cannulation)).ti,ab,kf. or cvc.ti,ab,kf. or cvcs.ti,ab,kf. or pivc.ti,ab,kf. or pivcs.ti,ab,kf. or (central adj3 (cath* or line*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter* or line or infusion or access or cannulation)).ti,ab,kf. or picc*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or portacath.ti,ab,kf. or (('venous access' or 'central venous' or cv or implant* or catheter*) adj2 port*).ti,ab,kf. or (implant* adj2 venous adj2 (device* or port*)).ti,ab,kf. or tivad*.ti,ab,kf. or tivap*.ti,ab,kf. or hickman*.ti,ab,kf. or ((tunnel* or cuffed) adj3 (catheter* or 'central catheter*' or line* or cvad*)).ti,ab,kf.	56560
2	(((ultrasound or ultrasonograph* or ultrasonic or echo* or sonograph*) adj3 (guidance or guided)) or 'point of care ultrasound*' or pocus).ti,ab,kf.	55540
3	Ultrasonography/ and (exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or exp Catheterization, Peripheral/)	1249
4	((1 and 2) or 3) not (comment/ or editorial/ or letter/) not ((exp animals/ or exp models, animal/) not humans/) not ((Adolescent/ or Child/ or Infant/ or adolescen*.ti,ab,kf. or child*.ti,ab,kf. or schoolchild*.ti,ab,kf. or infant*.ti,ab,kf. or girl*.ti,ab,kf. or boy*.ti,ab,kf. or teen.ti,ab,kf. or teens.ti,ab,kf. or teenager*.ti,ab,kf. or youth*.ti,ab,kf. or pediatr*.ti,ab,kf. or paediatr*.ti,ab,kf. or puber*.ti,ab,kf.) not (Adult/ or adult*.ti,ab,kf. or man.ti,ab,kf. or men.ti,ab,kf. or woman.ti,ab,kf. or women.ti,ab,kf.))	2476
5	limit 4 to yr="2012 -Current"	1651
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or	725135

	cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	
7	exp clinical trial/ or randomized controlled trial/ or exp clinical trials as topic/ or randomized controlled trials as topic/ or Random Allocation/ or Double-Blind Method/ or Single-Blind Method/ or (clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or multicenter study or clinical trial).pt. or random*.ti,ab. or (clinic* adj trial*).tw. or ((singl* or doubl* or treb* or tripl*) adj (blind$3 or mask$3)).tw. or Placebos/ or placebo*.tw.	2688744
8	5 and 6 - SR	88
9	(5 and 7) not 8 - RCT	340
10	8 or 9	428
11	("23249991" or "30032874" or "25656255").ui. - sleutelartikelen	3
12	10 and 11 – sleutelartikelen worden gevonden	3

Module 3: Controle tiplocatie

Evidence tabel

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Follow-up	Outcome measures and effect size	Comments
Yu, 2020 Study characteristics and results are extracted from the SR (unless stated otherwise)	SR and meta-analysis of RCTs *Literature search up to July 2019* **A**: Baldinelli, 2015 **B**: Barnwall, 2016 **C**: Cales, 2016 **D**: Elli, 2016 **E**: Gebhard, 2007 **F**: Lee, 2009 **G**: Yuan, 2017 **H**: Liu, 2015 **I**: Zheng, 2015 <u>Study design</u>: RCT <u>Setting and Country</u>: Single center, China <u>Source of funding and conflicts of interest:</u> This study was supported by a research grant from the Army Medical University. The authors declare no conflicts of interest.	Inclusion criteria SR: RCTs that investigated the use of ECGs to localize the peripherally inserted central catheter tip position. Eligible studies compared patients in whom the ECG localization technique was used with subsequent chest X-ray to confirm the tip position. Studies were considered eligible for inclusion regardless of publication status, language or size. Exclusion criteria SR: (a) were not RCTs, (b) did not compare ECG guidance technology and landmark	Electrocardiogram (ECG) localization technique followed by chest X-ray **A**: ECG **B**: ECG **C**: ECG **D**: ECG **E**: ECG **F**: ECG **G**: ECG **H**: ECG **I**: ECG	Landmark-based insertion followed by chest X-ray **A**: landmark **B**: landmark **C**: landmark **D**: landmark **E**: landmark **F**: landmark **G**: landmark **H**: landmark **I**: landmark	<u>End-point of follow-up</u>: Not specified <u>For how many participants were no complete outcome data available?</u> Not specified	<u>Correct placement</u> *RR [95% CI] of accurate placement* **A**: 1.24 [1.03, 1.49] **B**: 1.74 [1.28, 2.38] **C**: 1.13 [0.84, 1.52] **D**: 1.26 [1.06, 1.51] **E**: 1.27 [1.15, 1.40] **F**: 1.00 [0.95, 1.05] **G**: 1.18 [1.06, 1.51] **H**: 1.13 [1.04, 1.23] **I**: 0.99 [0.97, 1.01] Pooled effect (random effects model): 1.17 [1.04, 1.32] favoring ECG. Heterogeneity (I^2): 94% ECG N=1614 Landmark N=1580 <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Complications (not specified in review)</u> *RR [95% CI] of complications*	<u>Risk of bias (high, some concerns or low):</u> PEDro scale study quality (0-10) **A**: 8 **B**: 8 **C**: 7 **D**: 6 **E**: 7 **F**: 7 **G**: 8 **H**: 7 **I**: 6 The overall quality of all studies was fair to good, but the therapists and participants were not blinded in the design of all articles. <u>Author's conclusions:</u> The existing research shows that the application of atrial ECG in PICC tip positioning can improve the accuracy of catheter tip positioning, reduce the incidence of related complications and provide a scientific basis for further promotion of the atrial ECG positioning method.

		positioning, (c) were in a language for which a translation to English was not available or (d) were unpublished studies with only the abstracts presented at national and international meetings. *9 studies included* <u>Important patient characteristics at baseline</u>: *Number of patients; characteristics important to the research question and/or for statistical adjustment (confounding in cohort studies); for example, age, sex, bmi, ...* <u>N (ECG/landmark)</u> **A**: 42/48 **B**: 30/30 **C**: 102/85 **D**: 75/44 **E**: 147/143 **F**: 121/128 **G**: 499/504 **H**: 85/85 **I**: 513/515				**A**: 0.16 [0.01, 3.06] **B**: 0.04 [0.00, 0.60] **C**: 0.52 [0.29, 0.93] **D**: not reported **E**: 0.14 [0.06, 0.34] **F**: No events **G**: 0.48 [0.35, 0.65] **H**: 0.05 [0.00, 0.80] **I**: not reported Pooled effect (random effects model): 0.28 [0.14, 0.55] favoring ECG. Heterogeneity (I^2): 64% ECG N=1026 Landmark N=1023 <u>Catheter-related interventions</u> Not reported <u>Costs</u> Not reported <u>Resource availability</u> Not reported	

Study reference	Study characteristics	Patient characteristics [2]	Intervention (I)	Comparison / control (C) [3]	Follow-up	Outcome measures and effect size	
Gullo, 2021	Type of study: RCT Setting and country: Single center, Switzerland Funding and conflicts of interest: Funding not stated in publication. On clinicaltrials.gov Qanadli is stated as the study sponsor. S. D. Qanadli is a consultant for C.R. Bard, Inc. The remaining authors declare that they have no disclosures relevant to the subject matter of this article.	<u>Inclusion criteria</u>: All consecutive patients who were more than 18 years old and had been referred to the radiology department for PICC insertion were considered for study enrollment <u>Exclusion criteria</u>: Candidates were excluded if they weighed more	Electromagnetic guidance combined with intracavitary ECG tracing (ECG-EM) Combined ECG-EM guidance was performed using an ultrasound system (Site-Rite 8) with an integrated system for guidance and PICC tip confirmation (Sherlock-3CG Diamond-Tip Confirmation System, BD and Company). Inall patients, we used a 4-French single-lumen or 5-French dual-lumen catheter	Fluoroscopic guidance (FX) FX guidance was performed using a multipurpose x-ray system (Artis Zee, Siemens Healthcare). The FX-guided PICC placement procedure is based on the technique described by Glauser et al. At the end of the procedure, the final tip position was documented by immediate posteroanterior chest radiography, which was performed with the patient in a supine position during deep inspiration.	<u>Length of follow-up</u>: End of the PICC placement procedure <u>Loss-to-follow-up</u>: N/A <u>Incomplete outcome data</u>: N/A	<u>Correct placement</u> T1 corresponds to a final tip position of less than or equal to 1 cm from the CAJ and is defined as optimal placement; T2, more than 1 cm to less than or equal to 3 cm above or below the CAJ (suboptimal placement); and T3, more than 3 cm under the CAJ or not in the SVC (inadequate placement requiring repositioning). *T3, inadequate placement requiring repositioning* I: 13/60 (21.7%) C: 0/58 (0%)	<u>Authors' conclusions</u> our results showed optimal tip position in 71.9% of FX-guided procedures versus 40.4% of ECG-EM–guided procedures. With our stringent criteria for classifying tip position, 22.8% of the ECG-EM–guided procedures needed further correction, whereas 0% of the FX-guided procedures required reintervention in the FX group. Furthermore, all PICCs requiring additional actions were inserted from the left side. Thus, ECG-EM guidance could not replace FX guidance in unselected patients.

		than 150 kg (table load limit) or had cardiac arrhythmia affecting the P wave <u>N total at baseline</u>: Intervention: 60 Control: 60 <u>Important prognostic factors</u>[2]: *Age, mean ± SD:* *I: 59.8 ± 15.8* *C: 60.6 ± 18.3* *Sex:* *I: 51.7% M* *C: 37.9% M* *BMI, mean ± SD:* *I: 26.0 ± 6.5* *C: 25.4 ± 5.7* Left arm access I: 73.3% C: 63.8%	(PowerPICC2 Solo, C.R. Bard). The Y-shaped magnetic sensor and external ECG electrodes were placed on the patient to ensure distinct P-wave presence. The procedure was similar to the FX-guided procedure except for PICC length estimation and navigation to CAJ. the PICC was cut, prepared so that the magnetic tip stylet inserted therein was close to its tip, and advanced into central circulation through a “peel-away” sheath using EM guidance of the integrated system, until reaching the superior vena cava (SVC). The stylet generates a field detected by the Y sensor so that the PICC can be			*T2, suboptimal positioning* I: 21/60 (36.8%) C: 16/58 (28.1%) *T1, optimal positioning* I: 23/60 (40.4%) C: 41/58 (71.9%) <u>Complications</u> Not reported <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Catheter-related interventions</u> Not reported <u>Costs</u> Not reported <u>Resource availability</u> Not reported	However, ECG-EM guidance could be considered as an acceptable technique to replace FX guidance among patients in whom the PICC is inserted from the right side.

		Basilic vein access I: 66.7% C: 81.0% Groups were comparable at baseline	followed in real time on a display. Finally, the ECG was used to drive the catheter into the target position— that is, until the intracavitary P wave increased and reached its maximum height in the absence of negative deflection.				
Mack, 2020	Type of study: RCT Setting and country: Single center, Germany Funding and conflicts of interest: The study was funded with an educational grant from C. R. Bard GmbH, Karlsruhe, Germany (later joined Becton, Dickinson and Company, Franklin Lakes, NJ, USA). The company did neither have any influence on design and conduct of the study nor on collection and reporting of data. All authors declare that they have no conflict of interest with respect to this article.	<u>Inclusion criteria</u>: Patients were eligible for inclusion if they were at least 18 years of age and had a medical indication for PICC insertion. <u>Exclusion criteria</u>: Exclusion criteria were systemic infection, infection including puncture site, and known	Magnetic Tracking and Electrocardiography-Guided Tip Confirmation System (at bedside) Sherlock 3CG® TCS (including single-use PowerPICC SOLO catheter with Sherlock 3CG tip positioning system stylet, Becton, Dickinson and Company, Franklin Lakes, NJ, USA) was used for magnetic tracking of the PICC tip and real-time ECG confirmation of	Fluoroscopy (in the radiology department) Length of the guidewire was measured to determine the required PICC length. Subsequently, an introducer sheath was inserted over the wire, the guidewire was removed, and the PICC catheter inserted through the introducer sheath and then advanced under fluoroscopic control to the predetermined length. The same PICC kit type in different	<u>Length of follow-up</u>: 2 weeks <u>Loss-to-follow-up</u>: Access not possible I: 3 C: 1 No 2-week clinical investigation: I: 3 C: 1 <u>Incomplete outcome data</u>: N/A	<u>Correct placement</u> Correct PICC tip position was defined as within the mid to lower superior vena cava, at the level of the cavoatrial junction, or within the upper portion of the right atrium, corresponding to 1.5 vertebral body units (approximal 3 cm) from the tracheal carina on chest X-ray obtained immediately after insertion. I: 84/102 (82.4%) C: 103/104 (99.0%) <u>Complications</u> Bleeding event (minor access site bleedings)	<u>Authors' conclusions</u> TCS for PICC insertion was associated with less tip position accuracy than fluoroscopy. However, it was associated with reasonable success and a similar complication rate. For this reason, we conclude that TCS would be most useful in patients where fluoroscopy cannot be used, bedside placement is necessary, or resources are limited.

		allergy to materials used. Additionally, cardiac arrhythmia including atrial fibrillation, severe tachycardia, or paced rhythm was exclusion criterion because it could interfere with interpretation of the P-wave morphology when using the TCS system. <u>N total at baseline</u>: Intervention: 105 Control: 105 <u>Important prognostic factors</u>[2]: *Age, mean ± SD:*	the tip position during insertion.	sizes was used in all patients. Finally, in both groups, the PICC was attached on the arm with a seamless stabilization device (StatLockTM, Bard Access Systems, Becton, Dickinson and Company, Franklin Lakes, NJ, USA). Placement of the catheter was confirmed by obtaining chest X-ray.		I: 8/99 (8.1%) C: 13/103 (12.6%) Pain (mild to moderate) I: 8/99 (8.1%) C: 12/103 (11.7%) Allergic reaction (due to antimicrobial film dressing) I: 0/99 (0%) C: 3/103 (2.9%) Local wound infection I: 2/99 (2.0%) C: 2/103 (1.9%) Thrombosis I: 0/99 (0%) C: 0/103 (0%) Nerve damage I: 0/99 (0%) C: 0/103 (0%) Catheter malfunction I: 0/99 (0%) C: 0/103 (0%) <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported	

		I: 60.6 ± 13.8 *C: 64.1 ± 13.0* *Sex:* *I: 67.6% M* *C: 60.0% M* *BMI, mean ± SD:* *I: 26.0 ± 6.5* *C: 25.4 ± 5.7* Groups were comparable at baseline.				<u>Catheter-related interventions</u> Not reported <u>Costs</u> Not reported <u>Resource availability</u> Not reported	
Alexandrou, 2022 ACTRN 12620000919910	Type of study: RCT Setting and country: Single center, tertiary referral hospital, Australia Funding and conflicts of interest: Unrestricted investigator-initiated research grants form Cook Medical Australia, Flo Medical Australia and CR Bard. All funds were paid to Western Sydney University and not to individual researchers. The authors declared no conflict of interest.	<u>Inclusion criteria</u>: Age at least 18 years; native P wave on 12 lead ECG, ability to provide written informed consent in English. <u>Exclusion criteria</u>: Pacemaker dependency; <18 years old, no informed consent at	Intracavitary electrocardiography guided CVAD placement with CXR confirmation Portable, wireless IC-ECG navigation system (Nautilus Delta Tip Confirmation System – BARD access systems, Salt lake City, USA) When maximum P-wave amplitude was achieved, the tip was considered in position.	Landmark based CVAD placement with CXR confirmation. In both groups, CXR was taken immediately after catheter insertion to compare tip position.	<u>Length of follow-up</u>: Not specified <u>Loss-to-follow-up</u>: None <u>Incomplete outcome data</u>: None	<u>Catheters not requiring repositioning</u> *as interpreted on CXR: lower third of the SVC (within 3 cm above of tracheal carina), the CAJ (up to 3 cm below tracheal carina) or upper RA (3-5 cm below tracheal carina).* I: 162/172 (94%) C: 131/172 (76%) <u>Complications</u> CLABSI per 1000 catheter days I: 0/172 (0%) C: 1/172 (0.2%)	<u>Authors' conclusions</u> Intracavitary ECG is more accurate and efficient than traditional placement of CVADs and can be used across diverse patient cohorts requiring a wide range of devices.

		time of catheter insertion. <u>N total at baseline</u>: Intervention: 172 Control: 172 <u>Important prognostic factors</u>[2]: *Age, median (IQR):* *I: 58 (49-68)* *C: 60 (51-69)* *Sex:* *I: 56% M* *C: 60% M* *BMI, median (IQR):* *I: 28 (24-34)* *C: 28 (24-34)* Catheter type CVC double lumen I: 0% C: 1% CVC triple lumen				Catheter removal for suspected infection I: 7/172 (4.1%) C: 3/172 (1.7%) Catheter removal for symptomatic thrombosis I: 2/172 (1.2%) C: 1/172 (0.6%) Catheter removal for dislodgement I: 13/12 (7.6%) C: 5/172 (2.9%) <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Catheter-related interventions</u> Not reported <u>Costs</u> Total, in Australian dollars I: 36,546 C: 47,206 Average per patient I: 212 C: 265	

		I: 4% C: 3% Dialysis catheter I: 5% C: 5% PICC single lumen I: 59% C: 73% PICC double lumen I: 32% C: 18% Groups were comparable at baseline.				<u>Resource availability</u> Not reported	
Jayaraman, 2019	Type of study: RCT Setting and country: Single center, India Funding and conflicts of interest: No financial support and sponsorship. There are no conflicts of interest.	<u>Inclusion criteria</u>: patients aged between 18 to 65 years requiring central venous catheterization. <u>Exclusion criteria</u>:	Intra-atrial Electrocardiography (ECG) guided technique: the catheter was slowly advanced until the RA-ECG indicated a CVC position in the SVC/RA junction (peaked, tall P-wave) or in the RA (biphasic P-wave).[7] Thereafter, the CVC	Landmark technique the vertical distance between the right clavicular notch and the carina was measured on the routine preprocedure CXR, using an internal measuring tool available on the hospital's picture archiving communication system. The vertical	<u>Length of follow-up</u>: Catheter placement procedure <u>Loss-to-follow-up</u>: None <u>Incomplete outcome data</u>: None	<u>Proper positioning</u> CVC tip was properly positioned within 1 cm above and below the carina ECG: 58/60 (96.7%) Landmark: 56/60 (93.3%) Formula: 35/60 (58.3%) <u>Complications</u> Not reported	<u>Authors' conclusions</u> We conclude that both landmark guidance and ECG guidance are comparable with regard to accurate central venous catheter tip positioning when CVCs are placed through right internal jugular vein whereas formula based technique is least

		Patients with atrial fibrillation. Multifocal ventricular premature complexes, left bundle branch block, patient with cardiac pacemaker and altered coagulation profile. <u>N total at baseline</u>: Intervention: 60 Control: 60 <u>Important prognostic factors</u>[2]: *Age, mean ± SD:* *ECG: 40.8±16.22* *Landmark: 39.23±14.69* *Formula: 44.9±17.2*	was withdrawn at 0.5 cm intervals until the P-wave returned to a normal configuration. At that point, the CVC was secured at the skin with suture and dressed with a transparent dressing and the depth of insertion noted. If an intra atrial ECG could not be obtained, the CVC was fixed to a depth of 15 cms.	distance between the insertion point of the puncture needle and the right clavicular notch was measured using a sterile disposable ruler. The final depth of CVC insertion was determined by adding the two measurements. Peres' formula method: In the Formula group, heights of all the patients were measured prior to the procedure and the catheter was inserted and final insertion depth was kept as per the Peres' formula of "height (in cm)/10".		<u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Catheter-related interventions</u> Not reported <u>Costs</u> Total, in Australian dollars Not reported <u>Resource availability</u> Not reported	accurate and results in overinsertion of CVCs.

		Sex (male/female): *ECG: 43/17* *Landmark: 48/12* *Formula: 41/19* BMI: *ECG: 25.39±4.56* *Landmark: 25.18±3.99* *Formula: 25.88±3.75* Groups were comparable at baseline.					
Yin, 2019 Yin, 2020 ChiCTR 1900022763	Type of study: RCT Setting and country: Multicenter, China Funding and conflicts of interest: This work was supported by the Innovation and Achievement Transformation Fund of Shandong Province (No. 2013ZHZX2A0401). Hai-Jun Zhang holds intellectual property rights on	<u>Inclusion criteria</u>: (a) clinical indication to PICC insertion, (b) age between 18 and 80 years, and (c) normal P-wave appearance on the surface ECG recordings.	Intracavitary electrocardiogram (IC-ECG) guidance Tip-conductive PICC was advanced gently until 5 cm was remaining, after which IC-ECG was performed according to the standard technique. As the catheter was slowly advanced into the SVC, the P-	Traditional anatomical landmarks method was used to estimate the catheter length.	<u>Length of follow-up</u>: 6 months <u>Loss-to-follow-up</u>: Intervention: 6 patients (0.4%) with no P-wave changes were excluded Control: 0 <u>Incomplete outcome data</u>: None	<u>Unsatisfactory location by X-ray</u> The position of the tip close to the CAJ (approximately 3 cm below the tracheal carina) was considered optimal I: 11/1500 (0.7%) C: 99/750 (13.2%) <u>Complications</u> *At 1 week* Exit site infection I: 3/750 (0.2%)	<u>Authors' conclusions</u> our study demonstrated that the intra-procedural tip location by IC-ECG is safer and more accurate than the traditional method of verifying tip location only post-procedurally, by chest X-ray. It can achieve a rapid and accurate tip location during PICC placement, reduce the need of

	the technology licensed to Branded Tech Inc., who manufactured the PICCs described in the paper. Zhang guarantees the impartiality during implementation. Other authors have no conflict of interest.	<u>Exclusion criteria</u>: pregnancy, previous history of central line insertion, cardiovascular conditions such as valve heart disease, atrial fibrillation, supraventricular tachycardia, pulmonary heart disease, pacemaker implantation, and history of cardiac surgery, which may affect P-waves. <u>N total at baseline</u>: Intervention: 1500 Control: 750 <u>Important prognostic factors</u>[2]:	wave gradually increased, reaching a maximal peak at the CAJ. As the catheter entered the RA, a diphasic P-wave appeared and the catheter was retracted slowly to return to the position of maximal peak P-wave, with no negative components.			C: 4/1494 (0.5%) RR 2.68 (0.60–11.99) Phlebitis I: 0% C: 0% DVT I: 0% C: 0% Catheter malposition I: 2 (0.1%) C: 1 (0.1%) RR 1.00 (0.09–11.05) *At 6 months* Exit site infection I: 40 (2.7%) C: 30 (4.0%) RR 1.52 (0.94–2.46) Phlebitis I: 16 (1.1%) C: 10 (1.3%) RR 1.25 (0.57–2.78) DVT I: 18 (1.2%) C: 11 (1.5%) RR 1.23 (0.58–2.61) Catheter malposition I: 15 (1.0%) C: 12 (1.6%) RR 1.61 (0.75–3.46)	reposition, the whole time of procedure and X-ray exposures, especially decrease the PICC-related complications.

		Age, mean ± SD: *I: 55.1 ± 10.9* *C: 58.1 ± 10.5* *Sex:* *I: 57.9% F* *C: 57.2%* *Puncture site* *Upper left arm* *I: 47.5%* *C: 44.8%* *Upper right arm* *I: 39.4%* *C: 41.3%* *Basilic vein:* *I: 87.8%* *C: 86.1%* Groups were comparable at baseline.				Catheter breakage I: 3 (0.2%) C: 2 (0.3%) Extravasation I: 36 (2.4%) C: 22 (2.9%) Total complications I: 96/1494 (6.4%) C: 71/750 (9.5%) <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Catheter-related interventions</u> Not reported <u>Costs</u> Total, in Australian dollars Not reported <u>Resource availability</u> Not reported	
Glauser, 2016	Type of study: RCT Setting and country: Single center, Switzerland	<u>Inclusion criteria</u>: all consecutive patients >18	Fluoroscopy guided insertion. The final CTP was documented with an	Bedside insertion with postprocedural X-ray. Once the insertion site was identified, we	<u>Length of follow-up</u>: Insertion and following X-ray. <u>Loss-to-follow-up</u>:	<u>Reintervention</u> *- Type 1: optimal tip position located either more than or*	<u>Authors' conclusions:</u> <u>This study clearly demonstrates that techniques used for placement are not equal</u>

	Funding and conflicts of interest: The scientific guarantor of this publication is Salah Dine Qanadli. The authors of this manuscript declare relationships with the following companies: Salah Dine Qanadli was a consultant for C. R Bard Inc. during the last 3 years. The authors state that this work has not received any funding. No complex statistical methods were necessary for this paper.	years referred to the interventional radiology department for PICC insertion. <u>Exclusion criteria</u>: Patients were excluded if they were unable or refused to consent to participate. <u>N total at baseline</u>: Intervention: 90 Control: 90 <u>Important prognostic factors</u>: *Age, mean ± SD:* *I: 61.8 ± 1.8* *C: 60.7 ± 1.9* *Sex:* *I: 51% M* *C: 49% M*	immediate chest fluoroscopy (posteroanterior projection) with the patient's arm in adduction and the patient in deep inspiration. All PICCs were done in the Interventional Radiology Unit using a low-dose X-ray system and US guidance with a 5 to 10-MHz linear-array transducer. All procedures were performed by an interventional radiology team experienced in PICC placement (10 years' experience, with >800 procedures per year). Operators (SB, FG) were instructed to use a standardized procedure. All operators received specific BST training prior to the study. The PowerPICC2® Solo (4-F single	estimated catheter length using two cutaneous anatomic landmarks: the right clavicular head and the third intercostal space. The distance was measured between planned insertion sites to the right clavicular head, then down to the third intercostal space, with the shoulder abducted to 90°, as previously described. Once the insertion site was identified, we estimated catheter length using two cutaneous anatomic landmarks: the right clavicular head and the third intercostal space. The distance was measured between planned insertion sites to the right clavicular head, then down to the third intercostal space, with the shoulder abducted	none	*less than 1 cm from the CAJ* *– Type 2: suboptimal tip location not requiring repositioning, with tip located >1 cm under the CAJ or >1 cm above the CAJ but remaining in the SVC* *– Type 3: nonoptimal tip location requiring repositioning, with tip located >3 cm under the CAJ or not inside the SVC* *Type 3:* I: 1/89 (1%) C: 27/90 (30%) <u>Complications</u> I: 8/89 (9%) C: 6/90 (6.7%) <u>Cost-effectiveness</u> Not reported	<u>for attaining optimal CTP. Considering the importance of the CTP, the FGT should be considered at least for patients at high risk of complications. Further evaluations are needed to better select patients for the optimal placement technique, and technologica advances will aid in greater CTP accuracy when using the the BST.</u>

		Groups were comparable at baseline.	lumen or 5-F dual lumen) device was used for all participants.	to 90°, as previously described.			

Risk of bias table

Study reference (first author, publication year)	**Was the allocation sequence adequately generated?** Definitely yes Probably yes Probably no Definitely no	**Was the allocation adequately concealed?** Definitely yes Probably yes Probably no Definitely no	**Blinding: Was knowledge of the allocated interventions adequately prevented?** **Were patients blinded?** **Were healthcare providers blinded?** **Were data collectors blinded?** **Were outcome assessors blinded?** **Were data analysts blinded?** Definitely yes Probably yes Probably no Definitely no	**Was loss to follow-up (missing outcome data) infrequent?** Definitely yes Probably yes Probably no Definitely no	**Are reports of the study free of selective outcome reporting?** Definitely yes Probably yes Probably no Definitely no	**Was the study apparently free of other problems that could put it at a risk of bias?** Definitely yes Probably yes Probably no Definitely no	**Overall risk of bias If applicable/necessary, per outcome measure** **LOW** **Some concerns** **HIGH**

Gullo, 2021	Probably yes; Reason: Randomization was performed with 1:1 allocation using sequentially numbered opaque sealed envelopes	Definitely yes; Reason: opaque sealed envelopes	Definitely yes; Reason: final chest radiographs were anonymized, and tip positions were assessed in terms of navigation and localization success independently by radiologists and radiologic technicians, all of whom are members of the PICC team and were blinded to guiding technique. Blinding of patients was not reported.	Probably yes; Reason: Loss to follow-up was infrequent in intervention and control group. Adequate imputation methods (multiple imputation) were used.	Definitely yes; Reason: All relevant outcomes were reported	Probably yes; Reason: Some concerns about the role of the study sponsor. However, the results do not seem to be in favor of the sponsor.	**LOW**

Mack, 2020	Definitely yes; Reason: Eligible patients were allocated 1:1 to either TCS or fluoroscopy by means of computer-generated randomization.	No information	**Definitely no** Reason: Open-label trial	Definitely yes Reason: Loss to follow-up was infrequent in intervention and control group.	Probably yes Reason: All relevant outcomes were reported.	Probably yes; Reason: No other problems noted.	**LOW** The reported outcomes are likely not affected by lack of blinding

Alexandrou, 2022	Definitely yes; Reason: random allocations were computer generated in a 1:1 ratio using R	Definitely yes; Reason: random allocations were concealed to investigators and patients until enrolment.	**Definitely no** Reason: Pragmatic, open-label trial	Definitely yes; Reason: there was no loss to follow up.	Probably yes Reason: All relevant outcomes were reported.	Probably yes; Reason: No other problems noted.	**LOW** The reported outcomes are likely not affected by lack of blinding

Jayaraman, 2019	No information	No information	Definitely yes; Reason: CXRs were read by one attending radiologist, who was aware of the study protocol but blinded to the group assignment.	Definitely yes; Reason: there was no loss to follow up.	Probably yes Reason: All relevant outcomes were reported.	Probably yes; Reason: No other problems noted.	**SOME CONCERNS due to lack of information about randomization and allocation concealment**

Yin, 2019 Yin, 2020	Definitely yes; Reason: Patients were randomly assigned to either the study group or to the control group in a 2:1 allocation. A site-stratified block randomization with randomly varying block sizes of 4 and 6 was performed.	Definitely yes; Reason: Random assignment was performed by a statistician from Fudan University, and random envelopes were assigned to each site. Sequences were concealed from patients and clinical staff until assignment.	Definitely no; Reason: Open label study.	Definitely yes; Reason: there was no loss to follow up.	Probably yes Reason: All relevant outcomes were reported.	Probably yes; Reason: No other problems noted.	**LOW** The reported outcomes are likely not affected by lack of blinding

Glauser, 2016	Definitely yes; Patients were randomly assigned in a 1:1 manner to the BST or the FGT using sequentially numbered, opaque, sealed envelopes.	Definitely yes; Patients were randomly assigned in a 1:1 manner to the BST or the FGT using sequentially numbered, opaque, sealed envelopes.	Definitely yes; Chest X-rays were interpreted by senior interventional radiologists (SC, SDQ) blinded to the technique used for catheter insertion.	Definitely yes; Reason: there was no loss to follow up.	Probably yes; Reason: All relevant outcomes were reported.	Probably no; Reason: The criteria for repositioning used in the study did not exactly match the criteria as proposed by the guideline development group.	**SOME CONCERNS for the outcome repositioning**

Exclusie tabel

Reference	Reason for exclusion
Ling G, Zhiwen W, Guorong W, Shaomei S, Xue W. Guide wire electrode versus liquid electrode for intravascular electrocardiography-guided central venous catheterization in adults: A systematic review and meta-analysis. J Vasc Access. 2020 Sep;21(5):564-572. doi: 10.1177/1129729819868044. Epub 2019 Aug 17. PMID: 31422729.	wrong comparison
Liu G, Hou W, Zhou C, Yin Y, Lu S, Duan C, Li M, Toft ES, Zhang H. Meta-analysis of intracavitary electrocardiogram guidance for peripherally inserted central catheter placement. J Vasc Access. 2019 Nov;20(6):577-582. doi: 10.1177/1129729819826028. Epub 2019 Mar 6. PMID: 30838913.	more recent meta-analysis used
Practice Guidelines for Central Venous Access 2020: An Updated Report by the American Society of Anesthesiologists Task Force on Central Venous Access. Anesthesiology. 2020 Jan;132(1):8-43. doi: 10.1097/ALN.0000000000002864. PMID: 31821240.	wrong study design
Chu KS, Hsu JH, Wang SS, Tang CS, Cheng KI, Wang CK, Wu JR. Accurate central venous port-A catheter placement: intravenous electrocardiography and surface landmark techniques compared by using transesophageal echocardiography. Anesth Analg. 2004 Apr;98(4):910-914. doi: 10.1213/01.ANE.0000105865.94157.4C. PMID: 15041571.	wrong comparison
Dong H, Zhu Y, Zhang X, Yin X, Liu F. Chest CT tomography vs. intracavitary electrocardiogram guidance in predicting the length of PICC placement. BMC Surg. 2022 May 19;22(1):197. doi: 10.1186/s12893-022-01604-0. PMID: 35590297; PMCID: PMC9118803.	wrong comparison
Xu YF, Xu XF, Song K, Qiu C, Zhang XL, Mam DL, Huang S. Study on the Safety and Accuracy of Intracavitary Electrocardiography and Ultrasound in the Peripherally Inserted Central Venous Catheter tip positioning of Breast Cancer Patients. INDIAN JOURNAL OF PHARMACEUTICAL SCIENCES. 2021 Jan 1;83:6-11.	wrong comparison

Li A, Jiao J, Zhang Y, Tian L, Miao J, Hao X, Sun Z, Sun Q. A randomized controlled study of bedside electrocardiograph-guided tip location technique & the traditional chest radiography tip location technique for peripherally inserted central venous catheter in cancer patients. Indian J Med Res. 2018 May;147(5):477-483. doi: 10.4103/ijmr.IJMR_1120_16. PMID: 30082572; PMCID: PMC6094514.	Control group not sufficiently defined
Yuan L, Li R, Meng A, Feng Y, Wu X, Yang Y, Chen P, Qiu Z, Qi J, Chen C, Wei J, Qin M, Kong W, Chen X, Xu W. Superior success rate of intracavitary electrocardiogram guidance for peripherally inserted central catheter placement in patients with cancer: A randomized open-label controlled multicenter study. PLoS One. 2017 Mar 9;12(3):e0171630. doi: 10.1371/journal.pone.0171630. PMID: 28278167; PMCID: PMC5344315.	Data extracted from meta-analysis
Cales YK, Rheingans J, Steves J, Moretti M, PICC Team. Electrocardiogram-guided peripherally inserted central catheter tip confirmation using a standard electrocardiogram machine and a wide-mouth electrocardiogram clip compared with traditional chest radiograph. Journal of the Association for Vascular Access. 2016 Mar 1;21(1):44-54.	Data extracted from meta-analysis
Sharma D, Singh VP, Malhotra MK, Gupta K. Optimum depth of central venous catheter - Comparision by pere's, landmark and endocavitory (atrial) ECG technique: A prospective study. Anesth Essays Res. 2013 May-Aug;7(2):216-20. doi: 10.4103/0259-1162.118966. PMID: 25885836; PMCID: PMC4173511.	wrong study design
Lee JH, Bahk JH, Ryu HG, Jung CW, Jeon Y. Comparison of the bedside central venous catheter placement techniques: landmark vs electrocardiogram guidance. Br J Anaesth. 2009 May;102(5):662-6. doi: 10.1093/bja/aep046. Epub 2009 Mar 26. PMID: 19329467.	Data extracted from meta-analysis
Gebhard RE, Szmuk P, Pivalizza EG, Melnikov V, Vogt C, Warters RD. The accuracy of electrocardiogram-controlled central line placement. Anesth Analg. 2007 Jan;104(1):65-70. doi: 10.1213/01.ane.0000250224.02440.fe. PMID: 17179244.	Data extracted from meta-analysis

Zoekverantwoording

Algemene informatie

Richtlijn: NVvH Centraal veneuze toegang	
Uitgangsvraag: Wat zijn de (on)gunstige effecten van het controleren/bevestigen van de tip door middel van een elektrocardiogram (ECG) in vergelijking met doorlichting/een fluoroscopie bij patiënten die een centraal veneuze lijn krijgen?	
Database(s): Ovid/Medline, Embase	Datum:25-7-2023
Periode: nvt	Talen: nvt
Literatuurspecialist: Ingeborg van Dusseldorp	
BMI zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Voor deze vraag is gezocht met de volgende concepten: veneuze toegang EN electrocardiografie Omdat doorlichting/fluoroscopie de standaard is, wordt in overleg met de adviseur de PICO aangepast en wordt gezocht naar electrocardiografie als interventie.	

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SRs	67	10	66
RCTs	164	68	194
Observationele studies	76	72	91
Overig			
Totaal			351

Zoekstrategie

Embase

No.	Query	Results

#21	#12 AND #20 3e sleutelartikel gevonden	1
#20	#17 AND #18 NOT #7 NOT #8 Diagnostische accuratess	76
#19	#17 AND #18	106
#18	tip*:ti,ab,kw OR 'accurate placement':ti,ab,kw	164023
#17	#4 AND #16	1579
#16	'sensitivity and specificity'/de OR sensitivity:ab,ti OR specificity:ab,ti OR predict*:ab,ti OR 'roc curve':ab,ti OR 'receiver operator':ab,ti OR 'receiver operators':ab,ti OR likelihood:ab,ti OR 'diagnostic error'/exp OR 'diagnostic accuracy'/exp OR 'diagnostic test accuracy study'/exp OR 'inter observer':ab,ti OR 'intra observer':ab,ti OR interobserver:ab,ti OR intraobserver:ab,ti OR validity:ab,ti OR kappa:ab,ti OR reliability:ab,ti OR reproducibility:ab,ti OR ((test NEAR/2 're-test'):ab,ti) OR ((test NEAR/2 'retest'):ab,ti) OR 'reproducibility'/exp OR accuracy:ab,ti OR 'differential diagnosis'/exp OR 'validation study'/de OR 'measurement precision'/exp OR 'diagnostic value'/exp OR 'reliability'/exp OR 'predictive value'/exp OR ppv:ti,ab,kw OR npv:ti,ab,kw OR (((false OR true) NEAR/3 (negative OR positive)):ti,ab)	6105405
#15	#12 NOT #14	1
#14	#12 AND #13 1 sleutelartikel gemist	2
#13	#7 OR #8	231
#12	#9 OR #10 OR #11 sleutelartikelen	3
#11	'magnetic tracking and electrocardiography-guided tip confirmation system versus fluoroscopy for placement of peripherally inserted central catheters: a randomized, noninferiority comparison' AND mack	1
#10	'appropriateness of replacing fluoroscopic guidance with ecg-electromagnetic guidance for picc insertion: a randomized controlled trial'	1
#9	'ecg-based techniques to optimize peripherally inserted central catheters: rationale for tip positioning and practical use'	1
#8	#4 AND #6 NOT #7 RCT	164
#7	#4 AND #5 SR	67
#6	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	2079411

#5	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	733409
#4	#3 NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal'/exp OR 'animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	6457
#3	#1 AND #2	10251
#2	'electrocardiography'/exp OR 'electro cardiograph*':ti,ab,kw OR 'electrocardiograph*':ti,ab,kw OR 'electromyocardiograph*':ti,ab,kw OR 'polycardiograph*':ti,ab,kw OR 'electrocardiogram'/exp OR 'ecg':ti,ab,kw OR 'cardiogram':ti,ab,kw OR 'ekg':ti,ab,kw OR 'electrocardiogram':ti,ab,kw	469426
#1	'central venous catheter'/exp OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw) OR 'vascular access'/exp OR 'vascular access device'/exp OR cvc:ti,ab,kw OR ((central NEAR/3 line*):ti,ab,kw) OR 'vascular access':ti,ab,kw OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'implantable port system'/exp OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp OR 'subclavian vein catheter'/exp/mj OR (((intravascular OR intravenous OR venous OR vascular OR cardiovascular) NEAR/3 catheter*):ti,ab,kw) OR ((central NEAR/3 cath*):ti,ab,kw) OR vascath:ti,ab,kw OR 'peripherally-inserted central catheter*':ti,ab,kw OR ((tunnel* NEAR/3 central*):ti,ab,kw) OR hickman*:ti,ab,kw OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw	125759

Ovid/Medline

#	Searches	Results
18	17 not 13	3
17	13 or 16 Diagnostische accuratesse	72
16	4 and 7 and 15	6

15	accurate place*.ti,ab,kf.	1123
14	8 or 9 or 13	147
13	(4 and 12) not 8 not 9	69
12	10 and 11	92
11	tip*.ti,ab,kf.	135731
10	4 and 7	173
9	(4 and 6) not 8 RCT	68
8	4 and 5 SR	10
7	exp "Sensitivity and Specificity"/ or (sensitivity or specificity).ti,ab. or (predict* or ROC-curve or receiver-operator*).ti,ab. or (likelihood or LR*).ti,ab. or exp Diagnostic Errors/ or (inter-observer or intra-observer or interobserver or intraobserver or validity or kappa or reliability).ti,ab. or reproducibility.ti,ab. or (test adj2 (re-test or retest)).ti,ab. or "Reproducibility of Results"/ or accuracy.ti,ab. or Diagnosis, Differential/ or Validation Study/ or ((false or true) adj3 (negative or positive)).ti,ab.	4855739
6	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1632460
5	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	683284
4	3 not ((exp animals/ or exp models, animal/) not humans/) not (letter/ or comment/ or editorial/)	641
3	1 and 2	760
2	exp Electrocardiography/ or electro cardiograph*.ti,ab,kf. or electrocardiograph*.ti,ab,kf. or electromyocardiograph*.ti,ab,kf. or polycardiograph*.ti,ab,kf. or ecg.ti,ab,kf. or cardiogram.ti,ab,kf. or ekg.ti,ab,kf. or electrocardiogram.ti,ab,kf.	275190

1	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or (tivad* or tivap* or hickman* or (tunnel* adj 3 central)).ti,ab,kf. or exp Catheterization, Peripheral/ or picc*.ti,ab,kf. or vascath.ti,ab,kf. or 'Peripherally-Inserted Central Catheter*'.ti,ab,kf.	42947

Module 4: Optimale type lijn

Evidence tabel

Study reference	Study characteristics	Patient characteristics [2]	Intervention (I)	Comparison / control (C) [3]	Follow-up	Outcome measures and effect size [4]	Comments
Andrivet (1994)	Type of study: Randomized controlled trial. Setting and country: Centre Médico-Chirurgical de Bligny (ICU unit). Funding and conflicts of interest: No information.	Inclusion criteria: • Patients referred the de MICU for prolonged central venous catheterization. Exclusion criteria: No information. N total at baseline: Intervention: N = 106 Control: N = 97 Important prognostic factors[2]: *age ± SD:* *I: 55.7 (1.3)* *C: 53.7 (1.4)* *Sex:* *I: 71/106 (66%) M* *C: 67/97 (65%) M*	Describe intervention (treatment/procedure/test): Tunneled catheterization.	Describe control (treatment/procedure/test): Non-tunneled catheterization.	Length of follow-up: No information. Loss-to-follow-up: I: N = 5 C: N = 1	**Catheter-related bacteremia** I: 2/106 (1.9%) C: 5/97 (5.2%) **Non-bacteremic catheter-related infections** I: 3/106 (2.8%) C: 4/97 (4.1%)	Author's conclusion: In conclusion, our findings suggest that routine subcutaneous tunneling of central venous catheters is unnecessary in immunocompromised patients, a finding that allows for easier and quicker insertion of catheters in such patients, who often are disable and algid. Because subcutaneous tunneling in the present study was not associated with an increased rate of complications, we cannot suggest that this insertion technique should be abandoned. Since the completion of this study, we do not perform subcutaneous tunneling in our patients who require prolonged central venous access via the subclavian route. This

		Groups comparable at baseline? Yes.					therapeutic choice may not apply to other sites of venous access such as the internal jugular veins or to other materials such as cuffed or multilumen catheters.
Brandmeir (2020)	Type of study: Prospective, randomized controlled trial. Setting and country: NSICU. Funding and conflicts of interest: Database software was funded by NIH/NCRR Grant Number UL1RR033184, the remainder of the study was departmentally/institutionally funded. The authors declare that they have no conflict of interest to disclose.	Inclusion criteria: • Patients admitted to the NSICU and required central venous access. Exclusion criteria: • Inability to speak English; • Renal failure; • Emergent situation requiring central venous access that would preclude time for informed consent; • Preexisting LVT anywhere in the body; • Existing central venous access; • Preexisting bacteremia. N total at baseline: Intervention: N = 72 Control: N = 80	Describe intervention (treatment/procedure/test): PICC	Describe control (treatment/procedure/test): Centrally inserted central venous catheters (internal jugular placement or subclavian placement).	Length of follow-up: Loss-to-follow-up: None.	**Complications (all combined)** I: 14/72 (19.4%) C: 10/80 (12.5%) **Failure to insert** I: 8/72 (11.1%) C: 5/80 (6.3%) **Tip malposition** I: 0/72 (0%) C: 1/80 (1.3%) **Early removal** I: 2/72 (2.8%) C: 1/80 (1.3%) **Mortality** I: 13/72 (18.1%) C: 9/80 (11.3%)	Author's conclusion: This study provides evidence that PICCs and CVCs have similar risks of complications in the NSICU when compared in a randomized controlled clinical trial.

		Important prognostic factors[2]: *age ± SD:* *I: 59.7 (18.0)* *C: 63.3 (13.6)* *Sex:* *I: 35/72 (48.6%)M* *C: 45/80 (56.3%) M* Groups comparable at baseline? Yes.					
Clatot (2020)	Type of study: Phase II randomised study. Setting and country: Not reported. Funding and conflicts of interest: This work was supported by La Ligue Contre le Cancer de Haute-Normandie and Centre Henri Bec- querel. This funding source had no role in the design of the study, data	Inclusion criteria: • Females aged 18 years and older; • Histologically confirmed EBC treated with curative intent and an indication of anthracycline +taxane-based ACT as per the local guidelines. Exclusion criteria: • Metastatic disease; • Inflammatory breast cancer; • History of bilateral axillary node dissection;	Describe intervention (treatment/procedure /test): PICC	Describe control (treatment/procedure /test): PORT	Length of follow-up: 35 weeks. Loss-to-follow-up: None.	**Complications (all combined)** I: 21/126 (16.6%) C: 10/127 (7.8%) **DVT without local infection or septicaemia** I: 7/126 (5.6%) C: 5/127 (3.9%) **DVT with septicaemia** I: 2/126 (1.6%) C: 2/127 (1.2%) **DVT with local infection only** I: 1/126 (0.8%) C: 0/127 (0%) **Pocket infection/exit-site**	Author's conclusion: In conclusion, this prospective randomized study shows that CR-SAEs in patients with EBC are frequent (12.2%) but rarely impact the ACT process (4/253 ACT interruptions and 3/253 ACT delays > 1 week). PICCs are associated with a significantly higher risk of CR- SAEs than PORTs, which confirms the results from retrospective studies or prospective studies performed in various cancer situations. Moreover, patients reported more discomfort with PICCs than with PORTs. Taken together, these results support the preferential use of PORTs instead of PICCs in the case of EBC ACT.

	acquisition, interpretation, manuscript writing or decision to submit results. The authors have no conflict of interest to declare.	• Bilateral upper thoracic irradiation; • Cutaneous disease such as eczema, scleroderma or infection at the catheter insertion site; • Thrombosis of the upper body in the last 12 months; • Therapeutic anticoagulation therapy; • Tracheotomy; • Current treatment for bacteraemia; • Altered haemostasis; • Creatine clearance <60 mL/min; • Inclusion in a clinical trial. <u>N total at baseline</u>: Intervention: N = 127 Control: N = 126 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 57.5 (30 to 74)* *C: 56 (30 to 74)* *Sex:*				**infection without septicaemia** I: 3/126 (2.4%) C: 1/127 (0.8%) **Pocket infection/exit-site infection with septicaemia** I: 2/126 (1.6%) C: 0/127 (0%) **Implantation failure** I: 2/126(1.6%) C: 2/127 (1.2%) **Device withdrawal** I: 1/126 (1.6%) C: 0/127 (0%)	

		Not reported. Groups comparable at baseline? Yes.					
Clemons (2020)	Type of study: Multi-centre and unblinded trial. Setting and country: Ottawa Hospital Cancer Centre, the Irving Greenberg Family Cancer Centre, Ottawa; or the Cancer Centre of Southeastern Ontario, Kingston, Ontario, Canada. Funding and conflicts of interest: Funding of this study was through the Rethinking Clinical Trials (REaCT program).	Inclusion criteria: • Patients with newly diagnosed Her2-positive breast cancer; • Patients who had received no prior chemotherapy; • Patients who were planned to receive neo/adjuvant trastuzumab-based chemotherapy regimen. Exclusion criteria: • A contraindication to central line placement; • Not able to give oral consent. N total at baseline: Intervention: *N = 29* Control: *N = 27* Important prognostic factors[2]: *age ± SD:*	Describe intervention (treatment/procedure/test): PICC	Describe control (treatment/procedure/test): PORT	Length of follow-up: Unclear. Loss-to-follow-up: None.	**All complications** PICC: 5/29 PORT: 4/27 **Deep venous thrombosis** PICC: 2/29 (6.9%) PORT: 0/27 (0%) **Pulmonary embolism** PICC: 2/29 (6.9%) PORT: 0/27 (0%) **Infections** PICC: 8/29 (27.6%) PORT: 9/27 (33.3%) **Device removal** PICC: 3/29 (10.3%) PORT: 5/27 (18.5%)	Author's conclusion: In conclusion, while reliable central vascular access may improve the patient experience by reducing the number of extra peripheral IV attempts, reducing the risk of extravasation, and reducing long term damage to the intima of the vein, these benefits have not been shown in appropriately designed prospective trials. This is particularly true as we increasingly move away from anthracycline-containing chemotherapy regimens. This is important as lines are associated with higher initial costs, delayed beginning of systemic therapy and a broad range of complications. Optimizing the type of IV access may not only reduce variability in patient care and potentially offer cost savings but also improve patient comfort and acceptability. In the current study, we have failed to demonstrate the feasibility of our novel trials methodology. In addition, the incidence of

	Dr. Awan reports participating in the Novartis Canada Advisory Board on the use of Ribociclib. Dr. Hutton reports personal fees from Cornerstone Research, outside the submitted work. The remaining authors declare that they have no conflicts of interest	*I: 52 (32 to 84)* *C: 54 (34 to 82)* *Sex:* *Unclear*. Groups comparable at baseline? Yes.					toxicities reported in our study also means that for a future study to definitively determine optimal IV access however given the generally low level of physician engagement, performing such a trial may be challenging. More trials are clearly needed.
Dai (2020)	Type of study: Randomized controlled trial. Setting and country: Single center at Sun Yat-sen University Cancer Center in Guangzhou, China. Funding and conflicts of interest: The author(s) disclosed receipt	Inclusion criteria: • Patients between 18 and 75 years. • Able to complete the questionnaire independently. • Undergoing placement of PICC for the first time. • Able to receive regular catheter maintenance at the hospital. Exclusion criteria: • Patients with contraindications	Describe intervention (treatment/procedure /test): Tunneled PICC	Describe control (treatment/procedure /test): Non-tunneled PICC	Length of follow-up: No information. Loss-to-follow-up: None.	**Infection** I: 0/87 (0%) C: 3/87 (3.4%)	Author's conclusion: Our study compared the effect of the tunneled and non-tunneled PICC techniques, and these results confirm that tunneled PICC is safe, feasible, and effective. Although tunneled PICC adds 17.87 Yuan, less than 3 min, and 0.2mL of bleeding volume to the procedure, it has a lower incidence of complications during the placement. Moreover, it can also reduce the cost of PICC maintenance and the incidence of complications after the placement, especially in wound oozing, MARSI,

	of the following financial support for the research, authorship, and/or publication of this article: Financial support received from the Medical Scientific Research Foundation of Guangdong Province of China (A2019007). The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.	for PICC placement. <u>N total at baseline</u>: Intervention: N = 87 Control: N = 87 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 45.70 (11.32)* *C: 45.66 (11.45)* *Sex:* *I: 51/87 (58.6%) M* *C: 55/87 (63.2%) M* Groups comparable at baseline? Yes.					venous thrombosis, and catheter dislodgement. Altogether, the tunneled technique applied to PICC placement may hence be recommended.
Fletcher (2016)	<u>Type of study:</u> Pragmatic, prospective, randomized, open-label, independently	<u>Inclusion criteria</u>: • Patients >17 years of age; • Admitted to the neurological or trauma critical care	<u>Describe intervention (treatment/procedure /test):</u> PICC	<u>Describe control (treatment/procedure /test):</u> Centrally inserted central venous catheter.	<u>Length of follow-up</u>: Unclear. <u>Loss-to-follow-up</u>: None.	**Death** PICC: 5/39 (12.8%) CICVC: 5/41 (12.2%) **Pulmonary embolism (possible catheter-related)**	<u>Author's conclusion:</u> Our trial demonstrates that critically ill neurologic patients who require a CVC have significantly lower odds of CRLVT with placement of a CICVC as compared to a PICC.

	adjudicated outcome trial. <u>Setting and country:</u> Intensive care unit, USA. <u>Funding and conflicts of interest:</u> This research was funded by the Michigan Institute for Clinical & Health Research grant support (CTSA: UL1RR024986). Dr. Brown received a Clinical and Translational Science Award from the Michigan Institute for Clinical and Health Research (see below). All other authors declare that they have no conflicts of interest.	unit with a primary diagnosis falling under the umbrella of neurological critical care; • Patients in whom a de novo CVC was required as part of ICU care. <u>Exclusion criteria</u>: • Patients who were not expected to survive for 7 days; • Patients who were prisoners; • Patients who had a CVC in the upper extremity in the last 30 days; • Patients who had a known history of upper extremity thrombosis; • Patients who fell under the vein preservation program (renal insufficiency with elevated creatinine >2.9 mg/dl; • Patients who were undergoing haemodialysis. <u>N total at baseline</u>:				PICC: 1/39 (2.6%) CICVC: 1/41 (2.4%) **Thrombosis** PICC: 7/39 (17.9%) CICVC: 1/41 (2.4%)	Additional study seems warranted comparing safety and efficacy of CVCs in critically ill patient populations.

		Intervention: N = 39 Control: N = 41 <u>Important prognostic factors[2]</u>: *age ± SD:* *I: 61 (12)* *C: 59 (15)* *Sex:* *I: 24/39 (61.5%) M* *C: 25/41 (61%) M* Groups comparable at baseline? Yes.					
Moss (2021)	<u>Type of study:</u> Pragmatic, open-label, multicentre, mixed methods, randomised, controlled trial. <u>Setting and country:</u> 18 UK oncology units, United Kingdom. <u>Funding and conflicts of interest:</u> The funder of the study had no role in study design,	<u>Inclusion criteria</u>: • Patients aged 18 years or older expected to receive SACT for 12 weeks or more to treat solid or haematological malignancy; • Patients in whom CVAD insertion was possible via a suitable upper body vein, but for whom there was clinical uncertainty about the best evidence.	<u>Describe intervention (treatment/procedure /test):</u> I: PICC II: PORT III: PORT	<u>Describe control (treatment/procedure /test):</u> I: CVC (Hickman) II: CVC (Hickman) III: PICC	<u>Length of follow-up</u>: 12 months. <u>Loss-to-follow-up</u>: None.	**<u>PICC vs CVC (Hickman)</u>** **Number of patients with 0 complications (all combined)** PICC: 102/212 (48.1%) CVC: 110/212 (51.9%) **Number of patients with 1 or more complications (all combined)** PICC: 110/212 (51.9%) CVC: 103/212 (48.1%) **Number of patients with DVT**	<u>Author's conclusion:</u> CAVA has expanded the knowledge base on these CVADs and the case for a PORT-dominant strategy has been strengthened. These findings should prove useful for updating national and international guidelines to recommend the adoption of PORT-delivered services for relevant patient groups.

	data collection, data analysis, data interpretation, or writing of the report. All other authors declare no competing interests.	<u>Exclusion criteria</u>: • Treatment or life expectancy of less than 3 months; • Previous random assignment to CAVA; • CAVDs removed within 2 weeks before random assignment; • Active infection; • Need for high-flow volume CVADs; • Need for CVADs to be placed in a lower body vein. <u>N total at baseline</u>: See original study. <u>Important prognostic factors</u>[2]: *See original study*. *Sex:* *See original study*. Groups comparable at baseline? Yes.				PICC: 13/212 (6.1%) CVC: 10/212 (4.7%) **Number of patients with pulmonary embolism** PICC: 6/212 (2.8%) CVC: 4/212 (1.9%) **Number of patients with an infection** PICC: 23/212 (10.8%) CVC: 63/212 (29.7%) **Number of patients with laboratory confirmed bloodstream infection** PICC: 10/212 (4.7%) CVC: 41/212 (19.3%) **Number of patients with suspected catheter-related bloodstream infection** PICC: 10/212 (4.7%) CVC: 18/212 (8.5%) **Number of patients with exit site infections** PICC: 4/212 (1.9%) CVC: 19/212 (9.0%)	

						Number of patients with mechanical failures PICC: 31/212 (14.6%) CVC: 7/212 (3.3%) **Other complications** PICC: 23/212 (10.8%) CVC: 16/212 (7.5%) **<u>PORT vs PICC</u>** **Number of patients with 0 complications (all combined)** PORT: 100/147 (68.0%) PICC: 106/199 (53.3%) **Number of patients with 1 or more complications (all combined)** PORT: 47/147 (32.0%) PICC: 93/199 (46.7%) **Number of patients with DVT** PORT: 3/147 (2.0%) PICC: 22/199 (11.1%) **Number of patients with pulmonary embolism** PORT: 3/147 (2.0%)	

						PICC: 1/199 (0.5%) **Number of patients with an infection** PORT: 18/147 (12.2%) PICC: 16/199 (8.0%) **Number of patients with laboratory confirmed bloodstream infection** PORT: 8/147 (55.1%) PICC:7/199 (3.5%) **Number of patients with suspected catheter-related bloodstream infection** PORT: 8/147 (5.4%) PICC: 5/199 (2.5%) **Number of patients with exit site infections** PORT: 4/147 (2.7%) PICC: 4/199 (2.0%) **Number of patients with mechanical failures** PORT: 4/147 (2.7%) PICC: 21/199 (10.6%) **Other complications** PORT: 16/147 (10.9%)	

						PICC:19/199 (9.5%)	
Patel (2013)	Type of study: Randomized controlled trial. Setting and country: Three Australian centres, Victoria, Australia. Funding and conflicts of interest: The authors have no conflicts of interest to declare. The authors have full control of all primary data and agree to allow the journal to review the data if requested.	Inclusion criteria: • Adult patients with non-haematological malignancies planned for chemotherapy that required a CVC with a projected life expectancy of at least 3 months. Exclusion criteria: • Not reported. N total at baseline: Intervention: N = 36 Control: N = 34 Important prognostic factors[2]: *age ± SD:* *I: 59 (29 to 84)* *C: 60 (34 to 78)* *Sex:* *I: 17/36 (47%) M* *C: 19/34 (56%) M* Groups comparable at baseline? Yes.	Describe intervention (treatment/procedure/test): PICC	Describe control (treatment/procedure/test): PORT	Length of follow-up: 6 months or until CVC removal. Loss-to-follow-up: None.	**Complications (all combined)** I: 15/36 (41.7%) C: 6/34 (17.6%) **DVT/line occlusion** I: 4/36 (11.1%) C: 0/34 (0%) **Infection** I: 0/36 (0%) C: 1/34 (2.9%) **Line disruption** I: 2/36 (5.6%) C: 1/34 (2.9%) **Patient choice** I: 1/36 (2.7%) C: 0/34 (0%) **Line occlusion not requiring CVC** I: 3/36 (8.3%) C: 0/34 (0%) **Pain** I: 1/36 (2.7%) C: 4/34 (11.8%) **Pruritus** I: 1/36 (2.7%) C: 0/34 (0%) **Wound complication**	Author's conclusion: In summary, port devices were associated with a lower complication rate in particular significantly fewer thromboses, hence supporting port use over PICCs within our patient group. Specifically, placement of a port device rather than a PICC line should be considered for patients who are at high risk of thrombosis. On consideration of complications within the first 6 months, cost analyses alone did not support the use of one CVC over the other. However, further work is required to validate quality of life questionnaires and to ascertain cost and complication rates in order to demonstrate CVC cost-effectiveness.

						I: 1/36 (2.7%) C: 0/34 (0%)	
Picardi (2019)	Type of study: Randomized controlled trial. Setting and country: Unclear. Funding and conflicts of interest: Unclear.	Inclusion criteria: • Patients >18 years of age; • Patients with newly diagnosed AML according to the WHO classification system; • Patients who had not previously received systemic chemotherapy and/or radiotherapy. Exclusion criteria: • Patients with suspected or confirmed bacterial/fungal infection or thrombosis affecting the veins in the arms, neck, or mediastinum. • Patients with acute promyelocytic leukemia; • Patients with a diagnosis of other forms of cancer within 12 months before AML onset;	Describe intervention (treatment/procedure /test): PICC (open-ended, nonvalved pressure injectable polyurethane PICC with a flexible tip).	Describe control (treatment/procedure /test): Centrally inserted central venous catheters (CICC) (external nontunneled heparin coated Vialon CVC).	Length of follow-up: Unclear. Loss-to-follow-up: None.	**Catheter-related bloodstream infections** PICC: 2/46 (4.3%) CICC: 11/47 (23.4%) **Catheter-related deep venous thrombosis** PICC: 4/46 (8.7%) CICC: 12/47 (25.5%) **Catheter-positioning related complications** PICC: 2/26 (4.3%) CICC: 13/4727.7%) **Catheter malfunctions** PICC: 4/46 (8.7%) CICC: 5/47 (10.6%) **Catheter removals** PICC: 6/46 (13.0%) CICC: 16/47 (34.0%) **30-day mortality** PICC: 4/46 (8.7%) CICC: 10/47 (21.3%)	Author's conclusion: The presented data have shown that the PICC is an easy-to-use device that enables safe and effective central intravascular access for patients receiving intensive chemotherapy for hematologic remission induction of AML. In contrast, BSI and septic thrombophlebitis emerged as life-threatening complications for neutropenic patients with external nontunneled CICCs in situ. Our findings highlight the importance of a team experienced in PICC positioning and care, with a well-written protocol to optimize the catheter insertion procedures and subsequent management. With optimal conditions and experienced physicians, we propose the use of PICC as a new frontline option for CVC in patients with acute leukemia undergoing intensive chemotherapy.

		• Patients with any evidence of clinical conditions indicating an inability to receive intent-to-cure chemotherapy; • Patients who did not provide written informed consent. N total at baseline: Intervention: N = 46 Control: N = 47 Important prognostic factors[2]: *age ± SD:* *I: 54.5 (24 to 80) years* *C: 53 (18 to 74) years* *Sex:* *I: 25/46 (54.3%) M* *C: 22/47 (46.8%) M* Groups comparable at baseline? Yes.					
Taxbro (2019)	Type of study: Open-label, randomised, two-centre trial. Setting and country:	Inclusion criteria: • Patients 18 years and older with a life expectancy longer than 4 weeks and planned for	Describe intervention (treatment/procedure /test): PICC	Describe control (treatment/procedure /test): PORT	Length of follow-up: 12 months maximum. Loss-to-follow-up: None.	**All adverse events**PICC: 45/201 (22.4%) PORT: 26/198 (13.1%) **Overall mortality** PICC: 12/201 (6.0%)	Author's conclusion: In conclusion, we have demonstrated that the risk for CR- DVT and overall adverse events is higher in cancer patients with a PICC than those with a PORT. These findings are

	Two oncology centres in Sweden. Funding and conflicts of interest: Futurum (Academy for Healthcare, Jo€nko€ping County Council, Sweden; grant number 767451); FORSS (Research Council in South East Sweden; grant number 295881). The authors declare that they have no conflicts of interest.	chemotherapy through a CVC. Exclusion criteria: • Ongoing severe systematic infection; • Clinically significant upper extremity/central deep venous thrombosis; • Severe coagulopathy; • Inability to communicate; • Imminent need for a dialysis fistula. N total at baseline: Intervention: N = 201 Control: N = 198 Important prognostic factors[2]: *age ± SD:* *I: 66 (19 to 84)* *C: 65 (30 to 89)* *Sex:* *I: 91/201 (45.3%) M* *C: 83/198 (41.9%) M* Groups comparable at baseline? Yes.				PORT: 37/198 (18.7%) **Catheter-related deep venous thrombosis** PICC: 16/201 (8.0%) PORT: 2/198 (1.0%) **Catheter infection** PICC: 4/201 (2.0%) PORT: 16/198 (8.1%) **Exit, local or pocket infection** PICC: 4/201 (2.0%) PORT: 15/198 (7.8%) **Catheter-related bloodstream infections** PICC: 0/201 (0%) PORT: 2/198 (1.0%) **Catheter occlusion** PICC: 16/201 (8.0%) PORT: 1/198 (0.5%) **Mechanical failure** PICC: 9/201 (4.5%) PORT: 7/198 (3.5%)	of clinical importance and should be considered by anaesthetists, oncologists, and vascular access clinicians when advising patients eligible for a CVC before chemotherapy.

Timsit (1999)	Type of study: Randomized controlled trial. Setting and country: Three intensive care units at academic hospitals in Paris, France. Funding and conflicts of interest: The funding agencies had no input into the de-sign or conduct of this study or in the decision to submit the manuscript for publication.	Inclusion criteria: • All consecutive adult patients who were admitted to the participating ICUs from 30 November 1995 to 31 January 1998 and were expected to require femoral catheterization for at least 48 hours were eligible for this trial. • In addition, each patient's Simplified Acute Physiologic Score II (SAPS II) (7) had to be greater than 20 when he or she was randomly assigned to a study group. Exclusion criteria: • Patients with catheters introduced by guidewire exchange. • Patients who needed trilumen catheters. • Patients who had local impediments to femoral	Describe intervention (treatment/procedure /test): Tunneled catheters.	Describe control (treatment/procedure /test): Non-tunneled catheters.	Length of follow-up: Discharge or death. Loss-to-follow-up: None.	**Systemic catheter-related sepsis per 100 catheter-days** I: 0.36 C: 1.1 RR 0.25 (95% CI 0.09 to 0.72) **Catheter-related bloodstream infection per 100 catheter-days** I: 0.073 C: 0.23 RR 0.28 (95% CI 0.03 to 1.92)	Author's conclusion: We conclude that in critically ill patients in whom femoral access is mandatory, tunneled catheterization is associated with a lower rate of infectious complications than nontunneled catheterization.

		cannulation (infection, inflammation, recent surgery, or hematoma). • Patients with recent deep venous thrombosis or a history of phlebitis or pulmonary embolism. <u>N total at baseline</u>: Intervention: N = 168 Control: N = 168 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 61.4 (16.7)* *C: 61.1 (17.0)* *Sex:* *I: 105/168 (62.5%) M* *C: 104/168 (61.9%) M* Groups comparable at baseline? Yes.					
Timsit (1996)	<u>Type of study:</u> Randomized controlled trial. <u>Setting and country:</u>	<u>Inclusion criteria</u>: • All patients older than 18 years who were consecutively admitted to the participating ICU	<u>Describe intervention (treatment/procedure /test):</u> Tunneled catheters.	<u>Describe control (treatment/procedure /test):</u> Non-tunneled catheters.	<u>Length of follow-up</u>: Until discharge of death. <u>Loss-to-follow-up</u>:	**Systemic catheter-related sepsis** I: 7/117 (6.0%) C: 18/114 (15.8%)	<u>Author's conclusion:</u> We conclude that in critically ill pa¬ tients receiving mechanical ventilation for whom internal jugular access is chosen, tunnelization is more suitable

	Three ICUs in Paris, France. <u>Funding and conflicts of interest:</u> No information.	from March 1, 1993, to July 17, 1994, and were expected to need catheterization for at least 48 hours. <u>Exclusion criteria</u>: • Patients who needed a trilumen catheter. • Patients who had undergone tracheostomy. • Patients in whom tunnelization was unfeasible because of surgery of the neck or the infraclavicular region. <u>N total at baseline</u>: Intervention: N = 117 Control: N = 114 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 63.4 (16.1)* *C: 66.9 (13.7)* *Sex:* *I: 82/117 (70%) M* *C: 84/114 (73.7%) M*			None.	**Bacteremic catheter-related sepsis** I: 4/117 (3.4%) C: 13/114 (11.4%)	as it is associated with a lower rate of infectious complications than nontunneled access.

		Groups comparable at baseline? Yes.					
Xiao (2021)	Type of study: Randomized controlled trial. Setting and country: Sun Yat-Sen university cancer center in Guangzhou, China. Funding and conflicts of interest: The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was funded by the Medical Scientific Research Foundation of Guangdong Province of China (A2019007).	Inclusion criteria: • Age of 18-75 years. • The ability to understand and communicate in Chinese. • First time PICC placement. • Scheduled to regularly receive catheter maintenance at the hospital. Exclusion criteria: • Patients with any contraindications for PICC placement. N total at baseline: Intervention: N = 64 Control: N = 65 Important prognostic factors[2]: *age ± SD:* *I: 45.64 (11.59)* *C: 47.95 (11.96)* *Sex:* *I: 35/64 (54.7%) M*	Describe intervention (treatment/procedure/test): Subcutaneous tunnelling technique (PICC).	Describe control (treatment/procedure/test): Normal technique (PICC)	Length of follow-up: Unclear. Loss-to-follow-up: None.	**Infection** I: 1/64 (1.6%) C: 3/65 (4.6%) **Cathether-related bloodstream infection** I: 0/64 (0%) C: 1/65 (1.5%)	Author's conclusion: In this study, we evaluated the effect of the subcutaneous tunneling technique on improving outcomes in patients with PICCs. We demonstrated that the subcutaneous tunneling technique is a safe, feasible, and efficient method to expand the use of multilumen PICCs by allowing insertion of a larger PICC without increasing pain during placement. Moreover, this technique can reduce the cost of PICC maintenance and reduce complications after placement, especially with respect to catheter dislodgement, venous thrombosis, wound oozing, and unscheduled PICC removal. Therefore, the subcutaneous tunneling technique should be recommended to improve patient outcomes of PICC insertion.

	The authors declare that there is no conflict of interest.	*C: 39/65 (60%) M* Groups comparable at baseline? Yes.					

Risk of bias tabel

Study reference (first author, publication year)	**Was the allocation sequence adequately generated?** Definitely yes Probably yes Probably no	**Was the allocation adequately concealed?** Definitely yes Probably yes Probably no Definitely no	**Blinding: Was knowledge of the allocated interventions adequately prevented?** **Were patients blinded?** **Were healthcare providers blinded?** **Were data collectors blinded?** **Were outcome assessors blinded?** **Were data analysts blinded?** Definitely yes Probably yes Probably no Definitely no	**Was loss to follow-up (missing outcome data) infrequent?** Definitely yes Probably yes Probably no	**Are reports of the study free of selective outcome reporting?** Definitely yes Probably yes Probably no	**Was the study apparently free of other problems that could put it at a risk of bias?** Definitely yes Probably yes Probably no Definitely no	**Overall risk of bias** **If applicable/necessary, per outcome measure** **LOW** **Some concerns** **HIGH**

	Definitely no			Definitely no	Definitely no		
Andrivet (1994)	Definitely yes. Reason: each patient was randomly assigned to either the TC or the NTC group on an odd/even basis according to the order in which they presented for catheterization.	No information. Reason: -	No information. Reason: -	Probably no. Reason: More lost to follow-up in intervention group compared with control group.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.
Brandmeir (2020)	Definitely yes Reason: Randomization was carried out by means of a computer-generated randomized sequence with equal allocation to each arm and no blocking scheme.	Definitely yes Reason: Allocation was concealed to the patients and researchers prior to enrollment.	Definitely no Reason: The major limitation of this study is that outcomes were not blinded.	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably yes Reason: No other bias reported.	Some concerns; no blinding.
Clatot (2020)	Definitely yes Reason: Randomisation was per- formed at a 1:1 allocation ratio using a block size of 8, without a stratification factor	No information. Reason: -	No information. Reason: -	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably no Reason: a third limitation is a potential patient selection, particularly due to the high study refusal rate (54%)	Some concerns; no information regarding allocation concealment, blinding, and other bias.

						that we did not expect	
Dai (2020)	Definitely yes. Reason: A total of 174 participants were randomized to the experimental group (tunneled peripherally inserted central catheter) or the control group	Definitely yes. Reason: At baseline, the participants were allocated to either the intervention or the control group through a computer-generated permuted- block randomization scheme using the envelope method.	Definitely no. Reason: Non-blinded study.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.
Fletcher (2016)	Definitely yes Reason: Patients were randomized to receive either a PICC or CICVC	Definitely yes Reason: Allocation concealment was achieved using sequentially numbered, opaque, sealed envelopes stored in a central location.	Definitely no Reason: Open-label study.	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably no. Reason: -	Some concerns: no blinding in the study.
Moss (2021)	Definitely yes Reason: Randomisation was done using a minimisation algorithm stratifying	No information. Reason: -	Definitely no Reason: The study was necessarily open-label with all parties aware of	Probably yes Reason: all patients were included in the intention-to-treat analysis.	Probably yes Reason: all predefined outcomes were reported.	Probably yes Reason: Further limitations of the trial included a reduction in power of two of the	Some concerns; informating regarding allocation concealment and blinding.

	by centre, body-mass index, type of cancer, device history, and treatment mode.		treatment allocation.			comparisons after 18 months. All comparisons were initially designed with 90% power; however, a protocol-mandated review of recruitment at this time allowed adjustments to be made on the basis of actual recruitment to each comparison and the results of the pilot study.	
Patel (2013)	Definitely yes Reason: Patients were randomised 1:1	No information Reason: -	No information Reason: -	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably no Reason: Finally, the general- izability of our findings may be compromised due to loco- regional factors such as availability of skills and resources, patient selection bias and selected accrual.	Some concerns; no information regarding allocation concealmen, blinding and probably existence of other bias in the study.
Picardi (2019)	Definitely yes Reason: The patients were randomized 1:1	Definitely yes Reason: The random allocation sequence was performed using a	Definitely no Reason: Open-label study.	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably no. Reason: -	Some concerns: no blinding in the study.

		computerized system generated by the statistician's study					
Taxbro (2019)	Definitely yes Reason: Patients were randomised in a 1:1 allocation ratio	No information Reason: -	Definitely no Reason: It was not feasible to blind the patient, clinician, or trial assessors to the allocated arm, because of the particular properties of the catheters.	Definitely yes Reason: no lost to follow-up reported.	Probably yes Reason: all predefined outcomes were reported.	Probably no. Reason: -	Some concerns: no blinding in the study.
Timsit (1999)	Definitely yes. Reason: Patients were randomly assigned to one of the treatment groups.	Definitely yes. Reason: we randomly assigned patients to treatment groups immediately before catheter placement by using a computer- assisted system and a computer-generated allocation schedule.	Probably yes. Reason: Because clinicians were not blinded, a blinded five-physician steering committee deter- mined the presence of each study end point using all reported data (and, if necessary, the patient's full medical record).	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Low.
Timsit (1996)	Definitely yes. Reason: Patients were randomly	No information. Reason: -	Definitely no. Reason: Non-blinded study.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined	Probably yes. Reason: No other biases reported.	Some concerns.

	assigned to one of the treatment groups.				outcomes were reported.		
Xiao (2021)	Definitely yes. Reason: One hundred thirty patients were randomly divided into an experimental group (subcutaneous tunneling technique) and control group (normal technique)	No information. Reason: -	Definitely no. Reason: The first is that double blinding was not possible in our study because the wounds and surgical procedures were different between the groups, which might have influenced the degree of comfort in the two groups.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.

Exclusie tabel

Author and year	Reason for exclusion
Fukuda (2015)	Wrong comparison.
Golsorkhi (2022)	Wrong study design.
Guo (2021)	Wrong outcomes.
He (2021)	Wrong outcomes.
Hon (2019)	Wrong study design.
Li (2021)	Wrong study design.
Lv (2018)	Studies in SR already included.
Maria (2019)	Wrong comparison.
Mateo-Lobo (2019)	Includes observational studies only; excluded because of wrong study design.
Mavrovounis (2020)	Studies in SR already included.
Mitchell (2013)	Wrong comparison.
Nielsen (2021)	Wrong comparison.
Parienti (2019)	Wrong comparison.
Pikwer (2012)	Wrong study design.
Puri (2022)	Wrong study design.
Ricard (2013)	Wrong comparison.
Saber (2011)	Wrong study design.
Tran (2010)	Wrong study design.
Trerotola (2010)	Wrong comparison.
Ugas (2012)	Wrong study design.
Yeow (2022)	Wrong study design.
Zhong (2021)	Wrong study design.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is het optimale type lijn voor een centraal veneuze toegang?	
Database(s): Ovid/Medline, Embase.com	Datum: 23 augustus
Periode: 2007 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	

Toelichting:
Zoeken op P en I (zoals de standaard bij interventie vragen) leek voor de vraag niet gepast, gezien de P 'patiënten die een centraal veneuze toegang krijgen' en de interventie niet echt los van elkaar te zien/trekken zijn.
Er is daarom op de P en C gezocht. Bij het zoekelement van de C is naast de 3 genoemde katheters ook een stuk over centraal veneuze toegang meegenomen. Ook omdat er was aangegeven dat sommige type katheters niet altijd even duidelijk/eenduidig beschreven zijn in de literatuur.
 	
Voor deze vraag is gezocht op de elementen:
• Perifeer ingebrachte centrale katheter
• Andere katheters:
  ○ Poortkatheter
  ○ Hickman/getunnelde katheters
  ○ Ongetunnelde katheters
  ○ Katheters bij centraal veneuze lijnen
 	
De sleutelartikelen worden gevonden met de search.	

Te gebruiken voor richtlijnen tekst:
Nederlands
In de databases Embase.com en Ovid/Medline is op 23 augustus met relevante zoektermen gezocht naar systematische reviews en RCT het optimale type lijn voor een centraal veneuze toegang. De literatuurzoekactie leverde 536 unieke treffers op.

Engels
On the 23rd of August, relevant search terms were used to search for systematic reviews and RCT about the optimal type of central venous catheter for central venous access in the databases Embase.com and Ovid/Medline. The search resulted in 536 unique hits.

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SRs	155	143	198
RCT	228	277	338
Totaal	383	420	**536**

Zoekstrategie
Embase.com

No.	**Query**	**Results**
#13	#11 OR #12	383
#12	#8 AND #10 NOT #11 **= RCT**	228
#11	#8 AND #9 **= SR**	155
#10	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	1947921
#9	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	851042
#8	#5 AND (#6 OR #7) AND ([english]/lim OR [dutch]/lim) AND [2007-2022]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	2278
#7	'implantable port system'/exp OR port*:ti,ab,kw OR 'total* implantable':ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR hickman*:ti,ab,kw OR ((tunnel* NEAR/3 central*):ti,ab,kw) OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp OR subclavian:ti,ab,kw OR jugular:ti,ab,kw OR traditional:ti,ab,kw	1127154
#6	'central venous catheter'/exp/mj OR 'central venous catheterization'/exp/mj OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw)	32225

#5	'peripherally inserted central venous catheter'/exp OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw	12838

Ovid/Medline

#	Searches	Results
10	8 or 9	420
9	(5 and 7) not 8 **= RCT**	277
8	5 and 6 **= SR**	143
7	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1539720
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	613173
5	limit 4 to ((english language or dutch) and yr="2007 -Current")	2443
4	3 not (comment/ or editorial/ or letter/ or ((exp animals/ or exp models, animal/) not humans/))	3916
3	1 and 2	4347
2	exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or (port* or 'total* implantable' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or subclavian or jugular or traditional).ti,ab,kf.	875675
1	exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf.	17457

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de waarde van een getunnelde CVL (getunneld vs ongetunneld) voor het reduceren van het infectierisico?	
Database(s): Ovid/Medline, Embase.com	Datum: 10 januari 2023
Periode: 1990 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Zoeken op de populatie + i van de pico is bij deze vraag niet zinvol omdat de zoektermen overlappen of ruis veroorzaken in de zoekopbrengst. De vergelijking waar men naar op zoek is zou dan niet per se gevonden worden. Er is daarom gezocht op i en c van de pico: • Getunnelde CVL (Medline: geen passende MeSH en bestaande MeSH te breed → daarom niet meegenomen. Tiabkw term lijkt voldoende om op te zoeken) • Ongetunnelde CVL Het artikel van Wu (2021) wordt gevonden met de zoekopdracht.	

De artikelen van Sze Yong (2022) en Santacruz (2019) worden niet gevonden met de zoekopdracht omdat deze niet als SR of RCT geïndexeerd zijn. Qua zoektermen zouden ze wel gevonden zijn.
Te gebruiken voor richtlijnen tekst: *Nederlands* In de databases Embase.com en Ovid/Medline is op 10 januari 2023 met relevante zoektermen gezocht naar systematische reviews en RCT over de waarde van een getunnelde CVL (getunneld vs ongetunneld) voor het reduceren van het infectierisico. De literatuurzoekactie leverde 149 unieke treffers op. *Engels* On the 10th of January, relevant search terms were used to search in the databases Embase.com and Ovid/Medline for systematic reviews and RCT about the place of tunneled (versus nontunneled) CVL to reduce infection risk. The search resulted in 149 unique hits.

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SRs	46	28	47
RCT	86	92	102
Observationele studies			
Totaal	132	120	**149**

Zoekstrategie

Embase.com

No.	**Query**	**Results**
#12	#10 OR #11	132
#11	#7 AND #9 NOT #10	86
#10	#7 AND #8	46
#9	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	2003595
#8	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	891970
#7	#5 AND #6 AND ([english]/lim OR [dutch]/lim) AND [1990-2022]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	673

#6	'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non tunnel*':ti,ab,kw OR 'non-cuffed':ti,ab,kw OR noncuffed:ti,ab,kw OR 'peripherally inserted central venous catheter'/exp OR picc*:ti,ab,kw OR vascath:ti,ab,kw OR 'peripherally-inserted central catheter*':ti,ab,kw	9842
#5	'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR tunnel*:ti,ab,kw OR cuffed:ti,ab,kw OR hickman*:ti,ab,kw OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw	83015

Ovid/Medline

#	Searches	Results
10	8 or 9	120
9	(5 and 7) not 8	92
8	5 and 6	28
7	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1576706
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	641346

Module 5: Optimale locatie van de tip

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Reference	Reason for exclusion
Cavaliere (2014)	Wrong comparison of interventions.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de beste locatie van de tip van de katheter?	
Database(s): Ovid/Medline, Embase.com	Datum: 26 januari 2023
Periode: 1995 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Voor deze vraag is gezocht op de elementen: - Centraal veneuze lijn (terminologie uit vorige vragen voor groot deel overgenomen) - Plaats van de lijn; genoemde vena + termen als plaats en positie - Katheter tip; geen mesh/emtree termen voor, maar lijkt niet anders dan als tip beschreven te worden in de literatuur	
Te gebruiken voor richtlijnen tekst: *Nederlands* In de databases Embase.com en Ovid/Medline is op 26 januari 2023 systematisch gezocht naar systematische reviews en RCTs over de beste locatie van de kathetertip bij een centraal veneuze lijn. De literatuurzoekactie leverde 296 unieke treffers op. *Engels* On the 26th of January 2023, we performed a systematic search in the databases Embase.com and Ovid/Medline to find systematic reviews and RCTs about the best location of the catheter tip of a central venous line. The search resulted in 296 unique hits.	

Zoekopbrengst

	EMBASE	OVID/MEDLINE	Ontdubbeld
SRs	56	27	59
RCT	221	147	237
Totaal	277	174	**296**

Zoekstrategie
Embase.com

No.	Query	Results
#17	#15 OR #16	277
#16	#12 AND #14 NOT #15	221
#15	#12 AND #13	56
#14	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	2009433
#13	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	733409
#12	#9 AND #10 AND #11 AND ([english]/lim OR [dutch]/lim) AND [1995-2023]/py	2266

#11	'central venous catheter'/exp/mj OR 'central venous catheterization'/exp/mj OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw) OR 'vascular access'/exp/mj OR 'vascular access device'/exp/mj OR cvc:ti,ab,kw OR ((central NEAR/3 line*):ti,ab,kw) OR 'vascular access':ti,ab,kw OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'implantable port system'/exp/mj OR port*:ti,ab,kw OR 'total* implantable':ti,ab,kw OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'tunneled central venous catheter'/exp/mj OR 'hickman catheter'/exp/mj OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp/mj OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp/mj OR (((intravascular OR intravenous OR venous OR vascular OR cardiovascular) NEAR/3 catheter*):ti,ab,kw) OR 'total* implant*':ti,ab,kw OR ((central NEAR/3 cath*):ti,ab,kw) OR tunnel*:ti,ab,kw OR cuffed:ti,ab,kw OR 'non tunnel*':ti,ab,kw OR 'non-cuffed':ti,ab,kw OR noncuffed:ti,ab,kw OR vascath:ti,ab,kw OR 'peripherally-inserted central catheter*':ti,ab,kw OR ((tunnel* NEAR/3 central*):ti,ab,kw) OR hickman*:ti,ab,kw OR subclavian:ti,ab,kw OR jugular:ti,ab,kw OR traditional:ti,ab,kw OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw	1303403
#10	'superior cava vein'/exp OR 'heart right atrium'/exp OR 'brachiocephalic vein'/exp OR 'subclavian vein'/exp OR ((('superior cava*' OR brachiocephalic* OR brachycephalic* OR subclavia*) NEAR/3 (vein* OR vena)):ti,ab,kw) OR 'vena cava superior':ti,ab,kw OR 'superior vena cava':ti,ab,kw OR 'upper vena cava':ti,ab,kw OR ((atrium NEAR/3 right):ti,ab,kw) OR position*:ti,ab,kw OR place*:ti,ab,kw	2259062
#9	((tip* NEAR/5 (catheter* OR cvc)):ti,ab,kw) OR cathetertip*:ti,ab,kw	13029

Ovid/Medline

#	Searches	Results
10	8 or 9	174
9	(5 and 7) not 8	147
8	5 and 6	27
7	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1583845

6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	646969
5	limit 4 to ((english language or dutch) and yr="1995 -Current")	1281
4	1 and 2 and 3	1735
3	((tip* adj5 (catheter* or cvc)) or cathetertip*).ti,ab,kf.	8403
2	exp Vena Cava, Superior/ or exp Heart Atria/ or exp Brachiocephalic Veins/ or exp Subclavian Vein/ or (('superior cava*' or brachiocephalic* or brachycephalic* or subclavia*) adj3 (vein* or vena)).ti,ab,kf. or 'vena cava superior'.ti,ab,kf. or 'superior vena cava'.ti,ab,kf. or 'upper vena cava'.ti,ab,kf. or (atrium adj3 right).ti,ab,kf. or position*.ti,ab,kf. or place*.ti,ab,kf.	1762130
1	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or exp Catheterization, Peripheral/ or nontunnel*.ti,ab,kf. or 'non tunnel*'.ti,ab,kf. or 'non-cuffed'.ti,ab,kf. or noncuffed.ti,ab,kf. or picc*.ti,ab,kf. or vascath.ti,ab,kf. or 'Peripherally-Inserted Central Catheter*'.ti,ab,kf. or exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or (port* or 'total* implantable' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or subclavian or jugular or traditional).ti,ab,kf. or exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or port*).ti,ab,kf. or ((intravascular or intravenous or venous or vascular or cardiovascular) adj3 catheter*).ti. or cvc.ti,ab,kf. or (central adj3 line*).ti,ab,kf.	926849

Module 6: Staken van antistolling

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Niet van toepassing.

Zoekverantwoording

Niet van toepassing.

Module 7: Katheterslot

Evidence tabel

Systematic review(s)

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Follow-up	Outcome measures and effect size	Comments
Van den Bosch, 2022 Study characteristics and results are extracted from the SR, unless stated otherwise	SR and meta-analysis of RCTs *Literature search up to 15 February 2021* **A**: Gudiol, 2020 **B**: Longo, 2017 **C**: Wouters, 2018 **D**: Tribler, 2017 **E**: Klek, 2015 **F**: Bisseling, 2010 <u>Study design</u>: RCT, double	Inclusion criteria SR: original RCTs comparing the efficacy of TLs with any other lock solution for the prevention of CVC-related bloodstream infections in all patient populations were included. Exclusion criteria SR: non-RCTs, studies describing	Taurolidine containing lock **A**: Taurolidine 1.35%, Citrate 4% Heparin 100 IU/mL 2.5 mL 3x/week **B**: Taurolidine 1.35% Citrate 4%; 3.0 mL after use **C**: Taurolidine 2%; 5.0 mL 2-7x/week **D**: Taurolidine 1.35% Citrate 4% Heparin 100 IU/mL; 2.0-4.0 mL 2-7x/week **E**: Taurolidine 2% and Taurolidine 1.35%, Citrate 4%; dose and frequency not specified	Citrate/heparin/saline lock **A**: Heparin 100 IU/mL **B**: Saline 0.9% **C**: Saline 0.9% **D**: Heparin 100 IU/mL **E**: Saline 0.9% **F**: Heparin 150 IU/mL	<u>End-point of follow-up</u>: Not specified <u>For how many participants were no complete outcome data available?</u> (intervention/control) Not specified	<u>Infection events (primary outcome)</u> **A**: I 2/719; C 1/690 IRR 1.92 (0.18, 20.66), p=1.00 **B**: 1/10000; C 4/10000 IRR 0.23 (0.03, 2.06), p=0.21 **C**: I 5/15318; C 18/12493 IRR 0.23 (0.07, 0.63), P<0.01 **D**: I 0/9622; C 7/6956 IRR N/A **E**: I1 0/3658, I2 1/3650; C 0/3660 IRR N/A **F**: I 1/5370; C 10/4939 Infection per patient (data from original publications)	<u>Authors' conclusions</u> The use of TLs might be promising for the prevention of CVC-related bloodstream infections. Large-scale RCTs are needed to draw firm conclusions on the efficacy of TLs. VAP: vascular access port

	blind or open, parallel groups. <u>Setting and Country</u>: Not specified per study <u>Source of funding and conflicts of interest:</u> This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Conflict of interest statement: None.	<10 patients and studies using TLs as treatment instead of prevention. *9 studies included, 6 of which in current analysis* <u>Important patient characteristics at baseline</u>: <u>N, mean age (I/C)</u> **A**: 141, 56/57 **B**: 160, 62/61 **C**: 105, 59-47/55-47 **D**: 41, 56/58 **E**: 30, 44/46 **F**: 30, 55/49 <u>Sex</u>: Not reported <u>CVC type:</u> **A**: Non-tunnelled **B**: VAP	**F**: Taurolidine 2%; 5.0 mL, frequency not specified			**A**: I 3/72 (4.1%); C 7/69 (10.1%) **B**: TIVAP-BSI: I 1/84 (1%); C 4/76 (5%) **C**: I 5/52; C 18/50 **D**: I 0/20; C 7/21 **E**: tauro: 0/10; tauro+citr 1/10 (10%); C 0/10 **F**: I 1/16 (6%); C 10/14 (71%) <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Number of catheter-related interventions per year</u> Not reported <u>Antibiotic resistance</u> Not reported <u>Adverse events</u> Number of patients when reported, otherwise number of events **A**: I 0/72; C 0/69 **B**: I Local paresthesia (9), body warm sensation (4), unpleasant taste (1),	

		C: (Non)-tunnelled, VAP **D**: Tunnelled **E**: Tunnelled **F**: Tunnelled, VAP <u>Population:</u> **A**: Oncology **B**: Oncology **C**: Total parenteral nutrition **D**: Total parenteral nutrition **E**: Total parenteral nutrition **F**: Total parenteral nutrition Groups were comparable at baseline				pain (1); C not specified **C**: I Unpleasant taste (1), dizziness (1), erhythema exit-site (1); C Flushing (1) **D**: I Unpleasant taste (8), paresthesia (3), nausea/ vomiting (2); C Heartburn/acid reflux (1), paresthesia (1), dizziness (1) **E**: I 0/10; C 0/10 **F**: I 0/16; C 0/14	
Zhang, 2019 PROSPERO registration number CRD420	SR and meta-analysis of RCTs *Literature search up to March, 2018* **A**: Salonen, 2017	Inclusion criteria SR: Adults and children with a tunneled or nontunneled CVC as vascular access, regardless of	Ethanol lock **A**: Ethanol 70% Patients flushed their catheters with 10 ml 0.9% NaCl after completion of their parenteral nutrition and then locked the catheter	Control lock **A**: heparin **B**: heparin **C**: 0.9% NaCl **D**: heparin	<u>End-point of follow-up</u>: Not specified in SR <u>For how many participants were no complete outcome data available?</u> Not specified in SR	<u>Catheter-related bloodstream infection (primary outcome)</u> *CRBSI (as defined by the study author) per 1000 catheter days* heparin **A**: I 4/2597; C 1/3125 OR 4.82 (0.54, 43.14)	<u>Authors' conclusions</u> The present data indicate that ethanol lock prophylaxis is a potential candidate for the prevention of CRBSI in patients with CVC. However, more attention

15027833 Study characteristics and results are extracted from the SR, unless stated otherwise	**B**: Sanders, 2008 **C**: Slobbe, 2010 **D**: Worth, 2014 <u>Study design</u>: **A**: prospective double blind randomized controlled study **B**: prospective double-blind randomized trial **C**: randomized, placebo-controlled trial **D**: randomized trial <u>Setting and country</u>: **A**: USA **B**: New Zealand **C**: the Netherlands **D**: Australia	the type of disease; Ethanol lock solutions were used in the intervention group. Solutions were allowed to dwell rather than simply being flushed through the catheter. A control condition (e.g., heparin locks) was used in the control group. Exclusion criteria SR: Overlapping study populations, non-RCTs, unavailable full-text. *9 studies included in meta-analysis, 4 of*	with 3 ml 70% ethanol. Prior to administration of the next bag of parenteral nutrition, they again flushed their catheters with 10 mL 0.9% NaCl. **B**: Ethanol 70% Three milliliters of 70% ethanol was injected into each lumen of the catheter daily and left for 2 hours before being entirely removed and replaced with heparinized saline. **C**: Ethanol 70% During hospitalization, every lumen of the CVC was locked with 3 ml 70% ethanol for 15 minutes per day, following which the solution was flushed through with 10 ml 0.9% NaCl. During outpatient settings, ethanol locks were administered once weekly before the			**B**: I 3/5000; C 11/3537 OR 0.19 (0.05, 0.69) **D**: I 4/2216; C 5/2657 OR 0.96 (0.26, 3.58) NaCl **C**: I 10/14262; C 16/13483 OR 0.59 (0.27, 1.30) *CRBSI (as defined by the study author) per patient* heparin **A**: I 4/18; C 1/20 OR 5.43 (0.55, 54.01) **B**: I 3/34; 11/30 OR 0.17 (0.04, 0.68) **D**: I 4/42; C 5/43 OR 0.80 (0.20, 3.21) NaCl **C***: I 2/226; C 7/222 *retrieved from original publication *Exit site infection per 1000 catheter days* heparin **A**: not reported **B**: I 2/5000; C 1/3537 **C**: not reported **D**: I 2/2216; C 3/2657 <u>Quality of life</u> Not reported	should be paid to the uniform ethanol lock procedure and toxic effects after long-term ethanol lock exposure.

	Setting was not reported in SR <u>Source of funding and conflicts of interest:</u> The authors received no specific funding for this work. There was no additional external funding received for this study. The authors have declared that no competing interests exist.	*which relevant for current analysis*. <u>Important patient characteristics at baseline</u>: <u>N, population</u> **A**: 38, parenteral nutrition **B**: 64, hematology **C**: 376, hematology **D**: 85, hematology Sex and age not reported in SR <u>*Catheter type:*</u> **A**: not reported **B**: tunneled **C**: tunneled **D**: tunneled Insertion site **A**: not reported	replacement of the regular heparin solution. **D**: Ethanol 70% After flushing CVC lumens with 10 ml 0.9% NaCl, 2 ml 70% ethanol was instilled into each CVC lumen daily for inpatients and left in situ for 2 hours. A 5- to 10-ml aliquot was then aspirated from each lumen before locking under positive pressure with 10 mL 0.9% NaCl. Self-caring outpatients were instructed to administer the ethanol lock three times weekly, with 2 hours dwell time.			<u>Patient satisfaction</u> Not reported <u>Number of catheter-related interventions per year</u> Not reported <u>Antibiotic resistance</u> Not applicable for this intervention <u>Adverse events</u> Not reported at patient level **A**: No adverse events in either group **B**: I: Dyspnea immediately after the first treatment (n = 1); C Unusual taste sensation and anxiety (n = 1) **C**: I: Facial flushing (n = 39); nausea/vomiting (n = 20); altered taste (n = 31); dizziness/ drowsiness (n = 41); syncope shortly after the first treatment (n = 1); C: Facial flushing (n = 17); nausea/vomiting (n = 17); altered taste (n = 19); dizziness/	

		B: Subclavian veins **C**: Internal jugular vein, subclavian vein, femoral vein **D**: Subclavian, internal jugular veins Groups were comparable at baseline.				drowsiness (n = 10) **D**: I: Chest discomfort (3); nausea (n = 1); C: No adverse events.	

Randomized controlled trial(s)

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Follow-up	Outcome measures and effect size	Comments
Carratala, 1999	Type of study: RCT Setting and country: Single center, Spain Funding and conflicts of interest:	Inclusion criteria: Hospitalized patients with a nontunneled, multilumen, polyurethane CVC in place and who were to receive chemotherapy designed to	Lock solution containing heparin at 10 U/ml and vancomycin at 25 mg/ml.	Lock solution containing heparin at 10 U/ml Catheters were inserted into the subclavian vein by physicians who wore masks, caps, sterile gloves, and surgical gowns and	Length of follow-up: 28 days Loss-to-follow-up: Intervention: 0/60 (0%) Control: 0/57 (0%) Incomplete outcome data:	Catheter infection Significant colonization of catheter hub (primary outcome) I: 0/60 (0%) C: 9/57 (15.8%) P=0.001 Catheter-related bacteremia I: 0/60 (0%)	Authors' conclusions: Our study shows that a solution containing heparin and vancomycin administered by using an antibiotic-lock technique effectively prevents

	This study was supported in part by grant 93/1081 from Fondo de Investigacio´n Sanitaria, Madrid, Spain. No conflict of interest statement.	produce severe neutropenia were eligible for participation in the trial <u>Exclusion criteria</u>: Patients were excluded if they had clinical or microbiologic evidence of infection or had a known allergy to vancomycin. Patients already receiving antibiotics or parenteral nutrition were also excluded. <u>N total at baseline</u>: Intervention: 60 Control: 60 <u>Important prognostic factors</u>[2]: *Age, mean ± SD:* *I: 42* *C: 44*		who used large sterile drapes. Study catheters were not exchanged over guidewires. At the time of catheter insertion, the skin insertion site was disinfected with 4% chlorhexidine gluconate (Hibiscrub; ICI Farma, Pontevedra, Spain), which was applied by scrubbing for at least 30 s. The insertion sites were covered with sterile gauze.	Not specified.	C: 4/57 (7.0%) P=0.05 <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Number of catheter-related interventions per year</u> Not reported <u>Antibiotic resistance</u> No vancomycin-resistant organism was isolated from any source during the study period <u>Adverse events</u> Not reported	catheter hub colonization with gram-positive bacteria and subsequent bacteremia during chemotherapy-induced neutropenia in patients with hematologic malignancy.

		Sex: *I: 51.7% M* *C: 68.4% M* *Type of catheter* *Double lumen* *I: 66.7%* *C: 61.4&* *Triple lumen* *I: 33.3%* *C: 38.6%* *Duration of catheterization prior to randomization (days)* *I: 25* *C: 24* Groups were comparable at baseline.					

Risk of bias tabel

Systematic review(s)

Study	Appropriate and clearly focused question?[1]	Comprehensive and systematic literature search?[2]	Description of included and excluded studies?[3]	Description of relevant characteristics of included studies?[4]	Appropriate adjustment for potential confounders in	Assessment of scientific quality of included studies?[6]	Enough similarities between studies to make	Potential risk of publicatio n bias	Potential conflicts of interest reported?[9]

First author, year	Yes/no/unclear	Yes/no/unclear	Yes/no/unclear	Yes/no/unclear	observational studies?[5] Yes/no/unclear/not applicable	Yes/no/unclear	combining them reasonable?[7] Yes/no/unclear	taken into account?[8] Yes/no/unclear	Yes/no/unclear
Zhang, 2019	Yes	Yes	No Excluded studies were not.described.	Yes	N/A	Yes	Yes	No	Unclear Not specified for included studies
Van den Bosch, 2022	Yes	Yes	No Excluded studies were not.described.	Yes	N/A	Yes	Yes	Yes	Unclear Not specified for included studies

Randomized controlled trial(s)

Study reference (first author, publication year)	Was the allocation sequence adequately generated?	Was the allocation adequately concealed?	Blinding: Was knowledge of the allocated interventions adequately prevented? Were patients blinded? Were healthcare providers blinded? Were data collectors blinded?	Was loss to follow-up (missing outcome data) infrequent?	Are reports of the study free of selective outcome reporting?	Was the study apparently free of other problems that could put it at a risk of bias?	Overall risk of bias If applicable/necessary, per outcome measure

	Definitely yes Probably yes Probably no Definitely no	Definitely yes Probably yes Probably no Definitely no	**Were outcome assessors blinded?** **Were data analysts blinded?** Definitely yes Probably yes Probably no Definitely no	Definitely yes Probably yes Probably no Definitely no	Definitely yes Probably yes Probably no Definitely no	Definitely yes Probably yes Probably no Definitely no	**LOW** **Some concerns** **HIGH**
Carratala, 1999	Definitely yes; Reason: For study solution allocation a computer-generated list of random numbers, which was available only to the pharmacist, was used.	Definitely yes; Reason: The two solutions were indistinguishable to medical personnel and were dispensed in 20-ml vials that were numerically coded and that were kept refrigerated. The code list was kept in the hospital pharmacy and was opened only after the study was completed.	Definitely yes; Reason: The patients' physicians and nurses, the clinical investigators, and the research microbiologists who processed all cultures were blinded to each study group.	Probably yes; Reason: Loss to follow-up was infrequent.	Probably yes; Reason: All relevant outcomes were reported.	Probably yes; Reason: No other problems noted.	**LOW**

Exclusie tabel

Reference	Reason for exclusion
Dang FP, Li HJ, Wang RJ, Wu Q, Chen H, Ren JJ, Tian JH. Comparative efficacy of various antimicrobial lock solutions for preventing catheter-related bloodstream infections: A network meta-analysis of 9099 patients from 52 randomized controlled trials. Int J Infect Dis. 2019 Oct;87:154-165. doi: 10.1016/j.ijid.2019.08.017. Epub 2019 Aug 20. PMID: 31442627.	wrong P: includes hemodialysis
Gudiol C, Arnan M, Aguilar-Guisado M, Royo-Cebrecos C, Sánchez-Ortega I, Montero I, Martín-Gandul C, Laporte-Amargós J, Albasanz-Puig A, Nicolae S, Perayre M, Berbel D, Tebe C, Riera J, Sureda A, Cisneros JM, Carratalà J. A Randomized, Double-Blind, Placebo-Controlled Trial (TAURCAT Study) of Citrate Lock Solution for Prevention of Endoluminal Central Venous Catheter Infection in Neutropenic Hematological Patients. Antimicrob Agents Chemother. 2020 Jan 27;64(2):e01521-19. doi: 10.1128/AAC.01521-19. PMID: 31712211; PMCID: PMC6985755.	Reported in systematic review
Gudiol C, Nicolae S, Royo-Cebrecos C, Aguilar-Guisado M, Montero I, Martín-Gandul C, Perayre M, Berbel D, Encuentra M, Arnan M, Cisneros-Herreros JM, Carratalà J. Administration of taurolidine-citrate lock solution for prevention of central venous catheter infection in adult neutropenic haematological patients: a randomised, double-blinded, placebo-controlled trial (TAURCAT). Trials. 2018 May 2;19(1):264. doi: 10.1186/s13063-018-2647-y. PMID: 29720244; PMCID: PMC5932813.	Wrong study design: protocol
Longo R, Llorens M, Goetz C, Platini C, Eid N, Sellies J, Ouamara N, Quétin P. Taurolidine/Citrate Lock Therapy for Primary Prevention of Catheter-Related Infections in Cancer Patients: Results of a Prospective, Randomized, Phase IV Trial (ATAPAC). Oncology. 2017;93(2):99-105. doi: 10.1159/000470911. Epub 2017 May 3. PMID: 28463827.	Reported in systematic review
Norris LB, Kablaoui F, Brilhart MK, Bookstaver PB. Systematic review of antimicrobial lock therapy for prevention of central-line-associated bloodstream infections in adult and pediatric cancer patients. Int J Antimicrob Agents. 2017 Sep;50(3):308-317. doi: 10.1016/j.ijantimicag.2017.06.013. Epub 2017 Jul 6. PMID: 28689878.	Original publication used
Reitzel RA, Rosenblatt J, Chaftari AM, Raad II. Epidemiology of Infectious and Noninfectious Catheter Complications in Patients Receiving Home Parenteral Nutrition: A Systematic Review and Meta-Analysis. JPEN J Parenter Enteral Nutr. 2019 Sep;43(7):832-851. doi: 10.1002/jpen.1609. Epub 2019 Jun 6. PMID: 31172542.	wrong study design, only observational data
Salonen BR, Bonnes SL, Vallumsetla N, Varayil JE, Mundi MS, Hurt RT. A prospective double blind randomized controlled study on the use of ethanol locks in HPN patients. Clin Nutr. 2018 Aug;37(4):1181-1185. doi: 10.1016/j.clnu.2017.05.009. Epub 2017 May 17. PMID: 28576557.	Reported in systematic review
Taşdelen Öğülmen D, Ateş S. Use of alcohol containing caps for preventing bloodstream infections: A randomized controlled trial. J Vasc Access. 2021 Nov;22(6):920-925. doi:	Wrong intervention

10.1177/1129729820952961. Epub 2020 Aug 27. PMID: 32854563.	
van de Wetering MD, van Woensel JB, Lawrie TA. Prophylactic antibiotics for preventing Gram positive infections associated with long-term central venous catheters in oncology patients. Cochrane Database Syst Rev. 2013 Nov 25;2013(11):CD003295. doi: 10.1002/14651858.CD003295.pub3. Update in: Cochrane Database Syst Rev. 2021 Oct 7;10:CD003295. PMID: 24277633; PMCID: PMC6457614.	more recent systematic review used
Vassallo M, Dunais B, Roger PM. Antimicrobial lock therapy in central-line associated bloodstream infections: a systematic review. Infection. 2015 Aug;43(4):389-98. doi: 10.1007/s15010-015-0738-1. Epub 2015 Feb 6. PMID: 25657033.	no usable data in article
Vernon-Roberts A, Lopez RN, Frampton CM, Day AS. Meta-analysis of the efficacy of taurolidine in reducing catheter-related bloodstream infections for patients receiving parenteral nutrition. JPEN J Parenter Enteral Nutr. 2022 Sep;46(7):1535-1552. doi: 10.1002/jpen.2363. Epub 2022 Mar 25. PMID: 35233792.	more complete systematic review used
Worth LJ, Slavin MA, Heath S, Szer J, Grigg AP. Ethanol versus heparin locks for the prevention of central venous catheter-associated bloodstream infections: a randomized trial in adult haematology patients with Hickman devices. J Hosp Infect. 2014 Sep;88(1):48-51. doi: 10.1016/j.jhin.2014.06.007. Epub 2014 Jul 2. PMID: 25063013.	Reported in systematic review
Zacharioudakis IM, Zervou FN, Arvanitis M, Ziakas PD, Mermel LA, Mylonakis E. Antimicrobial lock solutions as a method to prevent central line-associated bloodstream infections: a meta-analysis of randomized controlled trials. Clin Infect Dis. 2014 Dec 15;59(12):1741-9. doi: 10.1093/cid/ciu671. Epub 2014 Aug 25. PMID: 25156111.	more complete systematic review used

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de waarde van antibioticaprofylaxe bij een centraal veneuze toegang?	
Database(s): Ovid/Medline, Embase.com	Datum: 6-9-2022
Periode: 2012-heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Voor deze vraag is gezocht op de elementen: - Centraal veneuze toegang en genoemde catheters - Catheter lock/antibiotica profylaxe → De opgegeven sleutelartikelen worden gevonden. → MeSH termen zijn veelal op major/focus gezet gezien de grote aantallen; de sleutelartikelen worden hiermee gevonden en relevante hits lijken de zoektermen goed, duidelijk en redelijk eenduidig te benoemen.	

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SRs	188	170	251
RCT	193	220	205
Totaal	381	390	**456**

Zoekstrategie

Embase.com

No.	**Query**	**Results**
#12	#10 OR #11	381
#11	#7 AND #9 NOT #10 **= RCT**	193
#10	#7 AND #8 **= SR**	188
#9	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	1954759
#8	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	855669
#7	#5 AND #6 AND ([english]/lim OR [dutch]/lim) AND [2012-2022]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	2137
#6	'antibiotic agent'/exp/mj OR 'antibiotic prophylaxis'/exp/mj OR antibiotic*:ti,ab,kw OR antimicrobial:ti,ab,kw OR 'vancomycin'/exp/mj OR 'taurolidine'/exp/mj OR 'heparin'/exp/mj OR taurolidin*:ti,ab,kw OR heparin*:ti,ab,kw OR 'vancomycin*':ti,ab,kw OR 'alcohol'/exp/mj OR 'alcohol':ti,ab,kw OR ethanol:ti,ab,kw OR 'citric acid'/exp/mj OR 'citric acid':ti,ab,kw OR citrate:ti,ab,kw OR ((catheter* NEAR/2 lock*):ti,ab,kw)	1954141
#5	'central venous catheter'/exp/mj OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw) OR 'peripherally inserted central venous catheter'/exp/mj OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'implantable port system'/exp/mj OR 'total* implant*':ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp/mj OR 'hickman catheter'/exp/mj OR hickman*:ti,ab,kw OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp OR ((central NEAR/3 cath*):ti,ab,kw)	47992

Ovid/Medline

#	Searches	Results
14	12 or 13	390
13	(9 and 11) not 12 **= RCT**	220
12	9 and 10 **= SR**	170
11	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1542846
10	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	615739
9	limit 8 to ((english language or dutch) and yr="2012 -Current")	2091
8	7 not (comment/ or editorial/ or letter/ or ((exp animals/ or exp models, animal/) not humans/))	5100
7	5 and 6	5439
6	exp *Anti-Bacterial Agents/ or exp *Antibiotic Prophylaxis/ or antibiotic*.ti,ab,kf. or antimicrobial.ti,ab,kf. or exp Vancomycin/ or exp Heparin/ or exp Thiadiazines/ or taurolidin*.ti,ab,kf. or heparin*.ti,ab,kf. or 'vancomycin*'.ti,ab,kf. or exp Ethanol/ or 'alcohol'.ti,ab,kf. or ethanol.ti,ab,kf. or exp Citric Acid/ or 'citric acid'.ti,ab,kf. or citrate.ti,ab,kf. or (catheter* adj2 lock*).ti,ab,kf.	1434059
5	exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf.	40914

Module 8: Getunnelde centraal veneuze lijn

Evidence tabel

Study reference	Study characteristics	Patient characteristics [2]	Intervention (I)	Comparison / control (C) [3]	Follow-up	Outcome measures and effect size [4]	Comments
Andrivet (1994)	Type of study: Randomized controlled trial. Setting and country: Centre Médico-Chirurgical de Bligny (ICU unit). Funding and conflicts of interest: No information.	Inclusion criteria: • Patients referred the de MICU for prolonged central venous catheterization. Exclusion criteria: No information. N total at baseline: Intervention: N = 106 Control: N = 97 Important prognostic factors[2]: *age ± SD:* *I: 55.7 (1.3)* *C: 53.7 (1.4)* *Sex:* *I: 71/106 (66%) M* *C: 67/97 (65%) M* Groups comparable at baseline?	Describe intervention (treatment/procedure/test): Tunneled catheterization.	Describe control (treatment/procedure/test): Non-tunneled catheterization.	Length of follow-up: No information. Loss-to-follow-up: I: N = 5 C: N = 1	**Catheter-related bacteremia** I: 2/106 (1.9%) C: 5/97 (5.2%) **Non-bacteremic catheter-related infections** I: 3/106 (2.8%) C: 4/97 (4.1%)	Author's conclusion: In conclusion, our findings suggest that routine subcutaneous tunneling of central venous catheters is unnecessary in immunocompromised patients, a finding that allows for easier and quicker insertion of catheters in such patients, who often are disable and algid. Because subcutaneous tunneling in the present study was not associated with an increased rate of complications, we cannot suggest that this insertion technique should be abandoned. Since the completion of this study, we do not perform subcutaneous tunneling in our patients who require prolonged central venous access via the subclavian route. This therapeutic choice may not apply to other sites of venous access such as the internal jugular veins or to other

		Yes.					materials such as cuffed or multilumen catheters.
Dai (2020)	Type of study: Randomized controlled trial. Setting and country: Single center at Sun Yat-sen University Cancer Center in Guangzhou, China. Funding and conflicts of interest: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Financial support received from the Medical Scientific Research Foundation of Guangdong Province of China (A2019007). The author(s) declared no potential conflicts of interest with respect to the	Inclusion criteria: • Patients between 18 and 75 years. • Able to complete the questionnaire independently. • Undergoing placement of PICC for the first time. • Able to receive regular catheter maintenance at the hospital. Exclusion criteria: • Patients with contraindications for PICC placement. N total at baseline: Intervention: N = 87 Control: N = 87 Important prognostic factors[2]: *age ± SD:* *I: 45.70 (11.32)* *C: 45.66 (11.45)* *Sex:* *I: 51/87 (58.6%) M* *C: 55/87 (63.2%) M*	Describe intervention (treatment/procedure/test): Tunneled PICC	Describe control (treatment/procedure/test): Non-tunneled PICC	Length of follow-up: No information. Loss-to-follow-up: None.	**Infection** I: 0/87 (0%) C: 3/87 (3.4%)	Author's conclusion: Our study compared the effect of the tunneled and non- tunneled PICC techniques, and these results confirm that tunneled PICC is safe, feasible, and effective. Although tunneled PICC adds 17.87 Yuan, less than 3 min, and 0.2mL of bleeding volume to the procedure, it has a lower incidence of complications during the placement. Moreover, it can also reduce the cost of PICC maintenance and the incidence of complications after the placement, especially in wound oozing, MARSI, venous thrombosis, and catheter dislodgement. Altogether, the tunneled technique applied to PICC placement may hence be recommended.

	research, authorship, and/or publication of this article.	Groups comparable at baseline? Yes.					
Timsit (1999)	Type of study: Randomized controlled trial. Setting and country: Three intensive care units at academic hospitals in Paris, France. Funding and conflicts of interest: The funding agencies had no input into the de-sign or conduct of this study or in the decision to submit the manuscript for publication.	Inclusion criteria: • All consecutive adult patients who were admitted to the participating ICUs from 30 November 1995 to 31 January 1998 and were expected to require femoral catheterization for at least 48 hours were eligible for this trial. • In addition, each patient's Simplified Acute Physiologic Score II (SAPS II) (7) had to be greater than 20 when he or she was randomly assigned to a study group. Exclusion criteria: • Patients with catheters introduced by guidewire exchange. • Patients who needed trilumen catheters. • Patients who had local impediments to femoral cannulation (infection,	Describe intervention (treatment/procedure/test): Tunneled catheters.	Describe control (treatment/procedure/test): Non-tunneled catheters.	Length of follow-up: Discharge or death. Loss-to-follow-up: None.	**Systemic catheter-related sepsis per 100 catheter-days** I: 0.36 C: 1.1 RR 0.25 (95% CI 0.09 to 0.72) **Catheter-related bloodstream infection per 100 catheter-days** I: 0.073 C: 0.23 RR 0.28 (95% CI 0.03 to 1.92)	Author's conclusion: We conclude that in critically ill patients in whom femoral access is mandatory, tunneled catheterization is associated with a lower rate of infectious complications than nontunneled catheterization.

		inflammation, recent surgery, or hematoma). • Patients with recent deep venous thrombosis or a history of phlebitis or pulmonary embolism. <u>N total at baseline</u>: Intervention: N = 168 Control: N = 168 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 61.4 (16.7)* *C: 61.1 (17.0)* *Sex:* *I: 105/168 (62.5%) M* *C: 104/168 (61.9%) M* Groups comparable at baseline? Yes.					
Timsit (1996)	<u>Type of study:</u> Randomized controlled trial. <u>Setting and country:</u> Three ICUs in Paris, France. <u>Funding and conflicts of interest:</u>	<u>Inclusion criteria</u>: • All patients older than 18 years who were consecutively admitted to the participating ICU from March 1, 1993, to July 17, 1994, and were expected to need catheterization for at least 48 hours.	<u>Describe intervention (treatment/procedure/test):</u> Tunneled catheters.	<u>Describe control (treatment/procedure/test):</u> Non-tunneled catheters.	<u>Length of follow-up</u>: Until discharge of death. <u>Loss-to-follow-up</u>: None.	**Systemic catheter-related sepsis** I: 7/117 (6.0%) C: 18/114 (15.8%) **Bacteremic catheter-related sepsis** I: 4/117 (3.4%)	<u>Author's conclusion:</u> We conclude that in critically ill pa¬ tients receiving mechanical ventilation for whom internal jugular access is chosen, tunnelization is more suitable as it is associated with a lower rate of infectious complications than nontunneled access.

	No information.	<u>Exclusion criteria</u>: • Patients who needed a trilumen catheter. • Patients who had undergone tracheostomy. • Patients in whom tunnelization was unfeasible because of surgery of the neck or the infraclavicular region. <u>N total at baseline</u>: Intervention: N = 117 Control: N = 114 <u>Important prognostic factors</u>[2]: *age ± SD:* *I: 63.4 (16.1)* *C: 66.9 (13.7)* *Sex:* *I: 82/117 (70%) M* *C: 84/114 (73.7%) M* Groups comparable at baseline? Yes.				C: 13/114 (11.4%)	
Trerotola (2010)	<u>Type of study:</u> Randomized controlled trial.	<u>Inclusion criteria</u>: • All patients referred to the interventional radiology department	<u>Describe intervention (treatment/procedure/test):</u>	<u>Describe control (treatment/procedure/test):</u>	<u>Length of follow-up</u>: 2 weeks, 1 months, and 3	**Infection** *2 weeks* I: 0/30 (0%) C: 0/28 (0%)	<u>Author's conclusion:</u> In summary, this prospective randomized trial did not show a benefit for a polyester cuff in

	Setting and country: Radiology department (country unclear). Funding and conflicts of interest: S.O.T. is a consultant for Bard. This study was funded by Bard Access Systems. None of the other authors have identified a conflict of interest.	for single- or dual-lumen SBCC placement. Exclusion criteria: • Previous enrolment in the study. • Patients unable to sign informed consent. • Anticipated catheter dwell time less than 2 weeks. • Patient's lack of a usable jugular (internal or external) vessel. N total at baseline: Intervention: N = 42 Control: N = 42 Important prognostic factors[2]: *age ± SD:* *I: 55.5 (range 22-9)* *C: 51.5 (range 25-77)* *Sex:* *I: 15/42 (36%) F* *C: 16/42 (38%) F* Groups comparable at baseline? Yes.	Cuffed catheters.	Uncuffed catheters.	months or at catheter removal. Loss-to-follow-up: None.	*1 month* I: 0/15 (0%) C: 0/15 (0%) *3 months* I: 0/4 (0%) C: 0/2 (0%)	tunneled SBCCs in terms of short-term infection or colonization in the chronic kidney disease population. On the basis of these results, we cannot recommend the use of cuffed SBCCs.
Xiao (2021)	Type of study: Randomized controlled trial.	Inclusion criteria: • Age of 18-75 years.	Describe intervention	Describe control (treatment/procedure/test):	Length of follow-up: Unclear.	**Infection** I: 1/64 (1.6%) C: 3/65 (4.6%)	Author's conclusion: In this study, we evaluated the effect of the subcutaneous

	Setting and country: Sun Yat-Sen university cancer center in Guangzhou, China. Funding and conflicts of interest: The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was funded by the Medical Scientific Research Foundation of Guangdong Province of China (A2019007). The authors declare that there is no conflict of interest.	• The ability to understand and communicate in Chinese. • First time PICC placement. • Scheduled to regularly receive catheter maintenance at the hospital. Exclusion criteria: • Patients with any contraindications for PICC placement. N total at baseline: Intervention: N = 64 Control: N = 65 Important prognostic factors[2]: *age ± SD:* *I: 45.64 (11.59)* *C: 47.95 (11.96)* *Sex:* *I: 35/64 (54.7%) M* *C: 39/65 (60%) M* Groups comparable at baseline? Yes.	(treatment/procedure/test): Subcutaneous tunnelling technique (PICC).	Normal technique (PICC)	Loss-to-follow-up: None.	**Catheter-related bloodstream infection** I: 0/64 (0%) C: 1/65 (1.5%)	tunneling technique on improving outcomes in patients with PICCs. We demonstrated that the subcutaneous tunneling technique is a safe, feasible, and efficient method to expand the use of multilumen PICCs by allowing insertion of a larger PICC without increasing pain during placement. Moreover, this technique can reduce the cost of PICC maintenance and reduce complications after placement, especially with respect to catheter dislodgement, venous thrombosis, wound oozing, and unscheduled PICC removal. Therefore, the subcutaneous tunneling technique should be recommended to improve patient outcomes of PICC insertion.

Risk of bias tabel

Study reference (first author, publication year)	**Was the allocation sequence adequately generated?** Definitely yes Probably yes Probably no Definitely no	**Was the allocation adequately concealed?** Definitely yes Probably yes Probably no Definitely no	**Blinding: Was knowledge of the allocated interventions adequately prevented?** **Were patients/healthcare providers/data collectors/assessors/data analysts blinded?** Definitely yes Probably yes Probably no Definitely no	**Was loss to follow-up (missing outcome data) infrequent?** Definitely yes Probably yes Probably no Definitely no	**Are reports of the study free of selective outcome reporting?** Definitely yes Probably yes Probably no Definitely no	**Was the study apparently free of other problems that could put it at a risk of bias?** Definitely yes Probably yes Probably no Definitely no	**Overall risk of bias** **If applicable/necessary, per outcome measure** **LOW** **Some concerns** **HIGH**
Andrivet (1994)	Definitely yes. Reason: each patient was randomly assigned to either the TC or the NTC group on an odd/even basis according to the order in which they presented for catheterization.	No information. Reason: -	No information. Reason: -	Probably no. Reason: More lost to follow-up in intervention group compared with control group.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.
Dai (2020)	Definitely yes. Reason: A total of 174 participants were randomized to the experimental group (tunneled	Definitely yes. Reason: At baseline, the participants were allocated to either the intervention or	Definitely no. Reason: Non-blinded study.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.

	peripherally inserted central catheter) or the control group	the control group through a computer-generated permuted- block randomization scheme using the envelope method.					
Timsit (1999)	Definitely yes. Reason: Patients were randomly assigned to one of the treatment groups.	Definitely yes. Reason: we randomly assigned patients to treatment groups immediately before catheter placement by using a computer- assisted system and a computer-generated allocation schedule.	Probably yes. Reason: Because clinicians were not blinded, a blinded five-physician steering committee deter- mined the presence of each study end point using all reported data (and, if necessary, the patient's full medical record).	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Low.
Timsit (1996)	Definitely yes. Reason: Patients were randomly assigned to one of the treatment groups.	No information. Reason: -	Definitely no. Reason: Non-blinded study.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.
Trerotola (2010)	Definitely yes. Reason: Eighty-four patients were	No information. Reason: -	No information. Reason: -	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined	Probably yes. Reason: No other biases reported.	Some concerns.

	randomly assigned to receive a 5-F single- or 6-F dual-lumen SBCC with (n=42) or without (n=42) a polyester cuff.				outcomes were reported.		
Xiao (2021)	Definitely yes. Reason: One hundred thirty patients were randomly divided into an experimental group (subcutaneous tunneling technique) and control group (normal technique)	No information. Reason: -	Definitely no. Reason: The first is that double blinding was not possible in our study because the wounds and surgical procedures were different between the groups, which might have influenced the degree of comfort in the two groups.	Definitely yes. Reason: No lost to follow-up reported.	Probably yes. Reason: All predefined outcomes were reported.	Probably yes. Reason: No other biases reported.	Some concerns.

Exclusie tabel

Author and year	Reason for exclusion
Maria (2019)	Wrong comparison.
Mateo-Lobo (2019)	Includes observational studies only; excluded because of wrong study design.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de waarde van een getunnelde CVL (getunneld vs ongetunneld) voor het reduceren van het infectierisico?	
Database(s): Ovid/Medline, Embase.com	Datum: 10 januari 2023
Periode: 1990 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Zoeken op de populatie + i van de pico is bij deze vraag niet zinvol omdat de zoektermen overlappen of ruis veroorzaken in de zoekopbrengst. De vergelijking waar men naar op zoek is zou dan niet per se gevonden worden. Er is daarom gezocht op i en c van de pico: • Getunnelde CVL (Medline: geen passende MeSH en bestaande MeSH te breed → daarom niet meegenomen. Tiabkw term lijkt voldoende om op te zoeken) • Ongetunnelde CVL Het artikel van Wu (2021) wordt gevonden met de zoekopdracht. De artikelen van Sze Yong (2022) en Santacruz (2019) worden niet gevonden met de zoekopdracht omdat deze niet als SR of RCT geïndexeerd zijn. Qua zoektermen zouden ze wel gevonden zijn.	
Te gebruiken voor richtlijnen tekst: *Nederlands* In de databases Embase.com en Ovid/Medline is op 10 januari 2023 met relevante zoektermen gezocht naar systematische reviews en RCT over de waarde van een getunnelde CVL (getunneld vs ongetunneld) voor het reduceren van het infectierisico. De literatuurzoekactie leverde 149 unieke treffers op. *Engels* On the 10th of January, relevant search terms were used to search in the databases Embase.com and Ovid/Medline for systematic reviews and RCT about the place of tunneled (versus nontunneled) CVL to reduce infection risk. The search resulted in 149 unique hits.	

Zoekopbrengst

	EMBASE	OVID/MEDLINE	Ontdubbeld
SRs	46	28	47
RCT	86	92	102
Observationele studies			
Totaal	132	120	**149**

Zoekstrategie

Embase.com

No.	Query	Results
#12	#10 OR #11	132

#11	#7 AND #9 NOT #10	86
#10	#7 AND #8	46
#9	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	2003595
#8	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	891970
#7	#5 AND #6 AND ([english]/lim OR [dutch]/lim) AND [1990-2022]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	673
#6	'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non tunnel*':ti,ab,kw OR 'non-cuffed':ti,ab,kw OR noncuffed:ti,ab,kw OR 'peripherally inserted central venous catheter'/exp OR picc*:ti,ab,kw OR vascath:ti,ab,kw OR 'peripherally-inserted central catheter*':ti,ab,kw	9842
#5	'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR tunnel*:ti,ab,kw OR cuffed:ti,ab,kw OR hickman*:ti,ab,kw OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw	83015

Ovid/Medline

#	Searches	Results
10	8 or 9	120
9	(5 and 7) not 8	92
8	5 and 6	28
7	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1576706
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	641346
5	limit 4 to ((english language or dutch) and yr="1990 -Current")	621
4	3 not (comment/ or editorial/ or letter/ or ((exp animals/ or exp models, animal/) not humans/))	674
3	1 and 2	720

2	exp Catheterization, Peripheral/ or nontunnel*.ti,ab,kf. or 'non tunnel*'.ti,ab,kf. or 'non-cuffed'.ti,ab,kf. or noncuffed.ti,ab,kf. or picc*.ti,ab,kf. or vascath.ti,ab,kf. or 'Peripherally-Inserted Central Catheter*'.ti,ab,kf.	16337
1	(tunnel* or cuffed or (hickman* or broviac or leonard or groshong or cook or permcath or tesio)).ti,ab,kf.	74191

Module 9: Geoccludeerde lijn

Evidence tabel

Systematic review(s)

Study reference	Study characteristics	Patient characteristics	Intervention (I)	Comparison / control (C)	Follow-up	Outcome measures and effect size	Comments
Van Miert, 2012 Study characteristics and results are extracted from the SR (unless stated otherwise)	SR and meta-analysis of RCTs *Literature search up to September 2011* **A**: Dietcher, 2004 **B**: Fink, 2004 **C**: Haire, 1994 **D**: Haire, 2004 **E**: Horne III, 1997 **F**: Ponec, 2011 <u>Study design</u>: RCT	Inclusion criteria SR: We selected randomized controlled trials which investigated the efficacy of an intervention (chemical, surgical or drug) used to restore patency to an occluded CVC lumen, in either adults or children. Exclusion criteria SR:	**A**: Recombinant urokinase (5000, 15000, 25000 IU/ml) **B**: Alteplase 1mg/1mL **C**: Urokinase 10,000 IU/2mL **D**: Urokinase 5000 IU/1mL **E**: Urokinase 250,000 IU/normal saline 50 mL infusing at 8 mL/hour (Urokinase 40,000 IU/hour) **F**: Alteplase 2 mg/2 mL, Alteplase 2 mg/2 mL, placebo	**A**: Placebo **B**: Alteplase 2mg/2mL **C**: Alteplase 2mg/2mL **D**: Placebo **E**: Urokinase 250,000 IU/sodium heparin 2,000 IU/normal saline 50 mL (Urokinase 40,000 IU/sodium heparin 320 IU/hour) **F**: Placebo, Alteplase 2 mg/2 mL, Alteplase 2 mg/2 mL	<u>End-point of follow-up</u>: **A**: 72 hours **B**: not specified **C**: end of procedure **D**: 30 minutes **E**: 12 hours **F**: 2 hours <u>For how many participants were no complete outcome data available?</u> (intervention/control) **A**: "Participants who were randomized but not treated were classified as failures in an Intention To Treat analysis for CVC patency."	<u>Restoration of patency (critical)</u> Effect measure I vs. C, n/N, RR [95% CI]: **A**: UK 25000 17/25 vs 3/10, RR 2.27 [0.85 to 6.06] in favor of UK UK 15000 19/27 vs 3/10, RR 2.35 [0.88 to 6.24] in favor of UK UK 5000 18/26 vs 2/10, RR 3.46 [0.98 to 12.27] in favor of UK **B**: 1st installation 20/27 vs 18/23, RR 0.95 [0.69 to 1.29]; 2nd installation 21/27 vs. 19/23, RR 0.94 [0.71 to 1.24] in favor of 2mg/2ml **C**: 25/28 vs 13/22, RR 1.51 [1.04 to 2.19] in favor of AP	<u>Risk of bias (high, some concerns or low):</u> Tool used by authors: Cochrane Handbook for Systematic Reviews of Interventions **A**: high risk due to potential conflict of interest and balance of group characteristics not reported **B**: high risk due to lack of blinding and study stopped early due to low subject accrual rate **C**: Low risk **D**: unclear risk for sequence generation, allocation

	Setting and Country: single center, UK Source of funding and conflicts of interest: Not specified for Cochrane review. Three studies (Dietcher 2004; Haire 1994; Haire 2004) documented being either partly or completely supported by commercial grants from the pharmaceutical companies who manufacture the drugs under investigation.	We excluded any studies that included dialysis catheters or pulmonary artery catheters from the review unless the study presented any data on CVCs separately. *7 studies included in review, 6 of which in current analysis* Important patient characteristics at baseline: N, mean age **A**: 108 patients, 23 yrs (included children) **B**: 50 patients, 50 yrs			"Safety analysis was performed on all treated patients." **B**: Insufficient reporting of exclusions to make judgement **C**: No missing outcome data **D**: One patient in the urokinase group was treated for two separate occluded catheters. This was considered a protocol deviation and the results were excluded from the efficacy analysis. Six patients (n=4 urokinase, n=2 placebo) did not receive study drug after enrolment because the catheter was found to be patent on re-examination (n=3), no volume of drug could be instilled (n=2) or a medical event precluded participation in the study (n=1). The statistical analysis for efficacy	**D**: 64/118 vs 18/61, RR 1.84 [1.21 to 2.8] in favor of UK **E**: at 1 hour 8/21 vs 5/21, RR 1.60 [0.63 to 4.09] in favor of UK plus heparin **F**: 51/75 vs 12/74, RR 4.19 [2.44 to 7.20] in favor of AP Adverse effects **A**: UK 25000 4/25 vs 0/10, RR 3.81 [0.22 to 64.87] One subject had two events of major severity both of which were probably not related to the study drug (subarachnoid haemorrhage status post a fall and injection site haemorrhage in the setting of thrombocytopenia requiring platelet transfusion); UK 15000 2/27 vs 0/10 (epistaxis 1, metorrhagia 1), RR 1.96 [0.10 to 37.72] in favor of placebo; UK 5000 no adverse effects **B**: not reported	concealment, and other bias **E**: insufficient information for all domains **F**: High risk of bias due to study design: study is neither 'true' parallel or crossover in design Author's conclusions: There is inadequate evidence to draw strong conclusions on the efficacy or safety of the drug interventions included in this review. There is some low quality evidence from a meta-analysis of two studies investigating urokinase (various strengths) and some very low evidence from two single studies investigating alteplase 2 mg/2 mL that suggest that these two drug interventions may be effective in treating withdrawal or total occlusion of CVC

		C: 48 patients, 50 CVCs, 44 yrs **D**: 180 patients, 46 yrs **E**: 42 patients, median 54/53 yrs **F**: 149 patients, 50 yrs <u>*Sex*</u>*:* **A**: 54% male **B**: 50% male **C**: 54% female **D**: 58% female **E**: 64% female **F**: 55% female *Eligibility* **A**: Adults and children with a semi-permanent or temporary CVC **B**: CVC (single, double, or triple lumen			was performed by intention-to-treat, these six patients were included as failures in their respective randomized treatment groups even though they received no treatment. **E**: Insufficient information on outcomes **F**: Insufficient information to assess the completeness of outcome data	**C**: not reported **D**: not reported **E**: not reported **F**: not reported <u>Persistance of successful treatment</u> **A**: not reported **B**: not reported **C**: not reported **D**: not reported **E**: patency at 12 hours 16/21 vs 16/21, RR 1.00 [0.71 to 1.40] **F**: not reported <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Cost-effectiveness</u> Not reported	lumens caused by thrombosis. <u>Notes</u> The study by Moll (2006) was excluded because the comparison with Alfimeprase was not considered relevant for the Dutch situation.

		Hickman catheter or implanted port) dysfunction **C**: Acquired CVC dysfunction **D**: Any type of semi-permanent or temporary CVC (implanted ports (80); PICCs (47); non-tunnelled percutaneous (33); tunnelled CVC (18); unspecified (1)), with either withdrawal or total occlusion **E**: impairment of catheter withdrawal that was refractory to urokinase instillation. Tunnelled					

		CVC (Hickman or Groshong; Bard) or implanted port CVC (Port-A-Cath; Bard) **F**: Clinically stable with a dysfunctional indwelling long-term CVC (PICCs, CVCs with valves and implanted ports).					

Randomized controlled trial(s)

Study reference	**Study characteristics**	**Patient characteristics** [2]	**Intervention (I)**	**Comparison / control (C)** [3]	**Follow-up**	**Outcome measures and effect size** [4]	**Comments**
Gabrail, 2010 TROPICS 1 NCT 00395876	Type of study: RCT Setting and country: Multicenter, USA	Inclusion criteria: Eligible pediatric and adult patients had demonstrated CVC occlusion, defined as an inability to	Initial dose of tenecteplase Tenecteplase, tenecteplase, placebo Patients weighing 30 kg or more received 2 mg of	Initial dose of placebo Placebo, tenecteplase and tenecteplase	Length of follow-up: 120 minutes for patency, 96 hours for adverse events Loss-to-follow-up: None	Restoration of patency (critical) *Restoration of catheter function within 120 minutes after administration of the first dose (primary outcome)* TNK 30/50 (60%)	

	Funding and conflicts of interest: This study was sponsored by Genentech, Inc. Support for third-party medical writing assistance was provided by Genentech, Inc. V.C. received research funding from Amgen, Genentech, Bristol-Myers Squibb, and GlaxoSmith-Kline. V.C. received honoraria for advisory board participation of Genentech. N.A. received honorarium for speaking at a meeting of study investigators from Genentech. M.B. is employed by Genentech,	withdraw 3 mL of blood for patients weighing 10 kg or more or inability to withdraw 1 mL of blood for patients weighing less than 10 kg. Single-lumen, double-lumen, or triplelumen CVCs were allowed, including umbilical catheters or implanted ports. <u>Exclusion criteria</u>: Patients who met at least one of the following were excluded from participation: CVCs inserted less than 2 days before study treatment or CVCs known to be	study drug in 2 mL. Patients weighing less than 30 kg received instillations of study drug equal to 110% of the internal lumen volume of the dysfunctional CVC, but not more than 2 mL (2 mg).		<u>Incomplete outcome data</u>: None	Placebo 11/47 (23%) RR 2.56 [1.46 to 4.51] *30 minutes after administration* TNK 44% Placebo 19% <u>Adverse effects</u> Not reported per group. In the MITT population, 20 of 97 patients (21%) experienced at least one treatment-emergent AE within 48–96 hours of study drug administration. <u>Persistence of successful treatment</u> Not reported per group. Catheter patency was maintained in most patients who achieved restoration of CVC function. Of the 56 patients who experienced restored catheter function after Tenecteplase treatment and had	

	Inc., and has ownership interest (stock, stock options in a publicly traded company) in Genentech, Inc. M.A. is employed by Genentech, Inc., and has ownership interest (stock, stock options in a publicly traded company) in Genentech, Inc. B.S.G. is employed by Quintiles, Inc., which was contracted by Genentech, Inc., to execute the TROPICS trials. S.M.B. is employed by Genentech, Inc., and has ownership interest (stock, stock options in a publicly traded company) in	dysfunctional for more than 7 days; CVCs internally coated with a therapeutic agent; known bacteremia or known or suspected infection in the CVC; use of a power injector on the selected study CVC; evidence of mechanical, nonthrombotic occlusion of the selected study CVC; previous treatment in this study or any tenecteplase catheter clearance trial; use of any investigational drug or therapy within the previous 28 days; use of a thrombolytic agent in the				their catheters assessed within the next 7 days, 45 (80%; 95% CI 70%–91%) had functional CVCs. <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Cost-effectiveness</u> Not reported	

	Genentech, Inc. Neither of the other authors has identified a conflict of interest.	previous 24 hours; use of heparin or other anticoagulant in the previous 24 hours. N total at baseline: Intervention: 47 Control: 50 Important prognostic factors[2]: *Mean age (SD):* *I: 37 (27)* *C: 42 (28)* *Sex:* *I: 52% F* *C: 66% F* Groups were comparable at baseline.					
Pabon-Ramos, 2019	Type of study: Retrospective data review Setting and country: Single center, USA	Inclusion criteria: all adult patients (≥18 years old) who underwent port replacement or salvage in	Port replacement N=48	Port salvaged N=47 Of which Stripped N=35 Exchanged N=12	Length of follow-up: 2000-2400 days Loss-to-follow-up: Intervention: 7/48 Control: 7/49 Incomplete outcome data:	Restoration of patency (critical) replaced: 100% salvaged: 100% Adverse effects replaced: 0 salvaged: 1 port malfunction	Authors' conclusions Because there was no difference in patency, malfunction rate, or infection rate between replacement and

	Funding and conflicts of interest: No funding reported. W.M.P.-R. is a paid consultant for Medtronic (Minneapolis, Minnesota) and Guerbet (Princeton, New Jersey).	interventional radiology. <u>Exclusion criteria</u>: Pediatric patients and patients with hemodialysis or infusion catheters. <u>N total at baseline</u>: Intervention: 48 Control: 47 <u>Important prognostic factors</u>[2]: *Age, mean (range):* *I: 52 (20-82)* *C: 51 (21-86)* *Sex:* *I: 79% F* *C: 74% F* *Malignant underlying disease* *I: 83%* *C: 62%* ***P=0.02*** *Outpatient*			Not specified	that was managed with port replacement 20 days after stripping. <u>Persistence of successful treatment</u> Median primary patency replaced: 239 days salvaged: 391 days - stripped 391 days (N=35) - exchanged 666 days (N=12) Malfunction rate >30 days replaced: 3 (6%) salvaged: 8 (17%) <u>Quality of life</u> Not reported <u>Patient satisfaction</u> Not reported <u>Cost-effectiveness</u> Not reported	salvage, or between stripping and exchange, the decision to perform one technique over the other should be based on the patient's estimated lifetime venous access requirements, cost, and physician preference.

		I: 94% *C: 94%* Groups were not comparable at baseline with regard to malignancy.					

Risk of bias tabel

Systematic review(s)

2. What are the efficacy and safety of a drug intervention to restore patency compared to or placebo or another drug intervention to restore patency in patients with an occluded central venous access lumen? **Study reference** (first author, publication year)	**Was the allocation sequence adequately generated?** Definitely yes Probably yes Probably no Definitely no	**Was the allocation adequately concealed?** Definitely yes Probably yes Probably no Definitely no	**Blinding: Was knowledge of the allocated interventions adequately prevented?** **Were patients blinded?** **Were healthcare providers blinded?** **Were data collectors blinded?** **Were outcome assessors blinded?** **Were data analysts blinded?** Definitely yes	**Was loss to follow-up (missing outcome data) infrequent?** Definitely yes Probably yes Probably no Definitely no	**Are reports of the study free of selective outcome reporting?** Definitely yes Probably yes Probably no Definitely no	**Was the study apparently free of other problems that could put it at a risk of bias?** Definitely yes Probably yes Probably no Definitely no	**Overall risk of bias** **If applicable/necessary, per outcome measure** **LOW** **Some concerns** **HIGH**

			Probably yes Probably no Definitely no				
Gabrail, 2010	Definitely yes; Reason: hierarchical, dynamic algorithm, implemented through an interactive voice response system.	Probably yes; Reason: Not specified	Probably yes; Reason: To facilitate blinding, identically configured treatment kits consisting of three numbered study drug vials (for the first, second, and third instillations) were dispensed on randomization.	Definitely yes; Reason: No loss to follow-up for main outcomes.	Probably yes; Reason: All relevant outcomes were reported	Probably yes; The study was sponsored by Genentech and several authors had financial connections to Genentech	**LOW**

Randomized controlled trial(s)

Author, year	**Selection of participants** **Was selection of exposed and non-exposed cohorts drawn from**	**Exposure** **Can we be confident in the assessment of exposure?**	**Outcome of interest** **Can we be confident that the outcome of interest was not present at start of study?**	**Confounding-assessment** **Can we be confident in the assessment of confounding factors?**	**Confounding-analysis** **Did the study match exposed and unexposed for all variables that are associated with the outcome of**	**Assessment of outcome** **Can we be confident in the assessment of outcome?**	**Follow up** **Was the follow up of cohorts adequate? In particular, was outcome**	**Co-interventions** **Were co-interventions similar between groups?**	**Overall Risk of bias**

	the same population? Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	**interest or did the statistical analysis adjust for these confounding variables?** Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	**data complete or imputed?** Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Low, Some concerns, High
Pabon-Ramos, 2019	Definitely yes Reason: Participants were selected from the hospital electronic medical record	Definitely yes Reason: The criteria were clearly defined	Definitely yes Reason: selection criteria were used excluding participants with the outcome of interest at the start date	**Probably no** Reason: While some patients with malfunctioning ports are given a tissue plasminogen activator (TPA) infusion, information regarding attempts at restoring patency by administering tissue plasminogen activator was incomplete and is	**Definitely no** Reason: no matching was performed. The replacement group had a significantly higher incidence of malignancy compared to the salvage group.	Probably yes Reason: outcome reporting seems consistent.	**Probably no** Reason: Follow up was equal but considerable in both groups.	Definitely yes Reason: Additional used medication was balanced between groups	**High**

				therefore not reported.					

Exclusie tabel

Reference	Reason for exclusion
Baskin JL, Reiss U, Wilimas JA, Metzger ML, Ribeiro RC, Pui CH, Howard SC. Thrombolytic therapy for central venous catheter occlusion. Haematologica. 2012 May;97(5):641-50. doi: 10.3324/haematol.2011.050492. Epub 2011 Dec 16. PMID: 22180420; PMCID: PMC3342964.	more complete SR used
Clase CM, Crowther MA, Ingram AJ, Cinà CS. Thrombolysis for restoration of patency to haemodialysis central venous catheters: a systematic review. J Thromb Thrombolysis. 2001 Apr;11(2):127-36. doi: 10.1023/a:1011272632286. PMID: 11406727.	more recent systematic review used
Cummings-Winfield C, Mushani-Kanji T. Restoring patency to central venous access devices. Clin J Oncol Nurs. 2008 Dec;12(6):925-34. doi: 10.1188/08.CJON.925-934. PMID: 19064386.	no data to extract
da Costa ACC, Ribeiro JM, Vasques CI, De Luca Canto G, Porporatti AL, Dos Reis PED. Interventions to obstructive long-term central venous catheter in cancer patients: a meta-analysis. Support Care Cancer. 2019 Feb;27(2):407-421. doi: 10.1007/s00520-018-4500-y. Epub 2018 Oct 29. PMID: 30370471.	more complete SR used
Deitcher SR, Fraschini G, Himmelfarb J, Schuman E, Smith TJ, Schulz GA, Firszt CM, Mouginis TL. Dose-ranging trial with a recombinant urokinase (urokinase alfa) for occluded central venous catheters in oncology patients. J Vasc Interv Radiol. 2004 Jun;15(6):575-80. doi: 10.1097/01.rvi.0000124950.24134.19. PMID: 15178717.	Included in systematic review
Donati G, Colì L, Cianciolo G, La Manna G, Cuna V, Montanari M, Gozzetti F, Stefoni S. Thrombosis of tunneled-cuffed hemodialysis catheters: treatment with high-dose urokinase lock therapy. Artif Organs. 2012 Jan;36(1):21-8. doi: 10.1111/j.1525-1594.2011.01290.x. Epub 2011 Aug 16. PMID: 21848863.	hemodialysis
Ernst FR, Chen E, Lipkin C, Tayama D, Amin AN. Comparison of hospital length of stay, costs, and readmissions of alteplase versus catheter replacement among patients with occluded central venous catheters. J Hosp Med. 2014 Aug;9(8):490-6. doi: 10.1002/jhm.2208. Epub 2014 May 14. PMID: 24825837; PMCID: PMC4374705.	No relevant outcomes reported
Haire WD, Deitcher SR, Mullane KM, Jaff MR, Firszt CM, Schulz GA, Schuerr DM, Schwartz LB, Mouginis TL, Barton RP. Recombinant urokinase for restoration of patency in occluded central venous access devices. A double-blind, placebo-controlled trial. Thromb Haemost. 2004 Sep;92(3):575-82. doi: 10.1160/TH03-11-0686. PMID: 15351854.	Included in systematic review
Hilleman D, Campbell J. Efficacy, safety, and cost of thrombolytic agents for the management of dysfunctional hemodialysis catheters: a systematic review. Pharmacotherapy. 2011 Oct;31(10):1031-40. doi: 10.1592/phco.31.10.1031. PMID: 21950645.	more recent systematic review used
Kennard AL, Walters GD, Jiang SH, Talaulikar GS. Interventions for treating central venous haemodialysis catheter malfunction. Cochrane Database Syst Rev. 2017 Oct 26;10(10):CD011953. doi:	hemodialysis

10.1002/14651858.CD011953.pub2. PMID: 29106711; PMCID: PMC6485653.	
Lok CE, Thomas A, Vercaigne L; Canadian Hemodialysis Catheter Working Group. A patient-focused approach to thrombolytic use in the management of catheter malfunction. Semin Dial. 2006 Sep-Oct;19(5):381-90. doi: 10.1111/j.1525-139X.2006.00168.x. PMID: 16970738.	wrong publication type
Macrae JM, Loh G, Djurdjev O, Shalansky S, Werb R, Levin A, Kiaii M. Short and long alteplase dwells in dysfunctional hemodialysis catheters. Hemodial Int. 2005 Apr;9(2):189-95. doi: 10.1111/j.1492-7535.2005.01131.x. PMID: 16191068.	hemodialysis
Moll S, Kenyon P, Bertoli L, De Maio J, Homesley H, Deitcher SR. Phase II trial of alfimeprase, a novel-acting fibrin degradation agent, for occluded central venous access devices. J Clin Oncol. 2006 Jul 1;24(19):3056-60. doi: 10.1200/JCO.2006.05.8438. PMID: 16809729.	Included in systematic review
Phelps KC, Verzino KC. Alternatives to urokinase for the management of central venous catheter occlusion. Hospital Pharmacy. 2001 Mar;36(3):265-74.	wrong study design
Pollo V, Dionízio D, Bucuvic EM, Castro JH, Ponce D. Alteplase vs. urokinase for occluded hemodialysis catheter: A randomized trial. Hemodial Int. 2016 Jul;20(3):378-84. doi: 10.1111/hdi.12391. Epub 2016 Feb 7. PMID: 26851872.	hemodialysis
Ponec D, Irwin D, Haire WD, Hill PA, Li X, McCluskey ER; COOL Investigators. Recombinant tissue plasminogen activator (alteplase) for restoration of flow in occluded central venous access devices: a double-blind placebo-controlled trial--the Cardiovascular Thrombolytic to Open Occluded Lines (COOL) efficacy trial. J Vasc Interv Radiol. 2001 Aug;12(8):951-5. doi: 10.1016/s1051-0443(07)61575-9. PMID: 11487675.	Included in systematic review
Tumlin J, Goldman J, Spiegel DM, Roer D, Ntoso KA, Blaney M, Jacobs J, Gillespie BS, Begelman SM. A phase III, randomized, double-blind, placebo-controlled study of tenecteplase for improvement of hemodialysis catheter function: TROPICS 3. Clin J Am Soc Nephrol. 2010 Apr;5(4):631-6. doi: 10.2215/CJN.06520909. Epub 2010 Feb 4. PMID: 20133491; PMCID: PMC2849682.	hemodialysis
Vercaigne LM, Zacharias J, Bernstein KN. Alteplase for blood flow restoration in hemodialysis catheters: a multicenter, randomized, prospective study comparing "dwell" versus "push" administration. Clin Nephrol. 2012 Oct;78(4):287-96. doi: 10.5414/CN107351. PMID: 22541682.	hemodialysis
Zacharias JM, Weatherston CP, Spewak CR, Vercaigne LM. Alteplase versus urokinase for occluded hemodialysis catheters. Ann Pharmacother. 2003 Jan;37(1):27-33. doi: 10.1345/aph.1C105. PMID: 12503929.	wrong study design

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: NVvH Centraal veneuze toegang	
Uitgangsvraag/modules: UV9a Wat is de optimale behandeling voor een geoccludeerde centraal veneuze katheter?	
Database(s): Embase.com, Ovid/Medline	Datum: 24 november 2023
Periode: vanaf 2000 (Embase) en 2018 (Medline)	Talen: geen restrictie

Literatuurspecialist: Alies van der Wal	Rayyan review: https://rayyan.ai/reviews/855236
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Deduplication: voor het ontdubbelen is gebruik gemaakt van http://dedupendnote.nl/	
Toelichting: Voor deze vraag is gezocht op de elementen: - centraal veneuze katheter - occlusie - trombolyse →Het sleutelartikel (PMID 30370471) wordt gevonden met deze search. →Er is voor gekozen om in Medline te zoeken vanaf de searchdate van het sleutelartikel (22 januari 2018). Omdat voor het sleutelartikel niet in Embase was gezocht, is er in Embase gezocht vanaf 2000.	
Te gebruiken voor richtlijntekst: In de databases Embase.com en Ovid/Medline is op 24 november 2023 systematisch gezocht naar systematische reviews en RCTs over trombolyse bij een geoccludeerde centraal veneuze katheter. De literatuurzoekactie leverde 226 unieke treffers op.	

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SR	54	20	63
RCT	163	20	163
Totaal	217	40	**226***

in Rayyan

Zoekstrategie

Embase.com

No.	**Query**	**Results**
#1	'central venous catheter'/exp OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous OR intravascular OR vascular OR cardiovascular) NEAR/3 (catheter* OR access OR line* OR device* OR port OR ports)):ti,ab,kw) OR cvc:ti,ab,kw OR 'vascular access'/exp OR 'vascular access device'/exp OR 'peripherally inserted central venous catheter'/exp OR ((peripheral* NEAR/3 (insert* OR catheter* OR line)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR portacath:ti,ab,kw OR ((('venous access' OR 'vascular access' OR 'central venous' OR cv OR implant* OR catheter*) NEAR/2 port*):ti,ab,kw) OR 'implantable port system'/exp OR 'total* implant*':ti,ab,kw OR ((implant* NEAR/2 (vascular OR venous) NEAR/2 device*):ti,ab,kw) OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR hickman*:ti,ab,kw OR (((tunnel* OR cuffed) NEAR/3 (catheter* OR 'central catheter*' OR line* OR picc OR piccs OR cvc OR cvad*)):ti,ab,kw) OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR noncuffed:ti,ab,kw OR vascath*:ti,ab,kw OR 'subclavian vein catheter'/exp OR ((central NEAR/3 (cath* OR line*)):ti,ab,kw)	119652
#2	'catheter occlusion'/exp OR (((catheter* OR port OR picc OR 'central line' OR cvc OR cvad* OR 'access device*') NEAR/5 (occlus* OR occlud* OR obstruct* OR block* OR clot OR clots OR clotting OR declot* OR thrombos* OR thrombotic* OR thrombus OR dysfunction* OR malfunction*)):ti,ab,kw) OR ((line NEAR/2 (occlus* OR occlud* OR obstruct* OR thrombos* OR thrombotic* OR dysfunction*)):ti,ab,kw) OR ((patency NEAR/3 (loss OR restor*)):ti,ab,kw) OR 'fibrin sheath'/exp OR 'fibrin sheath*':ti,ab,kw OR (((drug OR medicat* OR mineral OR electrolyte* OR lipid*) NEAR/2 (precipitat* OR deposit*)):ti,ab,kw)	38357

#3	'fibrinolytic therapy'/exp OR 'fibrinolytic agent'/exp OR 'fibrinolysis'/exp OR 'plasminogen activator'/exp OR thrombolysis:ti,ab,kw OR thrombolyses:ti,ab,kw OR thrombolytic:ti,ab,kw OR fibrinolysis:ti,ab,kw OR fibrinolyses:ti,ab,kw OR fibrinolytic:ti,ab,kw OR 'clot lysis':ti,ab,kw OR 'urokinase'/exp OR 'urokinase':ti,ab,kw OR 'alteplase'/exp OR 'alteplase':ti,ab,kw OR 'actilyse':ti,ab,kw OR 'plasminogen activator*':ti,ab,kw OR 'rt pa':ti,ab,kw OR tpa:ti,ab,kw OR 'tenecteplase'/exp OR 'tenecteplase':ti,ab,kw OR 'tnk tpa':ti,ab,kw OR 'metalyse':ti,ab,kw OR 'reteplase'/exp OR 'reteplase':ti,ab,kw OR 'bm 06.022':ti,ab,kw OR 'staphylokinase'/exp OR 'staphylokinase':ti,ab,kw	289355
#4	#1 AND #2 AND #3 NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal'/exp OR 'animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp) NOT (('adolescent'/exp OR 'child'/exp OR adolescent*:ti,ab,kw OR child*:ti,ab,kw OR schoolchild*:ti,ab,kw OR infant*:ti,ab,kw OR girl*:ti,ab,kw OR boy*:ti,ab,kw OR teen:ti,ab,kw OR teens:ti,ab,kw OR teenager*:ti,ab,kw OR youth*:ti,ab,kw OR pediatr*:ti,ab,kw OR paediatr*:ti,ab,kw OR puber*:ti,ab,kw) NOT ('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR adult*:ti,ab,kw OR man:ti,ab,kw OR men:ti,ab,kw OR woman:ti,ab,kw OR women:ti,ab,kw))	747
#5	#4 AND [2000-2024]/py	596
#6	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	980759
#7	'clinical trial'/exp OR 'randomization'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR 'placebo'/exp OR 'prospective study'/exp OR rct:ab,ti OR random*:ab,ti OR 'single blind':ab,ti OR 'randomised controlled trial':ab,ti OR 'randomized controlled trial'/exp OR placebo*:ab,ti	3922096
#8	#5 AND #6 = SR	54
#9	#5 AND #7 NOT #8 = RCT	163
#10	#8 OR #9	217

Ovid/Medline

#	Searches	Results
1	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous or intravascular or vascular or cardiovascular) adj3 (catheter* or access or line* or device* or port or ports)).ti,ab,kf. or cvc.ti,ab,kf. or Vascular Access Devices/ or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter* or line)).ti,ab,kf. or picc*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or portacath.ti,ab,kf. or (('venous access' or 'vascular access' or 'central venous' or cv or implant* or catheter*) adj2 port*).ti,ab,kf. or 'total* implant*'.ti,ab,kf. or (implant* adj2 (vascular or venous) adj2 device*).ti,ab,kf. or tivad*.ti,ab,kf. or tivap*.ti,ab,kf. or hickman*.ti,ab,kf. or ((tunnel* or cuffed) adj3 (catheter* or 'central catheter*' or line* or picc or piccs or cvc or cvad*)).ti,ab,kf. or broviac.ti,ab,kf. or leonard.ti,ab,kf. or	64215

	groshong.ti,ab,kf. or cook.ti,ab,kf. or permcath.ti,ab,kf. or tesio.ti,ab,kf. or nontunnel*.ti,ab,kf. or noncuffed.ti,ab,kf. or vascath*.ti,ab,kf. or (central adj3 (cath* or line*)).ti,ab,kf.	
2	exp Catheter Obstruction/ or ((catheter* or port or picc or 'central line' or cvc or cvad* or 'access device*') adj5 (occlus* or occlud* or obstruct* or block* or clot or clots or clotting or declot* or thrombos* or thrombotic* or thrombus or dysfunction* or malfunction*)).ti,ab,kf. or (line adj2 (occlus* or occlud* or obstruct* or thrombos* or thrombotic* or dysfunction*)).ti,ab,kf. or (patency adj3 (loss or restor*)).ti,ab,kf. or 'fibrin sheath*'.ti,ab,kf. or ((drug or medicat* or mineral or electrolyte* or lipid*) adj2 (precipitat* or deposit*)).ti,ab,kf.	25506
3	exp Fibrinolytic Agents/ or exp Fibrinolysis/ or exp Plasminogen Activators/ or exp Thrombolytic Therapy/ or thrombolysis.ti,ab,kf. or thrombolyses.ti,ab,kf. or thrombolytic.ti,ab,kf. or fibrinolysis.ti,ab,kf. or fibrinolyses.ti,ab,kf. or fibrinolytic.ti,ab,kf. or 'clot lysis'.ti,ab,kf. or exp Urokinase-Type Plasminogen Activator/ or 'urokinase'.ti,ab,kf. or 'alteplase'.ti,ab,kf. or 'actilyse'.ti,ab,kf. or 'plasminogen activator*'.ti,ab,kf. or 'rt pa'.ti,ab,kf. or tpa.ti,ab,kf. or exp Tenecteplase/ or 'tenecteplase'.ti,ab,kf. or 'tnk tpa'.ti,ab,kf. or 'metalyse'.ti,ab,kf. or 'reteplase'.ti,ab,kf. or "bm 06.022".ti,ab,kf. or 'staphylokinase'.ti,ab,kf.	281097
4	(1 and 2 and 3) not (comment/ or editorial/ or letter/) not ((exp animals/ or exp models, animal/) not humans/) not ((Adolescent/ or Child/ or Infant/ or adolescen*.ti,ab,kf. or child*.ti,ab,kf. or schoolchild*.ti,ab,kf. or infant*.ti,ab,kf. or girl*.ti,ab,kf. or boy*.ti,ab,kf. or teen.ti,ab,kf. or teens.ti,ab,kf. or teenager*.ti,ab,kf. or youth*.ti,ab,kf. or pediatr*.ti,ab,kf. or paediatr*.ti,ab,kf. or puber*.ti,ab,kf.) not (Adult/ or adult*.ti,ab,kf. or man.ti,ab,kf. or men.ti,ab,kf. or woman.ti,ab,kf. or women.ti,ab,kf.))	753
5	4 and 20180122:20231124.(dt).	119
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	709476
7	exp clinical trial/ or randomized controlled trial/ or exp clinical trials as topic/ or randomized controlled trials as topic/ or Random Allocation/ or Double-Blind Method/ or Single-Blind Method/ or (clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or multicenter study or clinical trial).pt. or random*.ti,ab. or (clinic* adj trial*).tw. or ((singl* or doubl* or treb* or tripl*) adj (blind$3 or mask$3)).tw. or Placebos/ or placebo*.tw.	2661177
8	5 and 6 = SR	20
9	(5 and 7) not 8 = RCT	20
10	8 or 9	40

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: NVvH Centraal veneuze toegang	
Uitgangsvraag/modules: UV9b Wat is de optimale behandeling voor een geoccludeerde centraal veneuze katheter?	
Database(s): Embase.com, Ovid/Medline	Datum: 24 november 2023
Periode: vanaf 2008	Talen: geen restrictie

Literatuurspecialist: Alies van der Wal	Rayyan review: https://rayyan.ai/reviews/855242
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Deduplication: voor het ontdubbelen is gebruik gemaakt van http://dedupendnote.nl/	
Toelichting: Voor deze vraag is gezocht op de elementen: - centraal veneuze katheter - occlusie - katheterwissel Er is geen sleutelartikel voor deze search	
Te gebruiken voor richtlijntekst: In de databases Embase.com en Ovid/Medline is op 24 november 2023 systematisch gezocht naar systematische reviews, RCTs en observationele studies over katheterwissel bij een geoccludeerde centraal veneuze katheter. De literatuurzoekactie leverde 654 unieke treffers op.	

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SR	54	34	54
RCT	203	103	235
Observationele studies	319	271	365
Totaal	576	408	**654***

in Rayyan

Zoekstrategie

Embase.com

No.	**Query**	**Results**
#1	'central venous catheter'/exp OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous OR intravascular OR vascular OR cardiovascular) NEAR/3 (catheter* OR access OR line* OR device* OR port OR ports)):ti,ab,kw) OR cvc:ti,ab,kw OR 'vascular access'/exp OR 'vascular access device'/exp OR 'peripherally inserted central venous catheter'/exp OR ((peripheral* NEAR/3 (insert* OR catheter* OR line)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR portacath:ti,ab,kw OR ((('venous access' OR 'vascular access' OR 'central venous' OR cv OR implant* OR catheter*) NEAR/2 port*):ti,ab,kw) OR 'implantable port system'/exp OR 'total* implant*':ti,ab,kw OR ((implant* NEAR/2 (vascular OR venous) NEAR/2 device*):ti,ab,kw) OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp OR 'hickman catheter'/exp OR hickman*:ti,ab,kw OR (((tunnel* OR cuffed) NEAR/3 (catheter* OR 'central catheter*' OR line* OR picc OR piccs OR cvc OR cvad*)):ti,ab,kw) OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR noncuffed:ti,ab,kw OR vascath*:ti,ab,kw OR 'subclavian vein catheter'/exp OR ((central NEAR/3 (cath* OR line*)):ti,ab,kw)	119652
#2	'catheter occlusion'/exp OR (((catheter* OR port OR picc OR 'central line' OR cvc OR cvad* OR 'access device*') NEAR/5 (occlus* OR occlud* OR obstruct* OR block* OR clot OR clots OR clotting OR declot* OR thrombos* OR thrombotic* OR thrombus OR dysfunction* OR malfunction*)):ti,ab,kw) OR ((line NEAR/2 (occlus* OR occlud* OR obstruct* OR thrombos* OR thrombotic* OR dysfunction*)):ti,ab,kw) OR ((patency NEAR/3 (loss OR restor*)):ti,ab,kw) OR 'fibrin sheath'/exp OR 'fibrin sheath*':ti,ab,kw OR (((drug OR medicat* OR mineral OR electrolyte* OR lipid*) NEAR/2 (precipitat* OR deposit*)):ti,ab,kw)	38357

#3	'catheter removal'/exp OR 'sheath removal'/exp OR 'guidewire exchange':ti,ab,kw OR 'guide wire exchange':ti,ab,kw OR (('guide wire'/exp OR 'catheter'/exp) AND (remov*:ti,ab,kw OR reinsert*:ti,ab,kw OR exchange:ti,ab,kw OR explant*:ti,ab,kw OR withdrawal:ti,ab,kw)) OR (((catheter* OR cvc OR pvc OR line OR port* OR picc OR tivad OR tivap OR device* OR hickman) NEAR/5 (remov* OR reinsert* OR replac* OR exchange OR explant* OR withdrawal)):ti,ab,kw) OR ((('fibrin sheath' OR 'catheter sheath*' OR 'catheter related sheath*') NEAR/3 (strip* OR unclog OR salvage OR remov* OR withdraw* OR disrupt*)):ti,ab,kw)	76874
#4	#1 AND #2 AND #3 NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal'/exp OR 'animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp) NOT (('adolescent'/exp OR 'child'/exp OR adolescent*:ti,ab,kw OR child*:ti,ab,kw OR schoolchild*:ti,ab,kw OR infant*:ti,ab,kw OR girl*:ti,ab,kw OR boy*:ti,ab,kw OR teen:ti,ab,kw OR teens:ti,ab,kw OR teenager*:ti,ab,kw OR youth*:ti,ab,kw OR pediatr*:ti,ab,kw OR paediatr*:ti,ab,kw OR puber*:ti,ab,kw) NOT ('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR adult*:ti,ab,kw OR man:ti,ab,kw OR men:ti,ab,kw OR woman:ti,ab,kw OR women:ti,ab,kw))	1271
#5	#4 AND [2008-2024]/py	845
#6	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	980759
#7	'clinical trial'/exp OR 'randomization'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR 'placebo'/exp OR 'prospective study'/exp OR rct:ab,ti OR random*:ab,ti OR 'single blind':ab,ti OR 'randomised controlled trial':ab,ti OR 'randomized controlled trial'/exp OR placebo*:ab,ti	3922096
#8	'major clinical study'/de OR 'clinical study'/de OR 'case control study'/de OR 'family study'/de OR 'longitudinal study'/de OR 'retrospective study'/de OR 'prospective study'/de OR 'comparative study'/de OR 'cohort analysis'/de OR ((cohort NEAR/1 (study OR studies)):ab,ti) OR (('case control' NEAR/1 (study OR studies)):ab,ti) OR (('follow up' NEAR/1 (study OR studies)):ab,ti) OR (observational NEAR/1 (study OR studies)) OR ((epidemiologic NEAR/1 (study OR studies)):ab,ti) OR (('cross sectional' NEAR/1 (study OR studies)):ab,ti)	6767914
#9	'case control study'/de OR 'comparative study'/exp OR 'control group'/de OR 'controlled study'/de OR 'controlled clinical trial'/de OR 'crossover procedure'/de OR 'double blind procedure'/de OR 'phase 2 clinical trial'/de OR 'phase 3 clinical trial'/de OR 'phase 4 clinical trial'/de OR 'pretest posttest design'/de OR 'pretest posttest control group design'/de OR 'quasi experimental study'/de OR 'single blind procedure'/de OR 'triple blind procedure'/de OR (((control OR controlled) NEAR/6 trial):ti,ab,kw) OR (((control OR controlled) NEAR/6 (study OR studies)):ti,ab,kw) OR (((control OR controlled) NEAR/1 active):ti,ab,kw) OR 'open label*':ti,ab,kw OR (((double OR two OR three OR multi OR trial) NEAR/1 (arm OR arms)):ti,ab,kw) OR ((allocat* NEAR/10 (arm OR arms)):ti,ab,kw) OR placebo*:ti,ab,kw OR 'sham-control*':ti,ab,kw OR (((single OR double OR triple OR assessor) NEAR/1 (blind* OR	14606125

	masked)):ti,ab,kw) OR nonrandom*:ti,ab,kw OR 'non-random*':ti,ab,kw OR 'quasi-experiment*':ti,ab,kw OR crossover:ti,ab,kw OR 'cross over':ti,ab,kw OR 'parallel group*':ti,ab,kw OR 'factorial trial':ti,ab,kw OR ((phase NEAR/5 (study OR trial)):ti,ab,kw) OR ((case* NEAR/6 (matched OR control*)):ti,ab,kw) OR ((match* NEAR/6 (pair OR pairs OR cohort* OR control* OR group* OR healthy OR age OR sex OR gender OR patient* OR subject* OR participant*)):ti,ab,kw) OR ((propensity NEAR/6 (scor* OR match*)):ti,ab,kw) OR versus:ti OR vs:ti OR compar*:ti OR ((compar* NEAR/1 study):ti,ab,kw) OR (('major clinical study'/de OR 'clinical study'/de OR 'cohort analysis'/de OR 'observational study'/de OR 'cross-sectional study'/de OR 'multicenter study'/de OR 'correlational study'/de OR 'follow up'/de OR cohort*:ti,ab,kw OR 'follow up':ti,ab,kw OR followup:ti,ab,kw OR longitudinal*:ti,ab,kw OR prospective*:ti,ab,kw OR retrospective*:ti,ab,kw OR observational*:ti,ab,kw OR 'cross sectional*':ti,ab,kw OR cross?ectional*:ti,ab,kw OR multicent*:ti,ab,kw OR 'multi-cent*':ti,ab,kw OR consecutive*:ti,ab,kw) AND (group:ti,ab,kw OR groups:ti,ab,kw OR subgroup*:ti,ab,kw OR versus:ti,ab,kw OR vs:ti,ab,kw OR compar*:ti,ab,kw OR 'odds ratio*':ab OR 'relative odds':ab OR 'risk ratio*':ab OR 'relative risk*':ab OR 'rate ratio':ab OR aor:ab OR arr:ab OR rrr:ab OR ((('or' OR 'rr') NEAR/6 ci):ab)))	
#10	#5 AND #6 = SR	54
#11	#5 AND #7 NOT #10 = RCT	203
#12	#5 AND (#8 OR #9) NOT (#10 OR #11) = observationeel	319
#13	#10 OR #11 OR #12	576

Ovid/Medline

#	Searches	Results
1	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous or intravascular or vascular or cardiovascular) adj3 (catheter* or access or line* or device* or port or ports)).ti,ab,kf. or cvc.ti,ab,kf. or Vascular Access Devices/ or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter* or line)).ti,ab,kf. or picc*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or portacath.ti,ab,kf. or (('venous access' or 'vascular access' or 'central venous' or cv or implant* or catheter*) adj2 port*).ti,ab,kf. or 'total* implant*'.ti,ab,kf. or (implant* adj2 (vascular or venous) adj2 device*).ti,ab,kf. or tivad*.ti,ab,kf. or tivap*.ti,ab,kf. or hickman*.ti,ab,kf. or ((tunnel* or cuffed) adj3 (catheter* or 'central catheter*' or line* or picc or piccs or cvc or cvad*)).ti,ab,kf. or broviac.ti,ab,kf. or leonard.ti,ab,kf. or groshong.ti,ab,kf. or cook.ti,ab,kf. or permcath.ti,ab,kf. or tesio.ti,ab,kf. or nontunnel*.ti,ab,kf. or noncuffed.ti,ab,kf. or vascath*.ti,ab,kf. or (central adj3 (cath* or line*)).ti,ab,kf.	64215
2	exp Catheter Obstruction/ or ((catheter* or port or picc or 'central line' or cvc or cvad* or 'access device*') adj5 (occlus* or occlud* or obstruct* or block* or clot or clots or clotting or declot* or thrombos* or thrombotic* or thrombus or dysfunction* or malfunction*)).ti,ab,kf. or (line adj2 (occlus* or occlud* or obstruct* or thrombos* or thrombotic* or dysfunction*)).ti,ab,kf. or (patency adj3 (loss or restor*)).ti,ab,kf. or 'fibrin sheath*'.ti,ab,kf. or ((drug or medicat* or mineral or electrolyte* or lipid*) adj2 (precipitat* or deposit*)).ti,ab,kf.	25506
3	exp Device Removal/ or 'guidewire exchange'.ti,ab,kf. or 'guide wire exchange'.ti,ab,kf. or (exp Catheters/ and (remov* or reinsert* or exchange or explant* or withdrawal).ti,ab,kf.) or ((catheter* or cvc or pvc or line or port* or picc or tivad or tivap or device* or hickman) adj5 (remov* or reinsert* or replac* or exchange or explant* or withdrawal)).ti,ab,kf. or (('fibrin sheath' or 'catheter sheath*' or 'catheter related sheath*') adj3 (strip* or unclog or salvage or remov* or withdraw* or disrupt*)).ti,ab,kf.	48339
4	(1 and 2 and 3) not (comment/ or editorial/ or letter/) not ((exp animals/ or exp models, animal/) not humans/) not ((Adolescent/ or Child/ or Infant/ or adolescen*.ti,ab,kf. or child*.ti,ab,kf. or schoolchild*.ti,ab,kf. or infant*.ti,ab,kf. or girl*.ti,ab,kf. or boy*.ti,ab,kf. or teen.ti,ab,kf. or teens.ti,ab,kf. or teenager*.ti,ab,kf. or youth*.ti,ab,kf.	1005

	or pediatr*.ti,ab,kf. or paediatr*.ti,ab,kf. or puber*.ti,ab,kf.) not (Adult/ or adult*.ti,ab,kf. or man.ti,ab,kf. or men.ti,ab,kf. or woman.ti,ab,kf. or women.ti,ab,kf.))	
5	limit 4 to yr="2008 -Current"	601
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	709476
7	exp clinical trial/ or randomized controlled trial/ or exp clinical trials as topic/ or randomized controlled trials as topic/ or Random Allocation/ or Double-Blind Method/ or Single-Blind Method/ or (clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or multicenter study or clinical trial).pt. or random*.ti,ab. or (clinic* adj trial*).tw. or ((singl* or doubl* or treb* or tripl*) adj (blind$3 or mask$3)).tw. or Placebos/ or placebo*.tw.	2661177
8	Epidemiologic studies/ or case control studies/ or exp cohort studies/ or Controlled Before-After Studies/ or Case control.tw. or cohort.tw. or Cohort analy$.tw. or (Follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or Longitudinal.tw. or Retrospective*.tw. or prospective*.tw. or consecutive*.tw. or Cross sectional.tw. or Cross-sectional studies/ or historically controlled study/ or interrupted time series analysis/ [Onder exp cohort studies vallen ook longitudinale, prospectieve en retrospectieve studies]	4590541
9	Case-control Studies/ or clinical trial, phase ii/ or clinical trial, phase iii/ or clinical trial, phase iv/ or comparative study/ or control groups/ or controlled before-after studies/ or controlled clinical trial/ or double-blind method/ or historically controlled study/ or matched-pair analysis/ or single-blind method/ or (((control or controlled) adj6 (study or studies or trial)) or (compar* adj (study or studies)) or ((control or controlled) adj1 active) or "open label*" or ((double or two or three or multi or trial) adj (arm or arms)) or (allocat* adj10 (arm or arms)) or placebo* or "sham-control*" or ((single or double or triple or assessor) adj1 (blind* or masked)) or nonrandom* or "non-random*" or "quasi-experiment*" or "parallel group*" or "factorial trial" or "pretest posttest" or (phase adj5 (study or trial)) or (case* adj6 (matched or control*)) or (match* adj6 (pair or pairs or cohort* or control* or group* or healthy or age or sex or gender or patient* or subject* or participant*)) or (propensity adj6 (scor* or match*))).ti,ab,kf. or (confounding adj6 adjust*).ti,ab. or (versus or vs or compar*).ti. or ((exp cohort studies/ or epidemiologic studies/ or multicenter study/ or observational study/ or seroepidemiologic studies/ or (cohort* or 'follow up' or followup or longitudinal* or prospective* or retrospective* or observational* or multicent* or 'multi-cent*' or consecutive*).ti,ab,kf.) and ((group or groups or subgroup* or versus or vs or compar*).ti,ab,kf. or ('odds ratio*' or 'relative odds' or 'risk ratio*' or 'relative risk*' or aor or arr or rrr).ab. or (("OR" or "RR") adj6 CI).ab.))	5565214
10	5 and 6 = SR	34
11	(5 and 7) not 10 = RCT	103
12	(5 and (8 or 9)) not (10 or 11) = observationeel	271
13	10 or 11 or 12	408

Module 10: Lijnvrij interval

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Reference	Reason for exclusion
Almeida (2022)	Wrong study population.
Böhlke (2015)	Wrong study design.
Buetti (2019)	Wrong study design.
Chaftari (2014)	Wrong study design.
Ghide (2010)	Wrong study design.
Ho (2012)	Wrong study design.
Katneni (2007)	Wrong study design.
Mellinghoff (2018)	Wrong study design.
Miller (2012)	Wrong study design.
Saleh (2017)	Wrong study design.
Zhong (2022)	Wrong study design.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de optimale duur tussen het verwijderen en plaatsen van een nieuwe lijn in het geval van infectie aan de centraal veneuze toegang?	
Database(s): Ovid/Medline, Embase.com	Datum: 26 september 2022
Periode: 2007 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	

Toelichting:
Er werden in eerste instantie veel (>1000) hits gevonden voor deze vraag. Toevoegen van een zoekelement met het *tijdselement (early/delay)* had niet de voorkeur omdat dit niet altijd duidelijk of eenduidig gerapporteerd wordt. Met de adviseur besloten om daarom eerst te zoeken naar SR en RCT met de volgende elementen:

- Centraal veneuze lijn
- Infectie van de CVC
- Verwijderen/verwisselen van de katheter

Op basis van de eerste selectie, kan bepaald worden of en hoe er eventueel voor observationeel onderzoek verder gezocht kan worden.

Zoekopbrengst

	EMBASE	**OVID/MEDLINE**	**Ontdubbeld**
SRs	123	110	128
RCT	182	188	220
Observationele studies			
Totaal	305	298	**348**

Zoekstrategie
Embase.com

No.	**Query**	**Results**
#15	#13 OR #14	305
#14	#10 AND #12 NOT #13	182
#13	#10 AND #11	123
#12	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	1839814

#11	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	733409
#10	#7 AND #8 AND #9 AND ([english]/lim OR [dutch]/lim) AND [2007-2022]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	1866
#9	'catheter removal'/exp/mj OR 'guidewire exchange':ti,ab,kw OR (('guide wire'/exp OR 'catheter'/exp) AND (remov*:ti,ab,kw OR reinsert*:ti,ab,kw OR replace*:ti,ab,kw OR exchange:ti,ab,kw)) OR (((catheter* OR cvc OR line) NEAR/5 (remov* OR reinsert* OR replace* OR exchange OR without OR free)):ti,ab,kw)	66632
#8	'catheter infection'/exp/mj OR 'infection'/exp/mj OR infect*:ti,ab,kw OR 'sepsis'/exp/mj OR sepsis:ti,ab,kw OR septic:ti,ab,kw OR bact?eremia:ti,ab,kw OR septic?emia:ti,ab,kw OR fung?emia:ti,ab,kw OR candid?emia:ti,ab,kw	4195128
#7	'central venous catheter'/exp/mj OR 'central venous catheterization'/exp/mj OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw) OR 'peripherally inserted central venous catheter'/exp/mj OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'implantable port system'/exp/mj OR port*:ti,ab,kw OR 'total* implantable':ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'tunneled central venous catheter'/exp/mj OR 'hickman catheter'/exp/mj OR hickman*:ti,ab,kw OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp/mj OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp/mj OR (((intravascular OR intravenous OR venous OR vascular OR cardiovascular) NEAR/3 catheter*):ti) OR cvc:ti,ab,kw OR ((central NEAR/3 line*):ti,ab,kw)	632534

Ovid/Medline

#	Searches	Results
11	9 or 10	298
10	(6 and 8) not 9	188

9	6 and 7	110
8	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1548834
7	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	620113
6	limit 5 to ((english language or dutch) and yr="2007 -Current")	1796
5	4 not (comment/ or editorial/ or letter/ or ((exp animals/ or exp models, animal/) not humans/))	3303
4	1 and 2 and 3	3409
3	exp Device Removal/ or (exp *Catheters/ and (remov* or reinsert* or replace* or exchange).ti,ab,kf.) or 'guidewire exchange'.ti,ab,kf. or ((catheter* or cvc or line) adj5 (remov* or reinsert* or replace* or exchange or without or free)).ti,ab,kf.	41261
2	exp Catheter-Related Infections/ or exp Infections/ or exp Sepsis/ or infect*.ti,ab,kf. or (sepsis or septic or bact?eremia or septic?emia or fung?emia or candid?emia).ti,ab,kf.	3868572
1	exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or port*).ti,ab,kf. or ((intravascular or intravenous or venous or vascular or cardiovascular) adj3 catheter*).ti. or cvc.ti,ab,kf. or (central adj3 line*).ti,ab,kf.	481691

Module 11: Voorlichting en communicatie

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Niet van toepassing.

Zoekverantwoording

Niet van toepassing.

Module 12: Vaattoegangsteam

Evidence tabel

Study reference	Study characteristics	Patient characteristics [2]	Intervention (I)	Comparison / control (C) [3]	Follow-up	Outcome measures and effect size [4]	Comments
Savage (2019)	Type of study: Observational study. Setting and country: Tertiary care center in western Kentucky. Funding and conflicts of interest: The authors of this article have no conflicts of interest to disclose	Inclusion criteria: • No information. Exclusion criteria: • No information. N total at baseline: No information.	Describe intervention (treatment/procedure/test): VAT	Describe control (treatment/procedure/test): Pre-VAT	Length of follow-up: Not applicable. Loss-to-follow-up: Not applicable.	Central line utilization *Before VAT implementation* 19.7% *During VAT implementation* 15.9% *After VAT implementation* 10.8%) CLABSI incidence *Before VAT implementation* N = 20 *During VAT implementation* N = 7	Author's conclusion: A dedicated VAT contributed to the reduction of central line usage and helped to prevent CLABSIs. When compar- ing a 16-month period before and after the creation of the VAT, central line usage decreased by 45.2% and central line infections decreased by 90%. Hospitals struggling with increased CLABSI rates and incidence of central line infec- tions would benefit from the creation of a team dedicated to monitoring central line usage as well as educating nurs- es about proper care and maintenance. While a VAT can contribute to decreased central line use as well as better care and maintenance, further inquiry is needed to identify and develop new methods to increase the effectiveness of these results. While this study specifically addressed the complication of

						After VAT implementation N = 2 <u>CLABSI rate</u> *Before VAT implementation* 1.6 infections pe 1000 central line days. *During VAT implementation* 1 infection per 1000 central line days. *After VAT implementation* 0.32 infections per 1000 central line days.	CLABSI, further research is warranted to determine whether rates of other complications, such as phlebitis and thrombosis, are affected.

Risk of bias tabel

Author, year	**Selection of participants** **Was selection of exposed and non-exposed cohorts drawn**	**Exposure** **Can we be confident in the assessment of exposure?**	**Outcome of interest** **Can we be confident that the outcome of interest was not**	**Confounding-assessment** **Can we be confident in the assessment of**	**Confounding-analysis** **Did the study match exposed and unexposed for all variables that are**	**Assessment of outcome** **Can we be confident in the assessment of outcome?**	**Follow up** **Was the follow up of cohorts adequate? In particular, was outcome data**	**Co-interventions** **Were co-interventions similar between groups?**	**Overall Risk of bias**

	from the same population?		**present at start of study?**	**confounding factors?**	**associated with the outcome of interest or did the statistical analysis adjust for these confounding variables?**		**complete or imputed?**		
	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Definitely yes, probably yes, probably no, definitely no	Low, Some concerns, High
Savage (2019)	*Definitely no* To evaluate the outcomes of the VAT, this study compared the utilization rate of central lines (including PICCs), incidence of CLABSI, and the CLABSI rate for 3 time periods surrounding the creation of the VAT. The first period (January 1, 2015 to April 30, 2016)	*Probably yes*	*Probably yes*	*Definitely no*	*Definitely no*	*Probably yes*	*Definitely no*	*Unclear*	**High**

	established the baseline prior to the creation of the VAT. The second period (May 1, 2016 to April 30, 2017) encompassed the inception of the VAT and its formative period. The final period (May 1, 2017 to August 31, 2018) was representative of the fully realized and operational VAT.								
Beard (2020)	*Probably yes* Reason: 354 patients who received either SAP, TEA or PA at two tertiary referral major trauma centers in the UK were included (2016–2018)	*Probably yes* Reason: We included all consecutive adults with MRFs who received SAP, TEA or PA catheters and were admitted to hospital between 2016 and 2018 in two tertiary referral major trauma centers in the UK.	*Definitely yes* Reason: -	*Definitely yes* Reason: Unadjusted and adjusted models are reported for each outcome. We adjusted for confounders that were chosen a priori, based on their expected associations with MRFs. For pain and inspiratory	*No information.* Reason: -	*Probably yes* Reason: Missing data were handled using a pairwise deletion approach. Missing data were as follows for the sample overall who had either a PA, TEA or SAP catheter (n=354): age: n=3, ISS: n=8, RFS: n=31, CCI score: n=2, sex: n=3, isolated or	*No information.* Reason: -	*No information.* Reason: -	**Low**

				volumes, the following covariates were adjusted for: age, gender, ISS and RFS score. For in-hospital mortality and LOS, the following covariates were adjusted for: age, gender, ISS, RFS score, CCI, most severely injured body region (head, chest and other), surgical rib fixation and isolated chest injury versus polytrauma.		polytrauma: n=3, mechanism: n=20, mechanism type: n=20, most severely injured body region: n=20, AIS score for the head, face, thorax, abdomen, spine, pelvis, limbs and other: n=20, preinspiratory and postinspiratory volume: n=231 and pre and post pain scores: n=155. Missing pain scores and inspiratory volumes were a result of patient inability to perform the tests due to intubation (n=50), confusion/reduced conscious level (n=8) and patient refusal (n=2). The remaining missing data had no reason provided.			

Exclusie tabel

Author and year	Reason for exclusion
Abad (2023)	Wrong study design.
Corcuera (2022)	Wrong comparison.
Martillo (2019)	Non-comparitive study.
Mussa (2021)	No intervention study.
Pernar (2016)	Wrong study design.
Robinson (2005)	Wrong comparison.
Wells (2016)	Wrong population.

Zoekverantwoording

Algemene informatie

Cluster/richtlijn: Centraal Veneuze Toegang	
Uitgangsvraag/modules: Wat is de waarde van een vaattoegangsteam?	
Database(s): Ovid/Medline, Embase.com	Datum: 19 april 2023
Periode: 2000 - heden	Talen: Engels, Nederlands
Literatuurspecialist: Miriam van der Maten	
BMI-zoekblokken: voor verschillende opdrachten wordt (deels) gebruik gemaakt van de zoekblokken van BMI-Online https://blocks.bmi-online.nl/ Bij gebruikmaking van een volledig zoekblok zal naar de betreffende link op de website worden verwezen.	
Toelichting: Voor deze vraag is gezocht op de elementen: • CVL; gebaseerd op eerdere searches. Ook perifere infusen meegenomen (zie opmerking zoekformulier) gezien dit niet heel veel extra hit opleverde • Vascular access teams; deels gebaseerd op de zoekstrategie van de Cochrane review (Carr, 2018).	
Te gebruiken voor richtlijnen tekst: *Nederlands* In de databases Embase.com en Ovid/Medline is op 19 april 2023 systematisch gezocht naar systematische reviews, RCT en observationele studies over de waarde van een vaattoegangsteam bij patiënten die een CVL krijgen. De literatuurzoekactie leverde 458 unieke treffers op. *Engels* On the 19th of April 2023, we performed a systematic search in the databases Embase.com and Ovid/Medline to find systematic reviews, RCT and observational studies about the value of vascular access teams for patients receiving a central venous line. The search resulted in 458 unique hits.	

Zoekopbrengst

	EMBASE	OVID/MEDLINE	Ontdubbeld
SRs	37	22	47
RCT	34	42	55
Observationele studies	211	223	356
Totaal	282	287	**458**

Zoekstrategie

Embase.com

No.	Query	Results

#10	#7 OR #8 OR #9	282
#9	#3 AND #6 NOT (#7 OR #8) **= observationeel**	211
#8	#3 AND #5 NOT #7 **= RCT**	34
#7	#3 AND #4 **= SR**	37
#6	'case control study'/de OR 'comparative study'/exp OR 'control group'/de OR 'controlled study'/de OR 'controlled clinical trial'/de OR 'crossover procedure'/de OR 'double blind procedure'/de OR 'phase 2 clinical trial'/de OR 'phase 3 clinical trial'/de OR 'phase 4 clinical trial'/de OR 'pretest posttest design'/de OR 'pretest posttest control group design'/de OR 'quasi experimental study'/de OR 'single blind procedure'/de OR 'triple blind procedure'/de OR (((control OR controlled) NEAR/6 trial):ti,ab,kw) OR (((control OR controlled) NEAR/6 (study OR studies)):ti,ab,kw) OR (((control OR controlled) NEAR/1 active):ti,ab,kw) OR 'open label*':ti,ab,kw OR (((double OR two OR three OR multi OR trial) NEAR/1 (arm OR arms)):ti,ab,kw) OR ((allocat* NEAR/10 (arm OR arms)):ti,ab,kw) OR placebo*:ti,ab,kw OR 'sham-control*':ti,ab,kw OR (((single OR double OR triple OR assessor) NEAR/1 (blind* OR masked)):ti,ab,kw) OR nonrandom*:ti,ab,kw OR 'non-random*':ti,ab,kw OR 'quasi-experiment*':ti,ab,kw OR crossover:ti,ab,kw OR 'cross over':ti,ab,kw OR 'parallel group*':ti,ab,kw OR 'factorial trial':ti,ab,kw OR ((phase NEAR/5 (study OR trial)):ti,ab,kw) OR ((case* NEAR/6 (matched OR control*)):ti,ab,kw) OR ((match* NEAR/6 (pair OR pairs OR cohort* OR control* OR group* OR healthy OR age OR sex OR gender OR patient* OR subject* OR participant*)):ti,ab,kw) OR ((propensity NEAR/6 (scor* OR match*)):ti,ab,kw) OR versus:ti OR vs:ti OR compar*:ti OR ((compar* NEAR/1 study):ti,ab,kw) OR (('major clinical study'/de OR 'clinical study'/de OR 'cohort analysis'/de OR 'observational study'/de OR 'cross-sectional study'/de OR 'multicenter study'/de OR 'correlational study'/de OR 'follow up'/de OR cohort*:ti,ab,kw OR 'follow up':ti,ab,kw OR followup:ti,ab,kw OR longitudinal*:ti,ab,kw OR prospective*:ti,ab,kw OR retrospective*:ti,ab,kw OR observational*:ti,ab,kw OR 'cross sectional*':ti,ab,kw OR cross?ectional*:ti,ab,kw OR multicent*:ti,ab,kw OR 'multi-cent*':ti,ab,kw OR consecutive*:ti,ab,kw) AND (group:ti,ab,kw OR groups:ti,ab,kw OR subgroup*:ti,ab,kw OR versus:ti,ab,kw OR vs:ti,ab,kw OR compar*:ti,ab,kw OR 'odds ratio*':ab OR 'relative odds':ab OR 'risk ratio*':ab OR 'relative risk*':ab OR 'rate ratio':ab OR aor:ab OR arr:ab OR rrr:ab OR ((('or' OR 'rr') NEAR/6 ci):ab)))	14002287
#5	'randomized controlled trial'/exp OR random*:ti,ab OR (((pragmatic OR practical) NEAR/1 'clinical trial*'):ti,ab) OR ((('non inferiority' OR noninferiority OR superiority OR equivalence) NEAR/3 trial*):ti,ab) OR rct:ti,ab,kw	1839814
#4	'meta analysis'/exp OR 'meta analysis (topic)'/exp OR metaanaly*:ti,ab OR 'meta analy*':ti,ab OR metanaly*:ti,ab OR 'systematic review'/de OR 'cochrane database of systematic reviews'/jt OR prisma:ti,ab OR prospero:ti,ab OR (((systemati* OR scoping OR umbrella OR 'structured literature') NEAR/3 (review* OR overview*)):ti,ab) OR ((systemic* NEAR/1 review*):ti,ab) OR (((systemati* OR literature OR database* OR 'data base*') NEAR/10 search*):ti,ab) OR (((structured OR comprehensive* OR systemic*) NEAR/3 search*):ti,ab) OR (((literature NEAR/3 review*):ti,ab) AND (search*:ti,ab OR database*:ti,ab OR 'data base*':ti,ab)) OR (('data extraction':ti,ab OR 'data source*':ti,ab) AND 'study selection':ti,ab) OR ('search strategy':ti,ab AND 'selection criteria':ti,ab) OR ('data source*':ti,ab AND 'data synthesis':ti,ab) OR medline:ab OR pubmed:ab OR embase:ab OR cochrane:ab OR (((critical OR rapid) NEAR/2 (review* OR overview* OR synthes*)):ti) OR ((((critical* OR rapid*) NEAR/3 (review* OR overview* OR synthes*)):ab) AND (search*:ab OR database*:ab OR 'data base*':ab)) OR metasynthes*:ti,ab OR 'meta synthes*':ti,ab	733409
#3	#1 AND #2 AND ([english]/lim OR [dutch]/lim) AND [2000-2023]/py NOT ('conference abstract'/it OR 'editorial'/it OR 'letter'/it OR 'note'/it) NOT (('animal experiment'/exp OR 'animal model'/exp OR 'nonhuman'/exp) NOT 'human'/exp)	712
#2	('vascular access'/exp OR 'central venous catheterization'/exp OR 'indwelling catheter'/exp OR 'pulmonary artery catheterization'/exp) AND team*:ti,ab,kw OR	2810

	(((inserter* OR mainte* OR 'vascular access*' OR 'vascular resource*' OR 'intravenous therap*' OR iv) NEAR/5 team*):ti,ab,kw)	
#1	'vascular access device'/exp/mj OR 'vascular access':ti,ab,kw OR 'venous access':ti,ab,kw OR (((intravascular OR intravenous OR venous OR vascular OR cardiovascular) NEAR/3 catheter*):ti,ab,kw) OR tunnel*:ti,ab,kw OR cuffed:ti,ab,kw OR 'non tunnel*':ti,ab,kw OR 'non-cuffed':ti,ab,kw OR noncuffed:ti,ab,kw OR vascath:ti,ab,kw OR 'peripherally-inserted central catheter*':ti,ab,kw OR broviac:ti,ab,kw OR leonard:ti,ab,kw OR groshong:ti,ab,kw OR cook:ti,ab,kw OR permcath:ti,ab,kw OR tesio:ti,ab,kw OR 'peripherally inserted central venous catheter'/exp OR 'implantable port system'/exp OR 'hickman catheter'/exp OR ((tunnel* NEAR/3 central*):ti,ab,kw) OR 'central venous catheter'/exp/mj OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device*)):ti,ab,kw) OR port*:ti,ab,kw OR 'total* implantable':ti,ab,kw OR 'tunneled central venous catheter'/exp/mj OR 'nontunneled central venous catheter'/exp/mj OR 'subclavian vein catheter'/exp/mj OR (((intravascular OR intravenous OR venous OR vascular OR cardiovascular) NEAR/3 catheter*):ti) OR cvc:ti,ab,kw OR ((central NEAR/3 line*):ti,ab,kw) OR 'central venous catheter'/exp OR 'central venous catheterization'/exp OR ((central* NEAR/3 (venous OR vein OR intravenous) NEAR/3 (catheter* OR 'access' OR line* OR device* OR lead*)):ti,ab,kw) OR 'peripherally inserted central venous catheter'/exp/mj OR ((peripheral* NEAR/3 (insert* OR catheter*)):ti,ab,kw) OR picc*:ti,ab,kw OR 'port a cath':ti,ab,kw OR 'implant* port*':ti,ab,kw OR 'implantable port system'/exp/mj OR 'total* implant*':ti,ab,kw OR tivad*:ti,ab,kw OR tivap*:ti,ab,kw OR 'tunneled central venous catheter'/exp OR hickman*:ti,ab,kw OR 'tunnel* central':ti,ab,kw OR 'nontunneled central venous catheter'/exp OR nontunnel*:ti,ab,kw OR 'non-tunnel*':ti,ab,kw OR 'subclavian vein catheter'/exp OR ((central NEAR/3 cath*):ti,ab,kw) OR cvad:ti,ab,kw OR 'vascular access'/exp/mj OR 'central venous catheterization'/exp/mj OR 'indwelling catheter'/exp/mj OR 'peripheral venous catheter'/exp OR ((peripheral NEAR/5 (catheter* OR line)):ti,ab,kw)	777212

Ovid/Medline

#	**Searches**	**Results**
12	9 or 10 or 11	287
11	(5 and 8) not (9 or 10) **= observationeel**	223
10	(5 and 7) not 9 **= RCT**	42
9	5 and 6 **= SR**	22
8	exp clinical trial/ or randomized controlled trial/ or exp clinical trials as topic/ or randomized controlled trials as topic/ or Random Allocation/ or Double-Blind Method/ or Single-Blind Method/ or (clinical trial, phase i or clinical trial, phase ii or clinical trial, phase iii or clinical trial, phase iv or controlled clinical trial or randomized controlled trial or multicenter study or clinical trial).pt. or random*.ti,ab. or (clinic* adj trial*).tw. or ((singl* or doubl* or treb* or tripl*) adj (blind$3 or mask$3)).tw. or Placebos/ or placebo*.tw. or Epidemiologic studies/ or case control studies/ or exp cohort studies/ or Controlled Before-After Studies/ or Case control.tw. or cohort.tw. or Cohort analy$.tw. or (Follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or Longitudinal.tw. or Retrospective*.tw. or prospective*.tw. or consecutive*.tw. or Cross sectional.tw. or Cross-sectional studies/ or historically controlled study/ or interrupted time series analysis/ or Case-control Studies/ or clinical trial, phase ii/ or clinical trial, phase iii/ or clinical trial, phase iv/ or comparative study/ or control groups/ or controlled before-after studies/ or controlled clinical trial/ or double-blind method/ or historically controlled study/ or matched-pair analysis/ or single-blind method/ or (((control or controlled) adj6 (study or studies or trial)) or (compar* adj (study or studies)) or ((control or controlled) adj1 active) or "open label*" or ((double or two or three or multi or trial) adj (arm or arms)) or (allocat* adj10 (arm or arms)) or placebo* or "sham-control*" or ((single or double or triple or assessor) adj1 (blind* or masked)) or nonrandom* or "non-random*" or	8206475

	"quasi-experiment*" or "parallel group*" or "factorial trial" or "pretest posttest" or (phase adj5 (study or trial)) or (case* adj6 (matched or control*)) or (match* adj6 (pair or pairs or cohort* or control* or group* or healthy or age or sex or gender or patient* or subject* or participant*)) or (propensity adj6 (scor* or match*))).ti,ab,kf. or (confounding adj6 adjust*).ti,ab. or (versus or vs or compar*).ti. or ((exp cohort studies/ or epidemiologic studies/ or multicenter study/ or observational study/ or seroepidemiologic studies/ or (cohort* or 'follow up' or followup or longitudinal* or prospective* or retrospective* or observational* or multicent* or 'multi-cent*' or consecutive*).ti,ab,kf.) and ((group or groups or subgroup* or versus or vs or compar*).ti,ab,kf. or ('odds ratio*' or 'relative odds' or 'risk ratio*' or 'relative risk*' or aor or arr or rrr).ab. or (("OR" or "RR") adj6 CI).ab.))	
7	exp randomized controlled trial/ or randomized controlled trials as topic/ or random*.ti,ab. or rct?.ti,ab. or ((pragmatic or practical) adj "clinical trial*").ti,ab,kf. or ((non-inferiority or noninferiority or superiority or equivalence) adj3 trial*).ti,ab,kf.	1605964
6	meta-analysis/ or meta-analysis as topic/ or (metaanaly* or meta-analy* or metanaly*).ti,ab,kf. or systematic review/ or cochrane.jw. or (prisma or prospero).ti,ab,kf. or ((systemati* or scoping or umbrella or "structured literature") adj3 (review* or overview*)).ti,ab,kf. or (systemic* adj1 review*).ti,ab,kf. or ((systemati* or literature or database* or data-base*) adj10 search*).ti,ab,kf. or ((structured or comprehensive* or systemic*) adj3 search*).ti,ab,kf. or ((literature adj3 review*) and (search* or database* or data-base*)).ti,ab,kf. or (("data extraction" or "data source*") and "study selection").ti,ab,kf. or ("search strategy" and "selection criteria").ti,ab,kf. or ("data source*" and "data synthesis").ti,ab,kf. or (medline or pubmed or embase or cochrane).ab. or ((critical or rapid) adj2 (review* or overview* or synthes*)).ti. or (((critical* or rapid*) adj3 (review* or overview* or synthes*)) and (search* or database* or data-base*)).ab. or (metasynthes* or meta-synthes*).ti,ab,kf.	663240
5	4 not (comment/ or editorial/ or letter/ or ((exp animals/ or exp models, animal/) not humans/))	539
4	limit 3 to ((english language or dutch) and yr="2000 -Current")	559
3	1 and 2	707
2	exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or exp Catheterization, Peripheral/ or nontunnel*.ti,ab,kf. or 'non tunnel*'.ti,ab,kf. or 'non-cuffed'.ti,ab,kf. or noncuffed.ti,ab,kf. or picc*.ti,ab,kf. or vascath.ti,ab,kf. or 'Peripherally-Inserted Central Catheter*'.ti,ab,kf. or exp Catheterization, Central Venous/ or exp Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or (port* or 'total* implantable' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or port*).ti,ab,kf. or ((intravascular or intravenous or venous or vascular or cardiovascular) adj3 catheter*).ti. or cvc.ti,ab,kf. or (central adj3 line*).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or (port* or 'total* implantable' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*' or subclavian or jugular or traditional).ti,ab,kf. or exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3	1010751

	(catheter* or 'access' or line* or device* or lead*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or (tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or ((intravascular or intravenous or venous or vascular or cardiovascular) adj3 catheter*).ti. or cvc.ti,ab,kf. or (central adj3 line*).ti,ab,kf. or (tunnel* or cuffed or (hickman* or broviac or leonard or groshong or cook or permcath or tesio)).ti,ab,kf. or exp Catheterization, Peripheral/ or nontunnel*.ti,ab,kf. or 'non tunnel*'.ti,ab,kf. or 'non-cuffed'.ti,ab,kf. or noncuffed.ti,ab,kf. or picc*.ti,ab,kf. or vascath.ti,ab,kf. or 'Peripherally-Inserted Central Catheter*'.ti,ab,kf. or exp *Catheterization, Central Venous/ or exp *Central Venous Catheters/ or (central* adj3 (venous or vein or intravenous) adj3 (catheter* or 'access' or line* or device*)).ti,ab,kf. or exp Catheterization, Peripheral/ or (peripheral* adj3 (insert* or catheter*)).ti,ab,kf. or PICC*.ti,ab,kf. or 'port a cath'.ti,ab,kf. or ('total* implant*' or tivad* or tivap* or hickman* or (tunnel* adj 3 central) or nontunnel* or 'non-tunnel*').ti,ab,kf. or (peripheral adj5 (catheter* or line)).ti,ab,kf.	
1	((exp Catheterization, Central Venous/ or exp Catheters, Indwelling/ or exp Vascular Access Devices/ or exp Catheterization, Peripheral/) and team*.ti,ab,kf.) or ((inserter* or mainte* or 'vascular access*' or 'vascular resource*' or 'intravenous therap*' or iv) adj5 team*).ti,ab,kf.	1246

Module 13: Organisatie van zorg

Evidence tabel

Niet van toepassing.

Risk of bias tabel

Niet van toepassing.

Exclusie tabel

Niet van toepassing.

Zoekverantwoording

Niet van toepassing.