Central Venous Catheter Pathway v3.0:**Table of Contents**

Stop and **Review**

Inclusion Criteria

- Patient meeting indicating criteria

Exclusion Criteria

- Patients not meeting indication criteria

Central Venous Catheter Care

Appendix

Central Venous Catheter Pathway v3.0: **CVC Selection**

Stop and **Review**

Inclusion Criteria
- Patient meeting indicating criteria*

Exclusion Criteria
- Patients not meeting indication criteria

[Central Venous Catheter Maintenance]

Indications for Central Line*
- Prolonged infusion (>7 days)
- Prolonged antibiotics (>7 days)
- Dialysis
- (A)Pheresis
- Chemotherapy
- Stem Cell Collection
- Frequent blood draws
- Infusates requiring central access

Patient meets indications for Central Line*? —NO→ Peripheral IV (PIV)

YES ↓

Expected duration of use?

Between 7 – 30 days

Indication	Recommended catheter type
NOT for dialysis or (a)pheresis	Peripherally inserted central catheter (PICC) (Only placed by IR)
	Temporary nontunneled central venous catheter
Dialysis or (a)pheresis	Temporary nontunneled dialysis/ (a)pheresis catheter

!

Do not place PICC if anticipated use will be less than 1 week (term neonates could have PICC for <7 days if requiring frequent blood draws)

!

A port is not the optimal central line for patients requiring long term Parenteral Nutrition

Greater than 30 days

Indication	Recommended catheter type
Usually nutrition only or chemotherapy in infants	Single lumen tunneled central venous catheter
Bone marrow transplant or intense chemotherapy	Double lumen tunneled central venous catheter
Some leukemia or most solid tumor patients	Implanted central venous port
Frequent blood draws	
Stem cell collection	Power injectable central venous catheters
Dialysis/ (A)pheresis	Tunneled dialysis catheter

Notes:
- Catheters are also placed by NICU, PICU, CICU, and Anesthesia providers. These do not require Interventional Radiology (IR) or General Surgery (GS) involvement nor this algorithm.
- The above chart is intended to be a guide. We realize that there are many variables involved in selection of a catheter.
- If assistance is required for decision making or timely placement, please page IR on-call OR GS on-call.

Last Updated: April 2024
Next Expected Review: October 2025

For questions concerning this pathway, contact:
CentralVenousCatheterPathway@seattlechildrens.org

Central Venous Catheter Pathway v3.0: **CVC Maintenance**

Stop and **Review**

Inclusion Criteria

- Patient qualifies for Central Line Insertion and **line has been placed**

Exclusion Criteria

- Patients without Central Line

[Central Venous Catheter Selection]

Catheter	Recommendations
Peripherally inserted central catheter (PICC) (Only placed by IR)	• PICC lines should be considered in patients who require intravenous access for greater than 7-14 days and always for patients receiving non-peripherally compatible infusates. Alternate forms of access should be considered if access is required for < 7 days. • For patients requiring frequent blood draws (> 1 per day) for > 7 days, a PICC line should be considered and a lumen diameter of 3 French or greater is suggested. ◦ Exception: PICC line indicated for term neonate for frequent blood draws. • Replace femoral PICC after 30 days. If anticipated need for venous access will exceed 30 days consider other line type i.e. tunneled central line or upper extremity PICC. • Remove PICC as soon as clinically indicated. If unsure whether a PICC line should be removed, strongly consider a 48 hour trial of non-use prior to removal.
Implanted central venous port	If port is being used for Parenteral Nutrition, use for as short a time as possible.
Tunneled central venous catheter (Hickman, Broviac)	• Repair line and lock one time with an antimicrobial lock post repair in a volume indicated by job aid. • After 3 line failures, discuss with the primary service regarding best option balancing the risks for repairing a broken line vs replacement. • For patients with intestinal failure, if the decision is to replace the catheter, consider accessing the same vein for vein preservation.

Any Central Venous Catheter → **If central venous catheter infection is suspected** → **Off Pathway** → **Consider** [Central Line Suspected Infection]

For questions concerning this pathway, contact:
CentralVenousCatheterPathway@seattlechildrens.org

Summary of Version Changes

Version 1.0 (9/9/2019): Central Line Placement Go live.
Version 2.0 (10/6/2020): Created integrated guidance and standard work for selection and maintenance of central venous catheters, in all clinical areas of the hospital; provides consistent and accessible documentation of defined processes for selection, placement, maintenance, and removal of central venous catheters.
Version 3.0 (4/5/2024): Removed PICC Table and links to it. Added PICC line recommendations to CVC Maintenance phase. Updated indications for central line.

Approval & Citation

Approved by the CSW Central Venous Catheter Selection and Maintenance Pathway team for October 6, 2020, go-live

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Retrieval Website: https://www.seattlechildrens.org/pdf/central-venous-catheter-pathway.pdf

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Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Certainty of Evidence

✪✪✪✪ High: The authors have a lot of confidence that the true effect is similar to the estimated effect
✪✪✪○ Moderate: The authors believe that the true effect is probably close to the estimated effect
✪✪○○ Low: The true effect might be markedly different from the estimated effect
✪○○○ Very low: The true effect is probably markedly different from the estimated effect
Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies)

Bibliography

Literature Search Methods:

A literature search was conducted in December 2019 to target synthesized literature on central lines or CLABSI for December 2018 to current and limited to English. The search was executed in Ovid Medline, Embase, Cochrane Database of Systematic Reviews (CDSR) and Turning Research into Practice (TRIP) databases.

Screening and data extraction were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Two reviewers independently screened abstracts and included [guidelines and systematic reviews] that addressed the following questions. One reviewer screened full text and extracted data and a second reviewer quality checked the results. Differences were resolved by consensus.

1. In patients receiving a central line are there fewer central line infections in clean cases than in clean-contaminated cases?
2. In patients receiving a central line do antibiotic impregnated lines reduce the risk of central line infection?
3. In patients receiving central lines do heparin impregnated lines reduce the risk of central line infection?
4. In patients receiving central lines do the number of line days increase the risk of central line infection?
5. In patients receiving central lines do the number of line breaks increase the risk of central line infection?
6. In patients receiving central lines does location / environment of placement increase the risk of central line infection?
7. In patients receiving central lines are there specific vessels that increase the rate of central line infection?
8. In patients receiving central lines do the number of line accesses increase the risk of central line infection?
9. In patients receiving central lines does the type of central line impact the rate of central line infection?
10. In patients receiving central lines what factors are associated with catheter clot formation (in line or in vessel)?
11. Does TPN infused via a port increase risk of line infection?
12. What is the optimal duration of a PICC?
13. Is it optimal to repair or replace central lines particularly in intestinal failure and / or oncology patients?

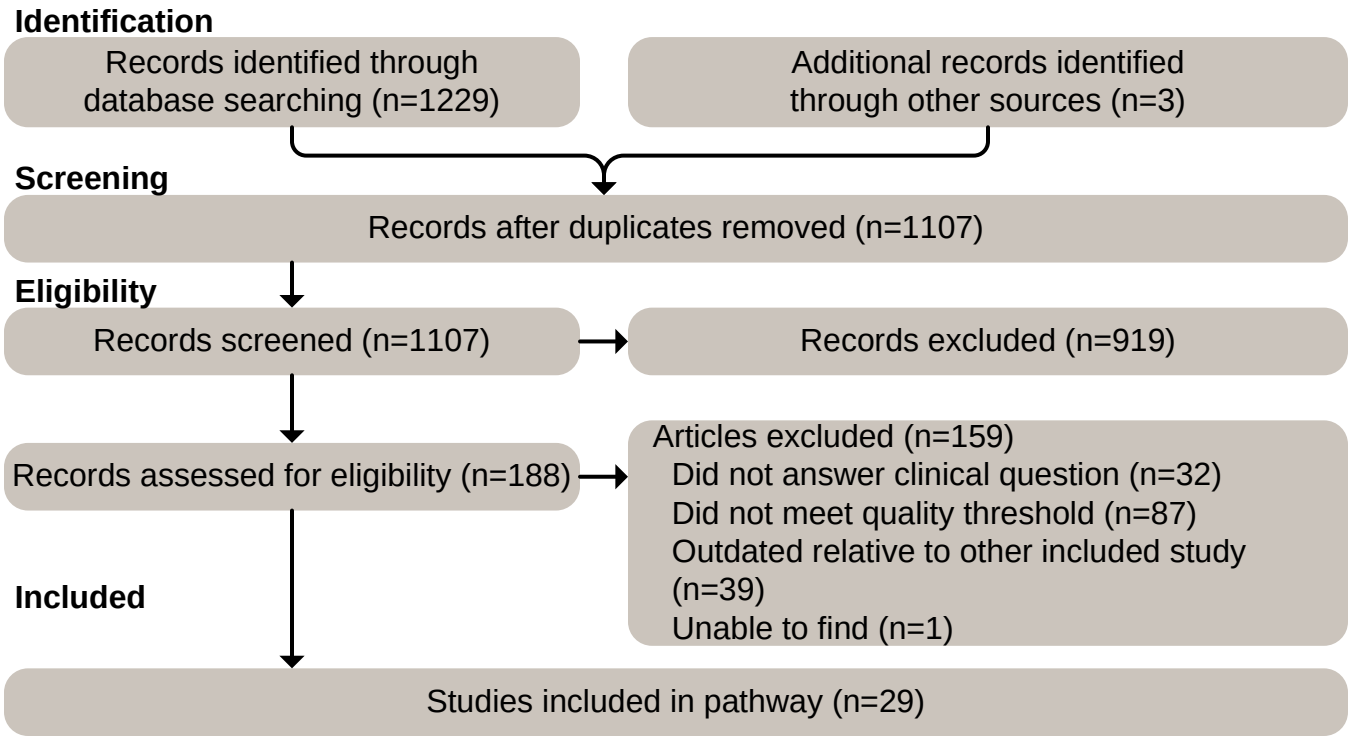
Literature Search Results:
The searches of the 4 databases (see Electronic searches) retrieved 1229 records. Our searches of other resources identified 3 additional studies that appeared to meet the inclusion criteria.

Once duplicates had been removed, we had a total of 1107 records. We excluded 919 records based on titles and abstracts. We obtained the full text of the remaining 188 records and excluded 159.

We included 29 studies. The flow diagram summarizes the study selection process.

Bibliography

Literature Search Results (continued):



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

Bibliography

Included Studies

Arvaniti, K., Lathyris, D., Blot, S., Fani Apostolidou-Kiouti, Koulenti, D., & Anna-Bettina Haidich. (2016). Cumulative evidence of randomized controlled and observational studies on catheter-related infection risk of central venous catheter insertion site in ICU patients: A pairwise and network meta-analysis. Critical Care Medicine, 45(4), 437. doi:10.1097/CCM.0000000000002092

Baskin, K. M., Mermel, L. A., Saad, T. F., Journeycake, J. M., Schaefer, C. M., Modi, B. P., . . . Registry Development Initiative Affected Persons Advisory, P. (2019). Evidence-Based Strategies and Recommendations for Preservation of Central Venous Access in Children. JPEN: Journal of Parenteral & Enteral Nutrition, 43(5), 591-614. doi:https://dx.doi.org/10.1002/jpen.1591

Bradford, N. K., Edwards, R. M., & Chan, R. J. (2016). Heparin versus 0.9% sodium chloride intermittent flushing for the prevention of occlusion in long term central venous catheters in infants and children: A systematic review. International Journal of Nursing Studies, 59, 51-59. doi:https://dx.doi.org/10.1016/j.ijnurstu.2016.02.014

Chong, H. Y., Lai, N. M., Apisarnthanarak, A., & Chaiyakunapruk, N. (2017). Comparative efficacy of antimicrobial central venous catheters in reducing catheter-related bloodstream infections in adults: Abridged cochrane systematic review and network meta-analysis. Clinical Infectious Diseases, 64(suppl_2), S131-S140. doi:https://dx.doi.org/10.1093/cid/cix019

Chopra, V., Anand, S., Hickner, A., Buist, M., Rogers, M. A., Saint, S., & Flanders, S. A. (2013). Risk of venous thromboembolism associated with peripherally inserted central catheters: A systematic review and meta-analysis. Lancet, 382(9889), 311-325. doi:https://dx.doi.org/10.1016/S0140-6736(13)60592-9

Chopra, V., O'Horo, J. C., Rogers, M. A. M., Maki, D. G., & Safdar, N. (2013). The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: A systematic review and meta-analysis. Infection Control & Hospital Epidemiology, 34(9), 908-918. doi:https://dx.doi.org/10.1086/671737

Ge, X., Cavallazzi, R., Li, C., Pan, S. M., Wang, Y. W., & Wang, F. (2012). Central venous access sites for the prevention of venous thrombosis, stenosis and infection. Cochrane Database of Systematic Reviews, , (3)-2012 Mar 14. doi:https://dx.doi.org/10.1002/14651858.CD004084.pub3

Han, X., Yang, X., Huang, B., Yuan, L., & Cao, Y. (2016). Low-dose versus high-dose heparin locks for hemodialysis catheters: A systematic review and meta-analysis. Clinical Nephrology, 86(7), 1-8. doi:https://dx.doi.org/10.5414/CN108701

Kolaček, S., Puntis, J. W. L., & Hojsak, I. (2018). ESPGHAN/ESPEN/ESPR/CSPEN guidelines on pediatric parenteral nutrition: Venous access. Clinical nutrition (Edinburgh, Scotland), 37(6 Pt B).

Kulkarni, S., Wu, O., Kasthuri, R., & Moss, J. G. (2014). Centrally inserted external catheters and totally implantable ports for the delivery of chemotherapy: A systematic review and meta-analysis of device-related complications. Cardiovascular & Interventional Radiology, 37(4), 990-1008. doi:https://dx.doi.org/10.1007/s00270-013-0771-3

Mateo-Lobo, R., Riveiro, J., Vega-Pinero, B., & Botella-Carretero, J. I. (2019). Infectious Complications in Home Parenteral Nutrition: A Systematic Review and Meta-Analysis Comparing Peripherally-Inserted Central Catheters with Other Central Catheters. Nutrients, 11(9), 04. doi:https://dx.doi.org/10.3390/nu11092083

Bibliography

Included Studies

Mihatsch, W. A., Braegger, C., Bronsky, J., Cai, W., Campoy, C., Carnielli, V., . . . Yan, W. (2018). ESPGHAN/ESPEN/ESPR/CSPEN guidelines on pediatric parenteral nutrition. Clinical nutrition (Edinburgh, Scotland), 37(6 Pt B).

Mitchell, M. D., Agarwal, R., Hecht, T. E. H., & Umscheid, C. A. (2013). Nonpharmacologic interventions for prevention of catheter-related thrombosis: A systematic review. Journal of Critical Care, 28(3), 316.e9-316.16. doi:https://dx.doi.org/10.1016/j.jcrc.2012.07.007

O'Grady NP1, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, Lipsett PA, Masur H, Mermel LA, Pearson ML, Raad II, Randolph AG, Rupp ME, Saint S, & Healthcare Infection Control Practices Advisory Committee (HICPAC). (2017). Guidelines for the prevention of intravascular catheter-related infections (2011). Retrieved from https://www.cdc.gov/infectioncontrol/guidelines/bsi/

Paterson, R. S., Chopra, V., Brown, E., Kleidon, T. M., Cooke, M., Rickard, C. M., . . . Ullman, A. J. (2020). Selection and Insertion of Vascular Access Devices in Pediatrics: A Systematic Review. Pediatrics, 145(Supplement 3), S243-S268. doi:10.1542/peds.2019-3474H

Pikwer, A., Akeson, J., & Lindgren, S. (2012). Complications associated with peripheral or central routes for central venous cannulation. Anaesthesia, 67(1), 65-71. doi:https://dx.doi.org/10.1111/j.1365-2044.2011.06911.x

Pu, Y. L., Li, Z. S., Zhi, X. X., Shi, Y. A., Meng, A. F., Cheng, F., . . . Wang, C. (2019). Complications and Costs of Peripherally Inserted Central Venous Catheters Compared With Implantable Port Catheters for Cancer Patients: A Meta-analysis. Cancer Nursing, 27, 27. doi:https://dx.doi.org/10.1097/NCC.0000000000000742

Rahhal, R., Abu-El-Haija, M. A., Fei, L., Ebach, D., Orkin, S., Kiscaden, E., & Cole, C. R. (2017). Systematic Review and Meta-Analysis of the Utilization of Ethanol Locks in Pediatric Patients With Intestinal Failure. Jpen: Journal of Parenteral & Enteral Nutrition, 148607117722753. doi:https://dx.doi.org/10.1177/0148607117722753

Rosado, V., Camargos, P. A. M., Anchieta, L. M., Bouzada, M. C. F., Oliveira, G. M. d., Clemente, W. T., & Romanelli, R. M. d. C. (2017). Risk factors for central venous catheter-related infections in a neonatal population - systematic review. Jornal De Pediatria, doi:https://dx.doi.org/10.1016/j.jped.2017.03.012

Saber, W., Moua, T., Williams, E. C., Verso, M., Agnelli, G., Couban, S., . . . Lee, A. Y. (2011). Risk factors for catheter-related thrombosis (CRT) in cancer patients: A patient-level data (IPD) meta-analysis of clinical trials and prospective studies. Journal of Thrombosis & Haemostasis, 9(2), 312-319. doi:https://dx.doi.org/10.1111/j.1538-7836.2010.04126.x

Schoot, R. A., Kremer, L. C. M., van de Wetering, M. D., & van Ommen, C. H. (2013). Systemic treatments for the prevention of venous thrombo-embolic events in paediatric cancer patients with tunnelled central venous catheters. Cochrane Database of Systematic Reviews, , (9)-2013 Se 11. doi:https://dx.doi.org/10.1002/14651858.CD009160.pub2

Shah Prakeshkumar, S., & Shah, N. (2014). Heparin-bonded catheters for prolonging the patency of central venous catheters in children. ().John Wiley & Sons, Ltd. doi:10.1002/14651858.CD005983.pub3 Retrieved from CDSR

Ullman, A. J., Marsh, N., Mihala, G., Cooke, M., & Rickard, C. M. (2015). Complications of central venous access devices: A systematic review. Pediatrics, 136(5), e1331-44. doi:https://dx.doi.org/10.1542/peds.2015-1507

Bibliography

Included Studies

Ullman, A. J., Bernstein, S. J., Brown, E., Aiyagari, R., Doellman, D., Faustino, E. V. S., Chopra, V. (2020). The Michigan Appropriateness Guide for Intravenous Catheters in Pediatrics: miniMAGIC. Pediatrics, 145(Suppl 3). doi:10.1542/peds.2019-3474I

Vidal, E., Sharathkumar, A., Glover, J., & Faustino, E. V. S. (2014). Central venous catheter-related thrombosis and thromboprophylaxis in children: A systematic review and meta-analysis. Journal of Thrombosis & Haemostasis, 12(7), 1096-1109. doi:https://dx.doi.org/10.1111/jth.12598

Wang, H., Huang, T., Jing, J., Jin, J., Wang, P., Yang, M., . . . Shen, H. (2010). Effectiveness of different central venous catheters for catheter-related infections: A network meta-analysis. Journal of Hospital Infection, 76(1), 1-11. doi:https://dx.doi.org/10.1016/j.jhin.2010.04.025

Wang, Y., Ivany, J. N., Perkovic, V., Gallagher, M. P., Woodward, M., & Jardine, M. J. (2016). Anticoagulants and antiplatelet agents for preventing central venous haemodialysis catheter malfunction in patients with end-stage kidney disease. Cochrane Database of Systematic Reviews, 4, 009631. doi:https://dx.doi.org/10.1002/14651858.CD009631.pub2

Wu, G., Chen, Z., Sun, Y., Xiao, S., & Xia, Z. (2017). Impregnated central venous catheters in children: A systematic review of randomized controlled trials. Intensive Care Medicine, 43(8), 1159. doi:10.1007/s00134-017-4777-1

Wu, S., Huang, J., Jiang, Z., Huang, Z., Ouyang, H., Deng, L., . . . Zeng, W. (2016). Internal jugular vein versus subclavian vein as the percutaneous insertion site for totally implantable venous access devices: A meta-analysis of comparative studies. BMC Cancer, 16(1) doi:10.1186/s12885-016-2791-2

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The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

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