

## STANDARD CARE

## ASSESSMENT

- **Educated and competent** clinicians, patients, family/carers involved with CVAD management
- **Catheter selection:** insert CVAD with the minimum number of lumens for the prescribed therapy
- **CVAD catheter tip:** located at cavoatrial junction, lower third of the superior vena cava or upper right atrium for upper body insertions or inferior vena cava above the level of diaphragm for femoral vein insertions
- **Syringes:** with 10 mL or 20 mL
- **Flushing:**
  - Using 0.9% sodium chloride
  - Using a pulsatile/start-stop flush technique and complete with the appropriate clamping-disconnection sequence to maintain positive pressure at the catheter tip according to the type of needleless connector
  - Regularly to remove intraluminal drug residue, blood components and in between incompatible solutions
  - Adults: 10 mL increasing to 20 mL post blood sampling or infusions, viscous or sticky solutions e.g. CT contrast, medications, dextrose, TPN
  - Paediatrics: at least double the volume of the CVAD system
- **Locking:**
  - Using 0.9% sodium chloride
  - Using a pulsatile/start-stop flush technique and complete with the appropriate clamping-disconnection sequence to maintain positive pressure at the catheter tip according to the type of needleless connector
  - For every lumen
  - Frequency: according to type of CVAD, intermittent use or in between prescribed therapy episodes

Easy injection / easy aspiration? IN1/AS1

**PATENCY ASSESSMENT**  
CINAS Catheter Injection Aspiration Classification

Assess *aspiration* and *injection* ability of the CVAD

CINAS CLASSIFICATION	INJECTION ABILITY (IN)			
	EASY ≥ 1 mL	DIFFICULT ≥ 1 mL	IMPOSSIBLE < 1 mL	UNKNOWN
EASY AS1	IN1AS1	IN2AS1	IN3AS1	INxAS1
DIFFICULT AS2	IN1AS2	IN2AS2	IN3AS2	INxAS2
IMPOSSIBLE AS3	IN1AS3	IN2AS3	IN3AS3	INxAS3
UNKNOWN ASx	IN1ASx	IN2ASx	IN3ASx	INxASx

Tool adapted from Goossens, G.A., Stas, M., Jérôme, M. and Moons, P., 2011. Systematic review: malfunction of totally implantable venous access devices in cancer patients. *Supportive care in cancer*, 19(7), pp.883-898.

Difficult aspiration / difficult injection? IN2/AS2

Impossible aspiration / injection? IN3/AS3

Unknown or no assessed aspiration or injection? INx/ASx

DOCUMENT

- SIGNS & SYMPTOMS: partial occlusion**
- No blood return but flushes easily
  - Flash back only and no frank blood return
  - Slow blood return
  - Increased resistance on flushing
  - Catheter tip not at cavoatrial junction on CXR
  - Sudden onset of resistance after medication administration
  - Drug precipitation in the catheter lumen
  - Prolonged creasing in catheter lumen
  - Blood remnants in catheter lumen
  - Closed clamp on catheter or IV tubing

- SIGNS & SYMPTOMS: complete occlusion**
- No blood return and
  - Inability to inject fluids

### MECHANICAL occlusion

- INTERVENTIONS OR INVESTIGATIONS:**
- **Actions:** change patient position, ask patient to cough or deep breathe, open clamps, change dressing, replace blocked needleless connectors or filters, re-access TIVAD, replace IV administration line/s
  - **Investigations:** e.g. flow studies for kink, occlusion, fibrin sheath/sleeve, catheter fracture; CXR for suspected catheter tip malposition, pinch-off syndrome

- Is there evidence of a mechanical occlusion**
- **CVAD factors:** closed clamps on catheter lumen or non coring TIVAD needle; kinked catheter under dressing; malpositioned, angled or inappropriate length non coring TIVAD needle, change in catheter length, blood in catheter lumen
  - **IV administration lines** - kinks, twists or closed clamps in IV lines including additive lines or in-line filters, blood in needleless connector
  - **Patient factors** - patient position, catheter tip malposition or adjacent to vein wall

- Is there evidence of DVT?**
- Pain +/- swelling e.g. arm, chest wall, neck, face, jaw
  - Discoloration of the extremity
  - Altered sensation of the extremity
  - Reduced function in the extremity
  - Engorged peripheral veins on the extremity or chest wall on the side of catheter insertion

**CLINICAL PRACTICE POINT**  
Act promptly and avoid delay in interventions

Resume use of CVAD

Easy injection / easy aspiration? IN1/AS1

Consult with medical staff

**i** Every patient: implement strategies for every patient, every time, for every CVAD by all clinical staff managing CVADs.

## ASSESSMENT

## INTERVENTION & OUTCOME

### THROMBOTIC or CHEMICAL occlusion

**CLINICAL PRACTICE POINT**  
If occlusion is not mechanical and no evidence of chemical occlusion - treat as thrombotic occlusion

**THROMBOTIC** occlusions: 58%  
**CHEMICAL & MECHANICAL** occlusions: 42%

#### Is there evidence of THROMBOTIC OCCLUSION

- Visible blood in catheter, needleless connector or IV line
- Frequent, recurring administration pump alarm
- Resistance or inability to inject fluids
- Sluggish flow of intravenous fluids
- Inability to withdraw blood
- Flash back but no frank blood return

#### Is there evidence of CHEMICAL OCCLUSION

- Visible medication precipitation in catheter
- Recent administration of medication, lipid, viscous solutions
- Sudden onset of resistance after medication administration

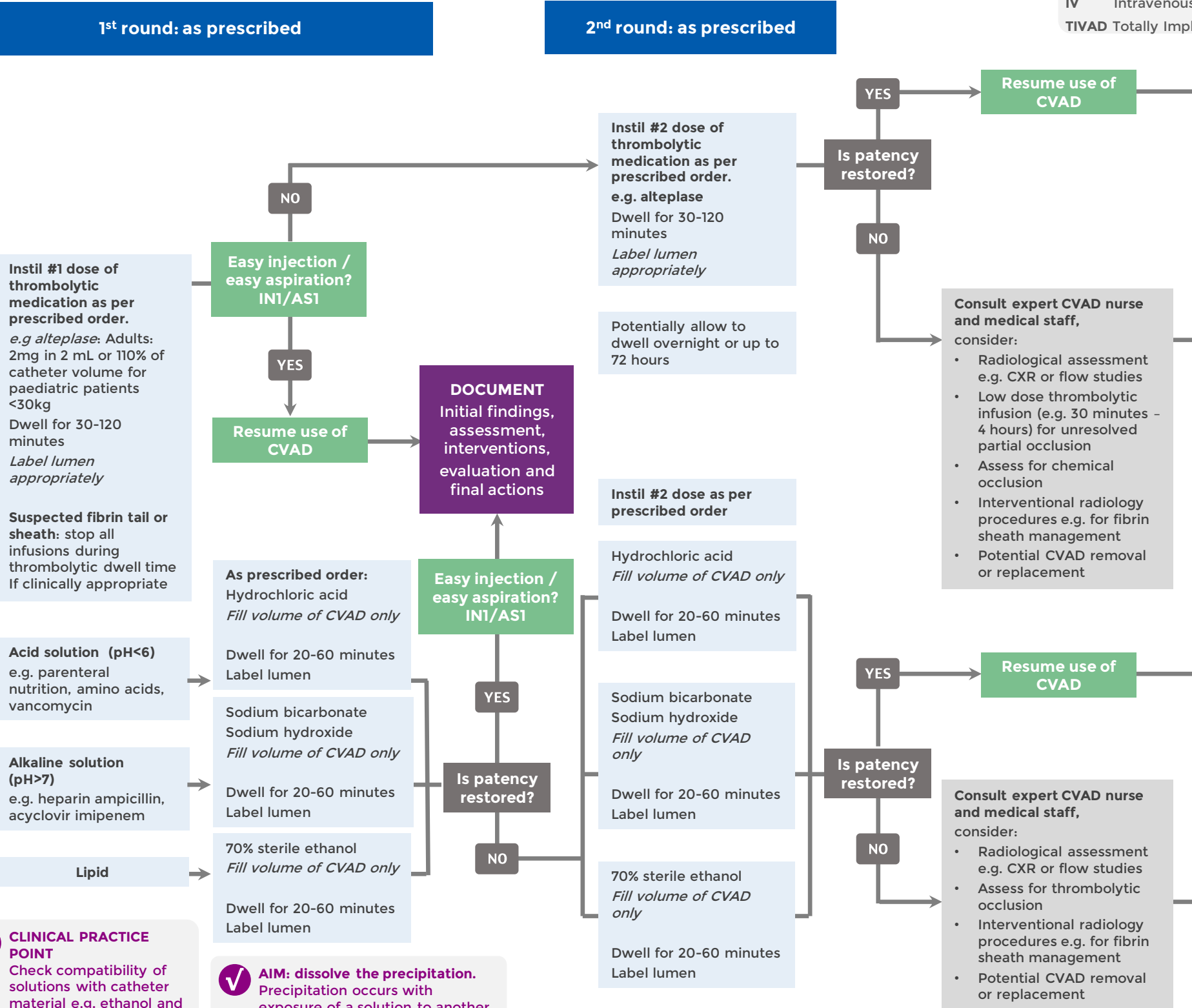
**CLINICAL PRACTICE POINT**  
Seek advice from pharmacist for management of chemical occlusions

**CLINICAL PRACTICE POINT**  
Check compatibility of solutions with catheter material e.g. ethanol and polyurethane

**AIM: dissolve the precipitation.** Precipitation occurs with exposure of a solution to another with an opposing pH

**CLINICAL PRACTICE POINT**  
Technique for partial occlusion: inject solution into CVAD via syringe  
Complete occlusion: use three-way tap technique (installation facilitated by creating negative pressure)

**ABBREVIATIONS**  
CT Computerised tomography  
CVAD Central Venous Access Device  
CXR Chest x-ray  
IV Intravenous  
TIVAD Totally Implanted Venous Access Device



- Anderson, D. M., K. A. Pesaturo, J. Casavant, et al. 2013. "Alteplase for the treatment of catheter occlusion in pediatric patients." *Ann Pharmacother* 47(3):405-409.
- Athale, U. H., S. Siciliano, J. Cheng, et al. 2012. "Central venous line dysfunction is an independent predictor of poor survival in children with cancer." *J Pediatr Hematol Oncol* 34(3):188-193.
- Bain, J., B. Goodgame, S. Mehringer, et al. 2018. "Association of bloodstream infection with central venous catheter administration of alteplase." *Crit Care Med* 46 (Supplement 1):60.
- Borretta, L., T. MacDonald, C. Digout, et al. 2018. "Peripherally Inserted Central Catheters in Pediatric Oncology Patients: A 15-Year Population-based Review From Maritimes, Canada." *J Pediatr Hematol Oncol* 40(1):e55-e60.
- Bradford, N. K., R. M. Edwards and R. J. Chan. 2015. "Heparin versus 0.9% sodium chloride intermittent flushing for the prevention of occlusion in long term central venous catheters in infants and children." *Cochrane Database Syst Rev*(11):CD010996.
- Buchini, S., S. Scarsini, M. Montico, et al. 2014. "Management of central venous catheters in pediatric onco-hematology using 0.9% sodium chloride and positive-pressure-valve needleless connector." *Eur J Oncol Nurs* 18(4):393-396.
- Canadian Vascular Access Association. 2019. *Canadian Vascular Access and Infusion Therapy Guidelines*. Pembroke, ON: Pappin Communications.
- da Costa, A. C. C., J. M. Ribeiro, C. I. Vasques, et al. 2019. "Interventions to obstructive long-term central venous catheter in cancer patients: a meta-analysis." *Support Care Cancer* 27(2):407-421.
- Cesaro, S., M. Cavaliere, A. Pegoraro, et al. 2016. "A comprehensive approach to the prevention of central venous catheter complications: results of 10-year prospective surveillance in pediatric hematology-oncology patients." *Ann Hematol* 95(5):817-825.
- Cesaro, S., G. Tridello, M. Cavaliere, et al. 2009. "Prospective, randomized trial of two different modalities of flushing central venous catheters in pediatric patients with cancer." *J Clin Oncol* 27(12):2059-2065.
- Chong, L. M., Y. L. Chow, S. S. Kong, et al. 2013. "Maintenance of patency of central venous access devices by registered nurses in an acute ambulatory setting: an evidence utilisation project." *Int J Evid Based Healthc* 11(1):20-25.
- Dal Molin, A., M. Clerico, M. Baccini, et al. 2015. "Normal saline versus heparin solution to lock totally implanted venous access devices: Results from a multicenter randomized trial." *Eur J Oncol Nurs* 19(6):638-643.
- Diaz, J. A., S. N. Rai, X. Wu, et al. 2017. "Phase II Trial on Extending the Maintenance Flushing Interval of Implanted Ports." *J Oncol Pract* 13(1):e22-e28.
- Durning, S. (2011). Multidisciplinary team approach to develop algorithms to guide clinical practice for key issues in pediatric vascular access. *JAVA - Journal of the Association for Vascular Access*, 16 (4), 214-215.
- Fleury, M., B. Guignard,, C. Fanzo-Christe, et al. 2014. "Subcutaneously implanted port-chamber central venous catheters: Prevention and care of occlusion." *Eur J Hosp Pharm*, 21 (Supplement 1), A25.
- Gabriel, J. 2011. "Vascular device occlusion: causes, prevention and management." *Nurs Stand*, 25(44), 49-55.
- Gerceker, G. O., S. A. Sevgili and F. Yardimci. 2018. "Impact of flushing with aseptic non-touch technique using pre-filled flush or manually prepared syringes on central venous catheter occlusion and bloodstream infections in pediatric hemato-oncology patients: A randomized controlled study." *Eur J Oncol Nurs* 33:78-84.
- Giordano, P., P. Saracco, M. Grassi, et al. 2015. "Recommendations for the use of long-term central venous catheter (CVC) in children with hemato-oncological disorders: management of CVC-related occlusion and CVC-related thrombosis. On behalf of the coagulation defects working group and the supportive therapy working group of the Italian Association of Pediatric Hematology and Oncology (AIEOP)." *Ann Hematol* 94(11):1765-1776.
- Gorski, L. A., L. Hadaway, M. E. Hagle, et al. 2021. "Infusion Therapy Standards of Practice, 8th Edition." *J Infus Nurs* 44(1S Suppl 1):S1-S224.
- Goossens, G.A., Stas, M., Jérôme, M. and Moons, P., 2011. Systematic review: malfunction of totally implantable venous access devices in cancer patients. *Supportive care in cancer*, 19(7), pp.883-898.
- Granic, M., D. Zdravkovic, S. Krstajic, et al. 2014. "Totally implantable central venous catheters of the port-a-cath type: complications due to its use in the treatment of cancer patients." *J BUON* 19(3):842-846.
- Heibl, C., V. Trommet, S. Burgstaller, et al. 2010. "Complications associated with the use of Port-a-Caths in patients with malignant or haematological disease: a single-centre prospective analysis." *Eur J Cancer Care (Engl)* 19(5):676-681.
- Hitchcock, J. 2016. "Preventing intraluminal occlusion in peripherally inserted central catheters." *Br J Nurs*. 25(19): S12-S18.
- Holt, D., & S. Lawrence. 2015. "The Influence of a Novel Needleless Valve on Central Venous Catheter Occlusions in Pediatric Patients." *JAVA - Journal of the Association for Vascular Access*, 20(4):214-220.e212.
- Hung, C. Y., S.Y. Chiu, S.K. Shum, et al. 2013. "Surveillance on central venous catheter complications in paediatric haematology-oncology unit." *Pediatr Blood Cancer*, 60(53):184.
- Jackson, A., L. Dougherty, & J. Kumwenda. 2019. "Prospective audit to study synerkinase us to restore patency in occluded central venous catheters in haematology and oncology patients - interim results from a multicentre study." *Journal of Vascular Access*, 20(1):NP4-NP5.
- Jain, S. A., S.N. Shukla, S.S. Talati, et al. 2013. "A retrospective study of central venous catheters GCRI experience. Indian journal of medical and paediatric oncology: official journal of Indian Society of Medical & Paediatric Oncology, 34(4):238-241.
- Kang, J., W. Chen, W. Sun, et al. 2017. "Peripherally inserted central catheter-related complications in cancer patients: a prospective study of over 50,000 catheter days." *J Vasc Access* 18(2):153-157.
- Keogh, S., J. Flynn, N. Marsh, et al. 2015. "Nursing and midwifery practice for maintenance of vascular access device patency. A cross-sectional survey." *Int J Nurs Stud* 52(11):1678-1685.
- Kim, H. J., J. Yun, H. J. Kim, et al. 2010. "Safety and effectiveness of central venous catheterization in patients with cancer: prospective observational study." *J Korean Med Sci* 25(12):1748-1753.
- Lee, A. C. and N. D. Ong. 2014. "Can implanted venous access ports remain patent without maintenance flush-lock?" *Pediatr Blood Cancer* 61(12):2326.
- Linnemann, B. 2014. "Management of complications related to central venous catheters in cancer patients: an update." *Semin Thromb Hemost* 40(3):382-394.
- Linnemann, B. and E. Lindhoff-Last. 2012. "Risk factors, management and primary prevention of thrombotic complications related to the use of central venous catheters." *Vasa* 41(5):319-332
- MacLean, J., T. MacDonald, C. Digout, et al. 2018. "Need for tissue plasminogen activator for central venous catheter dysfunction is significantly associated with thrombosis in pediatric cancer patients." *Pediatr Blood Cancer* 65(6):e27015. doi:10.1002/pbc.27015
- Mason, T. M., S. M. Ferrall, A. R. Boyington, et al. 2014. "Central venous access devices: an investigation of oncology nurses' troubleshooting techniques." *Clin J Oncol Nurs* 18(4):421-425.
- Muguet, S., S. Couraud, E. Perrot, et al. 2012. "Clearing obstructed totally implantable central venous access ports: an efficient protocol using a second needle." *Support Care Cancer* 20(11):2859-2864.
- Ociepa, T., E. Maloney, T. Urasinski, et al. 2010. "Thrombotic complications of tunneled central lines in children with malignancy." *J Pediatr Hematol Oncol* 32(2):88-92.
- Redkar, R., A. Bangar, J. Krishnan, et al. 2019. "Role of Chemoports in Children with Hematological/Solid Tumor Malignancies - Technical Implications and Complications: An Institutional Experience." *J Indian Assoc Pediatr Surg* 24(1):27-30.
- Rosenbluth, G., L. Tsang, E. Vittinghoff, et al. 2014. "Impact of decreased heparin dose for flush-lock of implanted venous access ports in pediatric oncology patients." *Pediatr Blood Cancer* 61(5):855-858.
- Schiffer, C. A., P. B. Mangu, J. C. Wade, et al. 2013. "Central venous catheter care for the patient with cancer: American Society of Clinical Oncology clinical practice guideline." *J Clin Oncol* 31(10):1357-1370.
- Schulmeister, L. 2010. "Management of non-infectious central venous access device complications." *Semin Oncol Nurs* 26(2):132-141.
- Sirilerttrakul, S., M. Jirajarus, & N. Ngamphiaboon. 2016. "Nurses role in de clotting thrombotic occlusion via implanted port in ramathibodi hospital." *Cancer Nurs* 39(6) (Supplement 1): S16-S17.
- Sofue, K., Y. Arai, Y. Takeuchi, et al. 2013. "Flow confirmation study for central venous port in oncologic outpatient undergoing chemotherapy: evaluation of suspected system-related mechanical complications." *Eur J Radiol* 82(11):e691-696.
- Stammers, D., B. Connolly, L. R. Brandao, et al. 2017. "Evaluation of the need for chest X-rays in the management of asymptomatic, intraluminal vascular access device occlusion in childhood cancer." *Pediatr Blood Cancer* 64(7).
- Tabatabaie, O., G. G. Kasumova, M. F. Eskander, et al. 2017. "Totally Implantable Venous Access Devices: A Review of Complications and Management Strategies." *Am J Clin Oncol* 40(1):94-105.
- Tsao, K., C.L Fuller, H.L. Green, et al. 2010. "Risk factors and treatment of port thrombosis in pediatric oncology patients." *Journal of Surgical Research*, 158(2):367-368.
- van Miert, C., R. Hill and L. Jones. 2012. "Interventions for restoring patency of occluded central venous catheter lumens." *Cochrane Database Syst Rev*(4):CD007119. doi:10.1002/14651858.CD007119.pub2
- Wells, J., B. Sharif, P. Najran, P, et al. 2011. "How effective are urokinase and lineograms in the management of hickman line occlusions?" *Pediatric Blood and Cancer* 57 (5):752.
- Zaghal, A., M. Khalife, D. Mukherji, et al. 2012. "Update on totally implantable venous access devices." *Surg Oncol* 21(3):207-215.
- Zottele Bomfim, G. A., Wolosker, N., Yazbek, G., Bernardi, C. V., Valentim, L. A., De Castro, T. M., ... Nishinari, K. (2014). Comparative study of valved and nonvalved fully implantable catheters inserted via ultrasound-guided puncture for chemotherapy. *Annals of Vascular Surgery*, 28(2), 351-357.