# Implementation of an Evidence-Based Practice Change Removing Heparin From Implanted Vascular Access Devices

Megan Hoffman, MSN, CNS, CMSRN, AOCNS®, AGCNS-BC, EBP(CH) •
Erica Fischer-Cartlidge, DNP, RN, AOCNS, EBP(CH)

**ABSTRACT**

The objective of this article was to describe the implementation and outcomes of an evidence-based practice change to remove heparin from implanted vascular access device (IVAD) management. An extensive search of the literature was performed, and articles were appraised and synthesized to determine the best practice. A common theme emerged from the literature, showing that 0.9% sodium chloride alone can be as effective as heparin in preventing occlusion in IVADs. In this nurse-led initiative, heparin was successfully removed from the IVAD deaccess process and replaced with a 0.9% sodium chloride flush using a pulsatile flushing technique. Alteplase administration rates were used to measure success of the project, with no statistically significant change observed in alteplase rates 6 mo post-implementation. Successful implementation of this practice change demonstrates that 0.9% sodium chloride may be used for IVAD lock when deaccessing.

**Key words:** 0.9% sodium chloride, evidence-based practice, heparin, implanted port, implanted vascular access device, nursing, occlusion

## INTRODUCTION

In the oncology population, central vascular access devices (CVADs) are often necessary to administer treatments requiring long-term intravenous access. An implanted vascular access device (IVAD), often called a *port*, may be selected for patients with poor peripheral veins and require treatment such as hematopoietic stem-cell transplant and chemotherapy. An IVAD is often chosen as a long-term option due to its advantages, including lower risk of infection, infrequent maintenance, and no dressing requirement when not accessed.[1] The catheter is accessed for each use and can be deaccessed in between therapies, reducing the risk of central line–associated bloodstream infection. Standard care, per the manufacturer of these devices, includes flushing every 4 to 12 weeks to maintain patency and ensure blood return. Historically, heparin has been used during the deaccessing process to prevent occlusion by dwelling in the device and catheter until the next access.

In the cancer center examined in this study, the policy was to flush implanted ports with 10 mL of 0.9% sodium chloride, followed by 500 units of heparin in adult patients and 300 units of heparin in pediatric patients before removing the needle. Historically, this practice was referenced in the literature with insufficient evidence to recommend removing it from practice. For all other CVADs used in this organization, the use of heparin was eliminated from the policy, sparking a clinical inquiry to search for the best evidence regarding heparin use in IVADs. Flushing and locking an IVAD with heparin is not a benign practice and carries risks to the patient, such as heparin-induced thrombocytopenia (HIT) and allergic reaction, even at the small dosage needed.[2] HIT is an adverse reaction caused from an interaction between platelet factor 4 and heparin, occurring in 0.2% to 5.0% of patients receiving heparin products.[3] HIT presents as a moderate thrombocytopenia, but it can put the patient at risk for thrombosis and is associated with a mortality rate of 17% to 30%.[3]

**Author Affiliation:** *Memorial Sloan Kettering Cancer Center, New York, NY (Ms Hoffman and Dr Fischer-Cartlidge).*

**Megan Hoffman, MSN, CNS, CMSRN, AOCNS®, AGCNS-BC, EBP(CH),** *is a clinical nurse specialist at Memorial Sloan Kettering Cancer Center. Megan has 14 years of nursing experience, including 8 years of experience as a clinical nurse specialist in the oncology population.* **Erica Fischer-Cartlidge, DNP, RN, AOCNS, EBP(CH),** *is the interim director of nursing practice at Memorial Sloan Kettering Cancer Center. She has 16 years of oncology nursing experience and is a nationally recognized expert in evidence-based practice and change management.*

**Disclosure:** *The authors have no conflicts of interest to disclose.*

**Corresponding Author:** *Megan Hoffman, MSN, CNS, CMSRN, AOCNS®, AGCNS-BC, EBP(CH), (hoffmanm@mskcc.org).*

*DOI: 10.1097/NAN.0000000000000482*

In recent literature, it has been noted that 0.9% sodium chloride can be as effective as heparin in preventing occlusion.[1-5] The purpose of this article was to describe the implementation and outcomes of an evidence-based practice change led by clinical nurse specialists to remove heparin from IVAD management.

## METHODS

### Review of Evidence

Using the methodology of the Helene Fuld Health Trust National Institute for Evidence-Based Practice in Nursing and Healthcare (Columbus, OH, USA), a review of the literature was conducted using a PICO question to guide the search: "In patients with central venous access (P), what is the effect of heparin (I) compared with normal saline (C) on central line complications (O)?" Due to the clinical nature of the question, databases chosen were PubMed, Cochrane, Embase, CINAHL, Joanna Briggs Institute, and Trip. Using the same search in all databases, a total of 238 articles were found. After removing duplicates, screening by title and abstract, and conducting critical appraisals, 18 articles were included in this project (Figure 1).

Two project leaders critically appraised the articles to verify that inclusion criteria were met and to determine the levels of evidence and quality of the work. Evidence was synthesized to identify themes (Figure 2). One common theme that emerged from the studies was that heparin is not superior to 0.9% sodium chloride in preventing occlusion in IVADs. Seventeen of the 18 studies addressed occlusion in CVADs using heparin and normal saline. Fifteen studies showed no change in occlusion in the heparin versus the 0.9% sodium chloride group; 8 of those studies included IVADs (excluding pediatrics). Additional breakdown relevant to the clinical inquiry showed that 5 of the studies showing no change in occlusion included an oncology population. In these studies, heparin was not found to be superior to 0.9% sodium chloride in preventing occlusion. Pulsatile flushing technique was also discussed as a key component of maintaining catheter patency. This technique consists of quick boluses of 1 mL of 0.9% sodium chloride followed by a pause.[6] Pulsatile flushing removes more solid deposits from catheters than continuous flushing. With education and encouragement, it reduces catheter occlusions in ambulatory cancer centers.[6]

Knowing that evidence-based practice is the merging of high-quality evidence, patient preferences and values, and clinician expertise, internal and external data were also sought. Comparable institutions were queried with regard to their current practices for IVAD management. Professional organization standards and guidelines from the Oncology Nursing Society and Infusion Nurses Society were reviewed for recommendations and reported 0.9% normal saline as equivalent to heparin for IVAD locking.[1,5]

Based on the evidence obtained and the inherent risks to the patient using heparin, the recommendation was to proceed with heparin removal from IVAD deaccess in adult patients. In pediatric patients, evidence was limited to 3 articles, and most comparable institutions had not yet changed practice in this population. Due to the limited amount of evidence, the organization left practice unchanged in the pediatric population.

### Stakeholder Engagement

To begin the process of implementation and integrating the evidence into practice, the engagement of stakeholders was necessary. This helped to create buy-in for implementation, but it also provided feedback from multiple points of view when integrating the evidence into practice. The first stakeholders engaged were experts in CVADs, the physicians in interventional radiology. This collaboration was also critical in disseminating the practice change to other providers in the organization. The nursing quality department was engaged to determine the metrics necessary to display success of implementation and development of a strategy to obtain the data. The patient education department assisted in updating all patient-facing education and videos, including creation of a document addressing justification of the practice change, highlighting that it was necessary for patient safety. The nursing informatics department updated the electronic medical record to reflect these changes by removing heparin from adult patient documentation options. The pharmacy was engaged for its knowledge and expertise on pharmacokinetics of the drug and to ensure that heparin indications and chain of custody were addressed. The supply chain and procurement department were critical in determining cost savings and removing heparin from patient care areas where it would no longer be administered.

### Implementation

The nursing department was a critical stakeholder in the project and was engaged through shared governance including all councils in the organization: inpatient, outpatient, perioperative, education, and practice councils. This structure was used for approvals, buy-in, and to share the education across the nursing department. The project proposal was presented to all councils and in short unit-based in-services. Nursing grand rounds were presented immediately before the launch date. Ongoing support was provided to nurses and patients from clinical nurse specialists across the organization. Practice was changed in May 2021 using evidence as the guide. The new policy for deaccessing IVADs consisted of flushing the catheter with 10 mL of 0.9% sodium chloride using a pulsatile flush technique,[7] followed by removal of the needle.

## RESULTS

Evidence of success was measured by review of alteplase utilization rates. These data were obtained in collaboration with the nursing quality department via a report detailing patients with both an IVAD and alteplase administration.

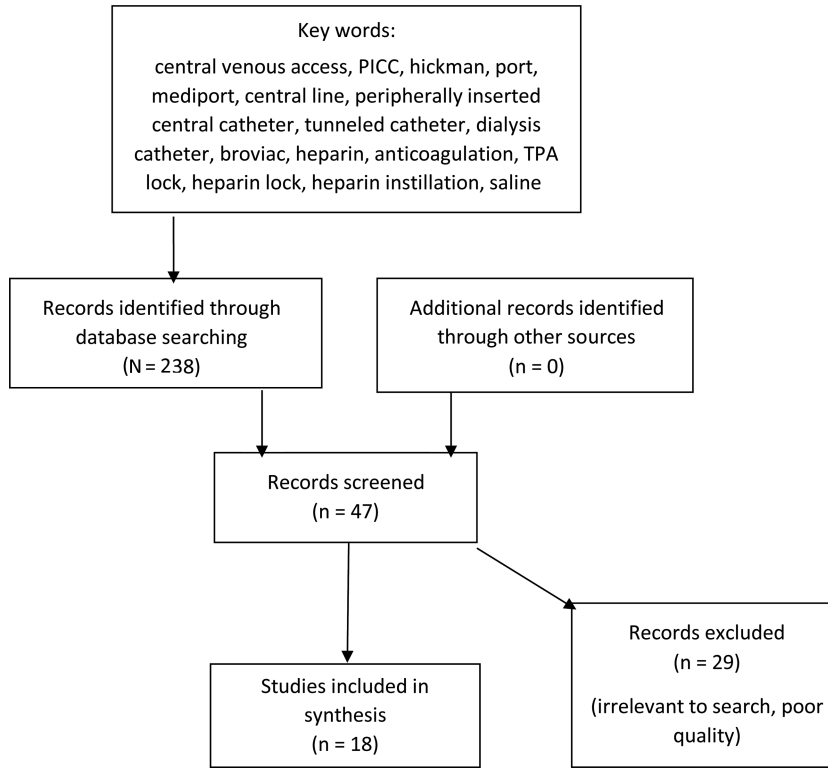


**Figure 1** PRISMA diagram. *Abbreviations: PICC, peripherally inserted central catheter; TPA, tissue plasminogen activator.*

Data were reviewed for 12 months preimplementation and 12 months postimplementation. During the COVID-19 pandemic, practice was changed to limit frequency of patients visiting the center to decrease risk of exposure to COVID-19. In April 2020, a change in the frequency of IVAD flushing and locking in patients not receiving active treatment was increased from 4 weeks to 10 to 12 weeks, and heparin was instilled prior to deaccess. In 2021, this new practice

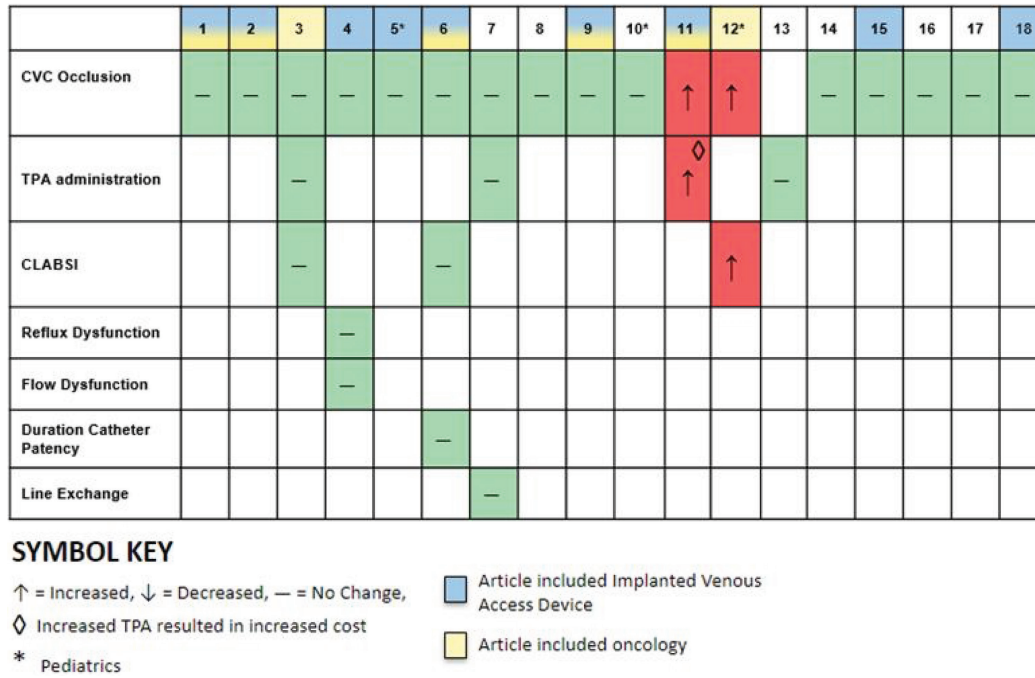


**Figure 2** Synthesis of outcomes when using saline only. *Abbreviations: CLABSI, central line bloodstream infection; CVC, central venous catheter; TPA, tissue plasminogen activator.*

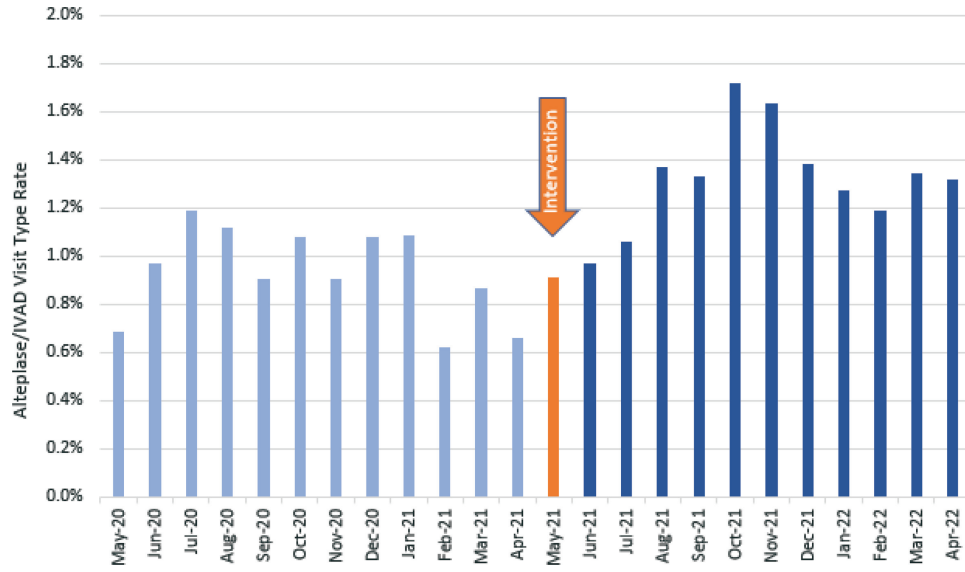


**Figure 3** Alteplase over implanted vascular access device (IVAD) visit types rate. Rate calculated using alteplase administration as a numerator over IVAD visit types.

change was implemented to remove heparin, and the frequency of flushing remained a minimum of 10 to 12 weeks due to the ongoing pandemic.

To account for fluctuations in census, a rate of alteplase use was created for the outpatient setting. Rates were captured in 2 ways. The first rate was calculated using alteplase administration as a numerator over IVAD visit types (Figure 3). In settings where the IVAD visit types are not captured, the rate was calculated as alteplase administration over total IVAD count (Figure 4). Data from May 2020 to April 2021 were used as baseline data, because the project was implemented in May 2021. At 6 months postimplementation, the data were not statistically significant from baseline data in both rates observed (Table 1). However, when analyzing data at 12 months postimplementation, alteplase rates increased slightly, and results became statistically significant from baseline (Table 1). This change in data is believed to be attributed to practice drift related to pulsatile flushing. Contributing to this change was the rate of new hires during the last 6 months of data collection. Nurses new to the organization more than doubled in the second half of data collection. Rates were calculated for individual practice areas. In the units in which alteplase rates trended upward postimplementation, follow-up education on the importance of pulsatile flushing was completed, and data will continue to be trended over time.

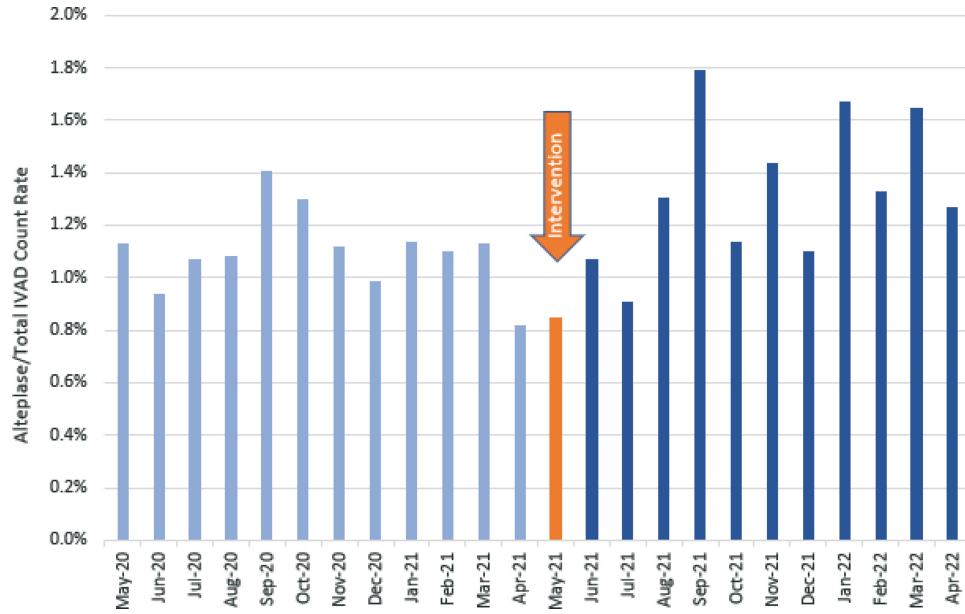


**Figure 4** Alteplase over total implanted vascular access device (IVAD) count rate. Rate calculated as alteplase administration over total IVAD count.

**TABLE 1**

## Alteplase Rates Postimplementation

| Rate type | Time Frame Pre-/Postimplementation, mo | Average Rate Baseline, % | Average Rate Postimplementation, % | *P* Value |
|---|---|---|---|---|
| Alteplase/IVAD visit types | 6 | 0.9 | 1.2 | .13 |
| Alteplase/total IVAD count | 6 | 1.0 | 1.2 | .41 |
| Alteplase/IVAD visit types | 12 | 0.9 | 1.3 | .0007 |
| Alteplase/Total IVAD count | 12 | 1.1 | 1.3 | .03 |

Abbreviation: IVAD, implanted vascular access device.

A cost-savings analysis was also completed for this work effort. As a result of this practice change, approximately $67 000 is saved annually from removing heparin from routine use. Intangible costs, such as storage space in a medication room and/or medication dispensing cabinets, are also saved; however, they cannot be measured.

## DISCUSSION

Historically, using heparin to lock CVADs has been assumed to be necessary for the prevention of catheter occlusion due to its anticoagulant properties.[2] However, literature continues to emerge suggesting that this may not be as essential as once purported and that 0.9% normal saline could be as effective in the prevention of occlusion. This was highlighted in a 2018 update of a Cochrane Review meta-analysis by Lopez-Briz et al,[8] including 11 studies with 2392 participants, and a 2017 systematic review and meta-analysis by Zhong et al,[9] with 10 randomized controlled trials involving 7875 subjects. These 2 studies found no differences between heparin and normal saline in occlusion. Of note, it was found that, in patients with a catheter in place for less than 30 days, heparin may be slightly superior. However, with an implanted port being surgically placed under the patient's skin, this access device is not temporary and would only be removed before 30 days due to complications in the device.

After initial implementation of this change, findings were consistent with the literature and exhibited no difference in occlusion rates. It is important to emphasize that as part of these changes and as discussed in 4 articles within the original literature search,[7,10-12] consistent practice using pulsatile flushing must be reinforced. It is suspected that minor rises in alteplase utilization in the extended time frame may be directly related to practice drift from pulsatile flushing and the stark increase in new graduate nurses in the practice environment. Reinforcement was provided and content was added to the nursing orientation for sustainability. Ongoing rates will be monitored for another 12 months.

In the pediatric population, limited evidence is available. In a systematic review and meta-analysis, Bradford et al[13] found insufficient evidence to determine the effect on occlusion between heparin and 0.9% sodium chloride flushing in infants and children. Therefore, this change was not implemented in patients younger than 18 years. Nurses must be able to appraise a body of evidence and the populations to which they can be extrapolated for successful change implementation.

### Challenges/Limitations

Challenges to implementing this practice change included changes in the hospital system during the COVID-19 pandemic. During the pandemic, practice was changing to reduce visits to the hospital to prevent exposure to the virus. A change was made in April 2020 to decrease patient's IVAD flush frequency from every 4 to 6 weeks up to 10 to 12 weeks. This change occurring before implementation accounted for 2 changes of practice within 1 year of each other.

An additional challenge to implementing and measuring the success of this change was finding a method to capture effective data. There is no established rate/denominator in the literature to measure this change, so a rate was created using internal data. Limitations in the electronic medical record also contributed to difficulty in obtaining data. Data for alteplase use are relatively easy to capture outside of a research setting; however, implanted port complications are difficult to assess outside of a controlled environment. Finally, the limited evidence available in the pediatric population led to a pause in implementing the practice change across the entire system, leading to different practice based on the age of the patient.

## CONCLUSIONS

Successful implementation of this practice change demonstrates that 0.9% sodium chloride may be used for IVAD lock when deaccessing; however, changes in the data over time postimplementation reinforced the need to monitor data continuously after practice change. The Institute of Medicine Roundtable on Evidence-Based Medicine established a goal that 90% of clinical decisions will be evidence based by 2020.[14] Nurses can play a critical part in achieving this goal by implementing evidence-based care

and continuing to reevaluate practice. With time, and as technology and equipment continue to evolve, nurses have an opportunity to evaluate long-standing practices against the evidence to continue to move closer to this goal.


## ACKNOWLEDGEMENT

*The authors thank Kurt David, MS, RN, CNS, AOCNS®, BMTCN®, EBP(CH), for his assistance in implementation of this project.*


## REFERENCES


1. Schulmeister L. Implanted venous ports. In: Camp-Sorrell D, Matey L, eds. *Access Device Standards of Practice for Oncology Nursing.* Oncology Nursing Society; 2017:65-73.
2. Egnatios D, Gloria C. Implanted port patency: comparing heparin and normal saline. *J Clin Oncol.* 2021;25(2):169-174.
3. Smith RS, Bullard Z. Heparin-induced thrombocytopenia: a management review for nurses. *Crit Care Nurs Q.* 2022;45(1):2-7.
4. Heparin. In: Lexi-Drugs. Lexi-Comp, Inc. Updated November 5, 2021. Accessed November 15, 2021. https://online.lexi.com/lco/action/search?q=heparin&t=name&va=heparin
5. Gorski LA, Hadaway L, Hagle ME, et al. Infusion therapy standards of practice, 8th ed. *J Infus Nurs*. 2021;44(1S suppl 1): S1-S224.
6. Boord C. Pulsatile flushing. *J Infus Nurs.* 2019;42(1):37-43.
7. Sivapuram MS. Evidence summary. Implantable venous ports: flushing. *The JBI EBP Database*. 2021; JBI-ES-324-4.
8. Lopez-Briz E, Ruiz Garcia V, Cabello JB, Bort-Martí S, Carbonell Sanchis R, Burls A. Heparin versus 0.9% sodium chloride locking for prevention of occlusion in central venous catheters in adults (review). *Cochrane Database Syst Rev.* 2018;7(7):CD008462.
9. Zhong L, Wang HL, Xu B, et al. Normal saline versus heparin for patency of central venous catheters in adult patients: a systematic review and meta-analysis. *Crit Care.* 2017;21(1):5.
10. Pittiruti M, Bertoglio S, Scoppettuolo G, et al. Evidence-based criteria for the choice and the clinical use of the most appropriate lock solutions for central venous catheters (excluding dialysis catheters): a GAVeCeLT consensus. *J Vasc Access.* 2016;17(6):453-464.
11. Bertoglio S, Solari N, Meszaros P, et al. Efficacy of normal saline versus heparinized saline solution for locking catheters of totally implantable long-term central vascular access devices in adult cancer patients. *Cancer Nurs*. 2012;35(4):E35-E42.
12. Dal Molin A, Clerico M, Baccini M, et al. Normal saline versus heparin solution to lock totally implanted venous access devices: results from a multicenter randomized trial. *Eur J Oncol Nurs.* 2015;19(6):638-643.
13. Bradford NK, Edwards RM, Chan RJ. Normal saline (0.9% sodium chloride) versus heparin flushing for the prevention of occlusion in long-term central venous catheters in infants and children. *Cochrane Database Syst Rev.* 2020;4(4):CD010996.
14. Institute of Medicine (US) Roundtable on Evidence-Based Medicine. *Leadership Commitments to Improve Value in Healthcare: Finding Common Ground: Workshop Summary*. National Academies Press; 2009.