

# The C.L.O.T. Tool for Identifying Strategies to Prevent PICC Catheter Occlusions



## TABLE OF CONTENTS

Part 1: Definition and Scope of Catheter Occlusion

Part 2: Predictors of Catheter Occlusion

Part 3: Preventing Catheter Occlusion: CLOT Tool

Part 4: Application of the CLOT Tool

Part 6: References

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### How to Use This Packet

This packet is intended for hospitals that are participating in the Michigan Hospital Medicine Safety Consortium (HMS) Peripherally Inserted Central Catheter (PICC) Improvement Project. It is meant to be a tool to help make patient care safer by identifying factors associated with PICC catheter occlusion as derived from HMS data, thus helping hospital staff (vascular access specialists, bedside nurses and infection preventionists) prevent catheter occlusion. The tool was developed using rigorous statistical methods after reviewing over 1,700 cases of occlusion from HMS. Although it is derived from HMS, it is applicable to patients receiving care at non-HMS sites as factors associated with occlusion are likely to be similar.

This packet introduces the C.L.O.T. tool, an acronym that helps identify factors associated with occlusion: Catheter Flush, Lumens, Optimal Access and Tip.

The package is intended to be complimentary to literature reviews and other evidence-based tools and resources.

## PART 1: DEFINITION AND SCOPE OF CATHETER OCCLUSION IN PERIPHERALLY INSERTED CENTRAL CATHETERS

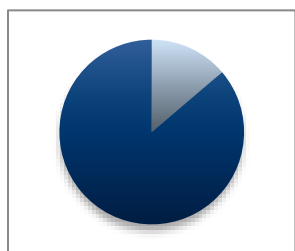
Catheter occlusion is defined as a temporary or permanent inability to aspirate blood or infuse therapeutics through a lumen of a vascular access device.

### Magnitude of the Problem

Like traditional central venous catheters, PICCs are vascular access devices that terminate in the great vessels of the chest adjacent to the heart. However, unlike traditional central venous catheters, PICCs can be placed in veins of the upper extremity and are increasingly inserted by trained vascular access specialists. These properties allow for PICCs to be safely and conveniently inserted at the patient's bedside. As a result, use of PICCs has grown dramatically in hospitalized patients across the world.<sup>1, 2</sup>

While PICC use has improved vascular access for patients, they are not without both major and minor complications. Catheter occlusion is one of the most common complications associated with PICC insertion, affecting 1 in every 8 PICCs placed<sup>8</sup>. Occlusion may have important consequences for patients including inability to use the device, delays in tests or treatment, and sometimes the need to remove and replace the device. Recent data from HMS shows that approximately 12% of the 14,000 PICCs placed in the consortium experienced a catheter occlusion during the life of the PICC.<sup>3</sup> These findings suggest that efforts to identify those at risk for catheter occlusion -- and prevent such events -- can not only help reduce costs, but might also substantially improve patient safety.

### "Real-World" Data from 51 Michigan Hospitals



12% of PICCs Experienced Catheter Occlusion

21%

of Occluded PICCs Were Removed Due to Irreversible Occlusion

\$249,500

Spent on tPA administration<sup>4</sup> for Catheter Occlusion

### What does this mean?

Identifying those at risk for catheter occlusion and establishing strategies to prevent catheter occlusion is critical to quality patient care.

## PART 2: PREDICTORS OF CATHETER OCCLUSION

Despite the prevalence and frequency of catheter occlusion, little is known about how best to predict or prevent these events. For example, available evidence suggests that the type of flush used (e.g., normal saline vs. heparin) or the frequency of flushing may not effectively reduce occlusion.<sup>5,6</sup> In part, these data are limited because available studies suffer from small sample size, variability in flushing technique, and poor statistical techniques to ascertain which approach is most effective.

Because the design, size and scope of the HMS initiative overcomes many of these barriers, a unique opportunity to better study occlusion exists. Using HMS data, we therefore identified predictors of catheter occlusion using statistical models taking into account patient, provider and device factors. The key factors identified as being associated with catheter occlusion in these data are listed below.

### Patient Factors

- Advanced Age
- Elevated BMI
- Severe Liver Disease
- Diabetes
- Hemoglobin less than 10

### Provider Factors

- Left Arm Access
- Administration of Cefepime
- Administration of Piperacillin-Tazobactam
- Administration of Vancomycin
- PICC use in the ICU Setting
- Transfusion of Packed Red Blood Cells
- Use of the SASH (Saline, Administration of Medication, Saline, Heparin) Method\*
- Verification of Optimal Catheter Tip Position at the time of insertion\*

### Device Factors

- Double Lumen
- Triple Lumen
- Catheter Tip Malposition

\*indicates a factor that can reduce catheter occlusion

## PART 3: PREVENTING CATHETER OCCLUSION: CLOT TOOL

After reviewing the predictors of catheter occlusion, factors associated with occlusion can be classified as those that are modifiable vs. those that are not. For instance, factors such as advanced age, elevated BMI, and severe liver disease are not factors that can be easily intervened upon to prevent occlusion. Conversely, some factors most associated with catheter occlusion might be reasonably modified in the clinical setting. From a pragmatic, patient-centered perspective, these might be targeted to prevent occlusion. These critical factors are therefore summarized and emphasized in the CLOT Tool.

The CLOT tool consists of four factors:

- C:** **Catheter Flush - Flush the PICC catheter(s) using the SASH method<sup>5</sup>**  
Flushing the PICC catheter(s) using the SASH (Saline, Administer medication, Saline, Heparin) method is associated with a decrease in PICC occlusion
- L:** **Lumens - Use the least number of lumens necessary**  
Double and triple lumen PICCs are associated with an increase in PICC occlusions. Depending on the clinical situation, single lumens should be preferred when placing PICCs
- O:** **Optimal Access— Insert the PICC catheter in the right arm, if possible**  
Left arm access is associated with an increase in PICC occlusions. Depending on the clinical situation, right arm access is preferred for reducing PICC occlusion
- T:** **Tip - Verification of appropriate catheter tip position upon insertion and prevention of malposition**  
Confirming the PICC tip is in the appropriate location\* upon insertion has been associated with a decrease in PICC occlusions. Conversely, tip malposition has shown an increase in catheter occlusion.

\*Appropriate PICC Tip Locations = cavo-atrial junction, superior vena cava (SVC) atrial junction, right atrial junction, lower 1/3rd of SVC, right atrium, level of the hilum, portion of the left SVC above the level of the coronary sinus, SVC at the level of the right atrial appendage, and the distal superior vena cava.

## PART 4: APPLICATION OF THE CLOT TOOL

To apply the CLOT tool in the clinical setting, several factors are necessary to consider prior to implementing an action plan. Some factors are addressed at the point of PICC insertion (single time point) and others are addressed during the life of the PICC (multiple time points).

Below is a table indicating these factors and potential suggestions of ways to improve practice in these areas. The recommendations are ordered from those that are easiest to implement to those that are hardest or more costly, whenever relevant.

	Catheter Flush	Lumens	Optimal Access	Tip
What?	Utilization of the SASH method for PICC catheter flushing	Utilize the least number of lumens necessary	Insert the PICC in the right arm, if possible	Verification of catheter tip upon insertion and prevent tip malposition
Who?	Registered Nurses Vascular Access Laboratory Technicians Nurse Assistants	Interventional Radiology Vascular Access Physicians/Advanced Practice Professionals	Interventional Radiology Vascular Access Physicians/Advanced Practice Professionals	Interventional Radiology Vascular Access Physicians/Advanced Practice Professionals Registered Nurses
When?	During the entire dwell of the PICC both during and beyond hospitalization	At the point of PICC insertion; when determining the most appropriate PICC type	At the point of PICC insertion	At the point of PICC insertion/during the life of the PICC
How?	<ul style="list-style-type: none"> <li>- Educate staff on the SASH method (identify units with high occlusion rates, begin education with individuals responsible for catheter care)</li> <li>- Obtain &amp; ensure adequate supplies (heparin and saline) on each unit</li> <li>- Create signs to post near the bedside to remind staff of the SASH method</li> <li>- Educate patients on how to perform this technique</li> </ul>	<ul style="list-style-type: none"> <li>- Use a multi-disciplinary approach that includes pharmacy, vascular access specialists and ordering providers when choosing a PICC and selecting lumens</li> <li>- Educate staff on the potential risks of using multiple lumens (e.g., more is not better)</li> <li>- Develop protocols that routinely use single lumen devices unless an exception identifying need for a multi-lumen PICC (e.g., total parenteral nutrition is identified)</li> </ul>	<ul style="list-style-type: none"> <li>- Educate staff on the potential higher rate of incidence when placing PICCs in the left arm</li> <li>- Discuss pros and cons of arm insertion with patient to ensure this is compatible with quality of life, especially if patient will be discharged with PICC</li> </ul>	<ul style="list-style-type: none"> <li>- Educate staff on the importance of catheter tip verification during insertion</li> <li>- Educate staff on appropriate tip location</li> <li>- Identify and treat catheter malposition early and effectively; avoid using PICCs if malposition is identified</li> <li>- Consider use of technologies such as EKG guidance or fluoroscopy when placing PICCs to ensure optimal tip location</li> </ul>

## PART 6: REFERENCES

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