Background
Central Venous Access Devices (CVADs) are routine in the treatment of critical care patients both in the hospital and when they return home. As the patient population ages and the prevalence of chronic diseases (e.g., diabetes, heart issues, cancer) increases, the need for home infusion therapy is expected to increase accordingly. That trend is already underway: home infusion and specialty infusion providers served more than 2 million patients in 2019, a 30% increase over previous years.15 Increasing technological advancements to ensure catheter patency are critical (home infusion is to be successful and patient outcomes are to improve). Thrombotic occlusions are common with CVADs, with self-reported incidence in 28% in home infusion patients. Outcomes of such large-scale data reflect the known risks of catheter occlusion (Figure 1). This initial step allows the blood to deposit a conditioning layer of plasma proteins inside the catheter. Once the conditioning layer is in place, subsequent reflux episodes trigger a cascade of events attracting more blood proteins to continue to layer into the site, leading to fibrin. Thrombotic occlusions are not currently known how long it takes to form a clot inside a catheter, or how much is required to cause occlusion, but studies are ongoing.

Reflux often results from mechanical and physiological pressure changes within the patient’s vasculature caused by patient activity (mechanical pressure), patient access management such that when occurring (e.g., bag slumping, disconnection, incorrect connection/disconnection, or syringe plunger rebound).

The recently released INS Standards recommend that infusion staff should recognize needleless connector (NC) use in cases because the directions for use vary, especially reflux. While reflux has been documented with all types of NCs, the Standards note that anti-reflux devices employing a bidirectional, pressure-sensitive valve (Figure 2) have the least amount of reflux. When CVADs are sterile, a saline flush is administered to clear the line. Thrombotic use in peripherally inserted central catheter (PICC) patients is associated with a 3-fold higher risk of infection (3.59 adjusted odds ratio).6 Anti-reflux intervention reduced alteplase use by 48%/therapy days (Figure 3), and by 36%/census. The ANC needleless connector intervention reduced a fixed cost savings of $123,570 (Figure 4).

Purpose
The purpose of this study was to measure the impact of anti-reflux needleless connector use in preventing thrombotic occlusions among CVADs, and whether ANC implementation will reduce occlusions, represented in alteplase usage, in this home infusion patient population.

Methods
This quality improvement initiative sought to quantify thrombolytic use and analyze the economic impact of the change in clinical practice. A transitional period of February–March 2020 included product changeover and staff education. Outcome parameters included patient census (PC), central venous access device occlusions requiring alteplase, and CVAD occlusions requiring alteplase ($144/2mg dose) from May 2019 through December 2020. A home infusion therapy study included 118 patients (83 CFU, 21 ERV, and 21 PICC) representing home infusion patients and 19 patient risk, discomfort, and inconvenience, not to mention cost, particularly if emergency department visits are necessary. Reducing thrombolytic complications led to a better overall patient experience under our service.

Results
The hypothesis was accepted with a total of 495,519 patient therapy days studied. 42% were NC-GNG (324,905) and 58% ANC (287,294) resulting in average occlusion days for ANC 20,260 (272,376), 118 CFU, and for the ANC 25,177 days (2019) result on 891 PICC, 220 CFU, 118 ERV, and 21 PICC (p = 0.02). The reduction in patient encounters required to declot catheters resulted in a 2.7% curtailment in nursing time (Figure 4). There was a 9% reduction in ER visits (Figure 4). Rates of alteplase usage with ANC and NC-GNG were 4.6% vs 2.9% with median 112 (95% CI:89-169), vs 82 (95% CI:68-109) (p = 0.04). Of patients requiring alteplase, 18% were recently discharged from the hospital suggesting that signs of occlusion likely occurred during their inpatient stay. Anti-reflux intervention avoided alteplase use in 49% therapy days (p = 0.05), and by 36%. The ANC needleless connector intervention reduced a fixed cost savings of $123,570 (Figure 4).

Discussion
Patients with peripheral (PICC) occlusion experience delays in treatment, increased ER visits, decreased patient satisfaction, and higher overall pharmacy costs from supplies and alteplase used to declot used catheters. While certain catheters, the emerald size diameters of 4F to 6F are more prone to occlusion, the thrombotic risk resulting from mechanical and physiologic pressure changes contributes to overall incidence of occlusion in all CVADs. Implementation of anti-reflux connectors reduced incidence in almost half and resulted in significant cost reduction over time. Patient occlusions were within 3 days of home infusion admission, future research may indicate ANC placement at the time of hospital insertion to improve patient outcomes.

Previous authors have noted that reducing the incidence of thrombotic occlusion has impact well beyond the cost of the thrombolytic therapy. Assessment of the device and its installation at the thrombolytic may require one to two extra nursing visits lasting 5-12 minutes for a single dose, and even more time if a second dose is required. Compromised catheter patency increases patient risk, discomfort, and inconvenience, not to mention cost, particularly if emergency department visits are necessary. Reducing thrombolytic complications led to a better overall patient experience under our service.

Conclusion
There is statistical evidence that integration of anti-reflux needleless connectors on CVADs reduce occlusion substantially reduced the need for alteplase in this home infusion study population. This quality improvement measure reduced cost associated with occlusion complications including those that required nursing and emergency room visits, while positively affecting patient satisfaction.

Disclosure: Nothing to disclose.

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