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The Problem With Peripherally Inserted Central Catheters

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Central venous catheters (CVCs) provide reliable venous access for tasks as diverse as delivery of medication, laboratory testing, and hemodynamic monitoring and occupy a fundamental role in the management of seriously ill patients. However, despite their many benefits, CVCs are not innocuous and are associated with important complications. Among these, central line–associated bloodstream infection (CLABSI) and venous thromboembolism are significant because they are difficult to detect, increase the cost of care, and are potentially life-threatening adverse events.

Consequently, studies to predict and prevent these complications have become a research priority. Because of the frequent use of CVCs in the intensive care unit (ICU), efforts to reduce these unfavorable outcomes have traditionally focused on critically ill patients, a population for which substantial progress has been made. For example, improvements in measurement of infectious episodes by standardized definitions and diffusion of evidence-based practices have led to a 58% decrease in CLABSI in ICUs across the United States.[1] Similarly, evidence-based guidelines emphasizing risk estimation and pharmacological prophylaxis have decreased the risk of CVC-related venous thromboembolism in ICU patients.

Important shifts in the epidemiology of CVCs from ICU to non-ICU settings, however, may threaten this progress. For instance, in a survey involving 2459 patients in 6 medical centers, the majority of CVCs (70%) were being used in non-ICU patients.[2] Furthermore, CVCs remain in place for longer durations when inserted in non-ICU settings, theoretically increasing the risk of CLABSI and venous thromboembolism. Recent data confirm this concern: of the 9826 CLABSIs reported by participating National Healthcare Safety Network hospitals in 2010, 31% occurred in non-ICU patients.[3] In a study seeking to simplify the estimation of venous thrombosis risk in hospitalized patients, the presence of a CVC was among 4 of the strongest risk factors associated with venous thromboembolism.[4] These findings are all the more concerning because lack of comprehensive surveillance for CLABSI in some non-ICU settings, absence of a homogenous patient and clinician population in contrast to those within ICUs, and controversies regarding venous thromboembolism prophylaxis represent major barriers to prevention in non-ICU settings.

Peripherally inserted central catheters (PICCs) are venous catheters that are inserted peripherally and terminate in central veins such that they may be categorized as CVCs. For multiple reasons, PICCs have become among the most frequently encountered CVC in non-ICU patients. For instance, these devices are safer to insert than CVCs, eliminate the discomfort associated with phlebotomy and scheduled peripheral intravenous line changes, and provide extended and reliable venous access. Because specially trained nurses commonly place PICCs at the patient's bedside, ready access to these devices has increased. Furthermore, because PICCs reduce cost by enabling earlier hospital discharge through home intravenous therapy, payers have welcomed and supported the widespread use of these venous catheters.

These logistical factors notwithstanding, a key factor contributing to increasing PICC use is the perception that they are safer than CVCs with respect to important complications. Initial studies found PICC-related bloodstream infection rates were significantly lower than rates associated with CVCs. However, accumulating evidence suggests that the risk of PICC-related complications is not uniform. For example, Ajenjo et al[5] reported that PICC-related CLABSI was almost twice as likely for PICCs that were inserted in ICU settings compared with non-ICU settings (4.79 vs 2.79 episodes per 1000 catheter-days, respectively; relative risk, 1.70 [95% CI, 1.10–2.61]). With respect to venous thromboembolism, factors such as site of PICC insertion (right or left arm), number of PICC lumens, the position of the PICC tip, and patient characteristics such as malignancy, prior venous thromboembolism, or both, interact to influence risk of thrombosis.[6] Taken together, these data suggest that the risk of CLABSI and venous thromboembolism

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associated with PICCs is dynamic and varies according to patient-, setting-, and device-related factors. As PICC use continues to increase in pediatric, hospitalized, cancer, and surgical cohorts, failure to appreciate these nuances may increase the risk of adverse outcomes for many patient populations.

Compared with studies evaluating CVCs, few studies have examined patterns of use and risk of complications associated with PICCs. The absence of this evidence is problematic, and glimpses into present-day practice raise concerns. For example, more than half of all PICCs placed in hospitalized patients at a tertiary care center had at least 1 day of catheter nonuse in a recent study.[7] Each day with a CVC increases the risk of adverse outcomes, and days of catheter nonuse may represent instances of preventable harm. Similarly, in a recent study, prior PICC use in 54% of patients receiving hemodialysis treatment was strongly associated with subsequent nonfunctioning of arteriovenous fistulae.[8] In addition, the presence of a PICC was associated with increased risk of nursing home–associated infections in a point prevalence study of 10 939 veterans.[9] While this finding may relate to study limitations such as selection bias or unmeasured confounding, continuation of intravenous treatment in long-term care settings remains one of the principle uses of PICCs, and this study illustrates the potential risks associated with the proliferation of PICCs in contemporary practice.

How might physicians address these potential harms? The absence of a well-developed evidence base leads to critical knowledge gaps regarding best practice. For instance, is venous access a justifiable reason to place a PICC in a patient who otherwise does not need long-term intravenous therapy? What infectious or noninfectious complications should be considered when making this decision? Are there important advantages or risks of PICCs compared with CVCs in this context? Does placement of a PICC increase the odds of upper-extremity thrombosis in certain patient subsets and can this risk be mitigated? Without robust prospective studies evaluating comparative effectiveness and adverse outcomes, physicians are likely to remain uninformed about these important clinical issues.

Physicians must acknowledge the mounting evidence that suggests that not all PICCs are safe, necessary, or appropriate. Exercising restraint in the decision to insert these devices is a first step in the prevention of PICC-related adverse outcomes. This is particularly important among hospitalized patients for whom PICCs are increasingly used when peripheral veins are difficult to locate, leading to the adage "peripherally inserted convenient catheters." Because hospitalized patients are especially at risk of CLABSI and venous thromboembolism, discrimination in use of PICCs is a necessary and fundamental aspect of CLABSI and venous thromboembolism prevention in this patient population. With the expansion of the hospitalist movement across the United States, an opportunity to realize this practice shift exists. By virtue of hospitalists' presence and influence on inpatient care, even small changes in their practice could reduce the risk of these adverse outcomes related to PICCs.

The use of PICCs increases each year, which has generated many questions but fewer answers. A research agenda dedicated to understanding best practices and broadening the evidence base for these devices is needed. Until these data are available, physicians should exercise restraint when placing PICCs. Indeed, an ounce of prevention appears obligatory when it comes to avoiding PICC-related complications.

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Flanders reported serving as a consultant to the Institute for Healthcare Improvement Faculty for Antibiotic Stewardship Pilot; providing expert testimony in legal cases; receiving grants or having grants pending with Blue Cross Blue Shield of Michigan and the CDC Foundation; receiving nonpharmaceutical honoraria for talks at academic meetings; and receiving royalties from Elsevier and Wiley. Dr Saint reported receiving honoraria and speaker's fees for lectures on hospital-acquired infection prevention, implementation science, and patient safety from hospitals, academic medical centers, professional societies, and nonprofit foundations; holding stock or stock options in Doximity; and serving on the medical advisory board for Doximity. Dr Chopra did not report any disclosures.
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REFERENCES

1. Srinivasan A; Centers for Disease Control and Prevention (CDC). Vital signs: central line-associated blood stream infections—United States, 2001, 2008, and 2009. *MMWR Morb Mortal Wkly Rep*. 2011;60(8):243-248.
2. Climo M, Diekema D, Warren DK, et al. Prevalence of the use of central venous access devices within and outside of the intensive care unit: results of a survey among hospitals in the Prevention Epicenter Program of the Centers for Disease Control and Prevention. *Infect Control Hosp Epidemiol*. 2003;24(12):942-945.
3. Dudeck MA, Horan TC, Peterson KD, et al. National Healthcare Safety Network (NHSN) Report, data summary for 2010, device-associated module. *Am J Infect Control*. 2011;39(10):798-816.
4. Woller SC, Stevens SM, Jones JP, et al. Derivation and validation of a simple model to identify venous thromboembolism risk in medical patients. *Am J Med*. 2011;124(10):947-954, e2.
5. Ajenjo MC, Morley JC, Russo AJ, et al. Peripherally inserted central venous catheter-associated bloodstream infections in hospitalized adult patients. *Infect Control Hosp Epidemiol*. 2011;32(2):125-130.
6. Chopra V, Anand SA, Krein SL, Chenoweth CE, Saint S. Bloodstream infection, venous thrombosis, and peripherally inserted central catheters: reappraising the evidence. *Am J Med*. 2012;125(8):733-741.
7. Tejedor SC, Tong D, Stein J, et al. Temporary central venous catheter utilization patterns in a large tertiary care center: tracking the "idle central venous catheter." *Infect Control Hosp Epidemiol*. 2012;33(1):50-57.
8. El Ters M, Schears GJ, Taler SJ, et al. Association between prior peripherally inserted central catheters and lack of functioning arteriovenous fistulas: a case-control study in hemodialysis patients. *Am J Kidney Dis*. 2012;60(4):601-608.
9. Tsan L, Langberg R, Davis C, et al. Nursing home-associated infections in Department of Veterans Affairs community living centers. *Am J Infect Control*. 2010;38(6):461-466.