Development and Testing of a Short Peripheral Intravenous Catheter Insertion Skills Checklist

Catherine Schuster, PhD, RN
Brian Stahl, BSN, RN, CRNI, PLNC
Connie Murray, MEd, RD
B. Braun Medical, Bethlehem, PA
Nowai L. Keleekai, PhD, RN
Overlook Medical Center, Summit, NJ
Kevin Glover, MS, MEd
B. Braun Medical, Bethlehem, PA

Abstract

To date, there is no published, psychometrically validated, short peripheral intravenous catheter (PIVC) insertion skills checklist. Creating a valid, reliable, and generalizable checklist to measure PIVC skill is a key step in assessing baseline competence and skill mastery. Based on recognized standards and best practices, the PIVC Insertion Skills Checklist was developed to measure all the steps necessary for a best practice PIVC insertion. This includes the entire process from reading the prescriber's orders to documentation and, if the first attempt is unsuccessful, a second attempt option. Content validity was established using 3 infusion therapy experts. Evidence in support of response process validity is described. The PIVC Insertion Skills Checklist was used by 8 trained raters to assess the PIVC insertion skills, in a simulated environment, of 63 practicing clinicians working on medical and surgical units in a US teaching hospital. Internal consistency of the PIVC Insertion Skills Checklist was $\alpha = 0.84$. Individual item intraclass correlation coefficients (ICCs) between rater and gold standard observations ranged from −0.01 to 1.00 and total score ICC was 0.99 (95% confidence interval, 0.99-0.99). The current study offers validity and reliability evidence to support the use of the PIVC Insertion Skills Checklist to measure PIVC insertion skill of clinicians in a simulated environment.

Keywords: *checklist, peripheral intravenous catheter, skill assessment*

Background

Short peripheral intravenous catheters (PIVCs) are often placed by clinicians who have had little substantive peripheral vascular access education, training, or opportunities to practice the skill until competent before attempting on a real patient.[1-5] The lack of robust, standardized training processes for this invasive procedure has resulted in clinical performance variability, which has been associated with procedural failures, including multiple insertion attempts, patient discomfort, and frequent catheter failure.[6-9] PIVC failure rates due to phlebitis, infiltration, dislodgement, mechanical failure, or infection range between 35% and 50% and lead to premature catheter removal. These adverse events increase patient discomfort, delay vital therapy, and increase health care costs through extended treatment and length of hospital stay.[6,10] The global financial burden for premature PIVC removal can be conservatively estimated to range from $9.8 to $17.5 billion annually, considering the reported PIVC failure rates of 35%-50%, multiplied by the estimated 1 billion PIVCs inserted each year worldwide,[7] and by the reported uncomplicated procedure cost range of $28-$35.[6]

Correspondence concerning this article should be addressed to Catherine.schuster@bbraun.com
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Hospitals are under intense pressure to improve the quality of patient care while reducing total cost of care. One of the primary strategies to accomplish this is to use evidence-based practices to minimize the unnecessary clinical variation that regularly occurs with invasive procedures.[11,12]

Despite the need to reduce PIVC insertion procedure variability, prevent undesirable clinical outcomes, and limit costly clinical services following catheter failure, it is difficult to locate validated checklists to measure practicing clinician PIVC placement skill. Although checklists are commonly used to assess clinician skills in simulated training environments,[13-18] there is a lack of validity and reliability evidence to support the scores obtained by these checklists. Accurately measuring PIVC insertion skill is an integral, but missing, part of the quality improvement process required to complete a PIVC insertion procedure needs assessment, uncover clinical variation, intervene with appropriate training, and monitor and report on the clinical quality and cost of care outcomes. Providing psychometric evidence related to the checklist gives users a quantitative way to judge its performance and compare its use over many clinical and research applications.[19,20] Creating a valid, reliable, and generalizable checklist to measure PIVC insertion skill is a key step in assessing baseline competence and skill mastery.[21]

Review of Literature

A literature review revealed only 1 published short PIVC insertion skill assessment tool. Gaies et al[22] created a PIVC checklist, based on Children's Hospital Boston Department of Nursing's vascular access curriculum, that they used in a skills training study involving pediatric interns. Their checklist consisted of 22 items with 12 items worth 1 point each and 10 items worth one-tenth of a point each. A successful intravenous line insertion was defined as inserting a catheter suitable for at least 1 therapeutic infusion within 2 attempts. Seven senior residents were trained to use the checklist; the training time was not reported. Subjects were scored by 1 evaluator and were also observed by the 2 primary investigators to ensure accurate assessment. Sessions were videotaped but it was not necessary to refer back to the recordings. At the time of the research by Gaies et al,[22] previous data on checklists were not available and thus, they describe the need to create their own tool specifically for their study. This was identified as a limitation because the checklist was not internally or externally validated.

Diverse PIVC insertion procedure recommendations that range from broad process goals[23] to more thorough self-assessment surveys informed by best practice guidelines[4] are more common in the literature than validated checklists. Brydges et al[23] describe a simple 7-step PIVC process list starting with tourniquet placement and ending with flushing to check patency. Wilfong et al[4] describe a more comprehensive PIVC self-assessment survey that includes a 40-step/substep PIVC placement competency checklist. Although both groups state that their PIVC placement evaluation tools were created using published guidelines, they are not similar.

Using an effectively constructed checklist can become complex in dynamic health care settings with procedural interactions, multiple pathways to achieve an end goal, and subtleties in how people communicate.[24] Furthermore, a PIVC checklist can have broad implications. For example, if a checklist is used to assess a procedure skill, it can reveal errors that could potentially compromise the integrity of the entire procedure, despite the procedural end goal being reached successfully.[22] Historically, a PIVC insertion has been considered successful if blood could be aspirated and the catheter could be easily flushed immediately following insertion. Although this PIVC may be patent at the time of insertion, site selection, catheter selected, and insertion technique can directly influence PIVC patency, dwell time, and patient comfort and safety.

We propose that the successful insertion of a short PIVC needs to be redefined to encompass the total episode of PIVC access and care. An evidence-based standardized PIVC insertion procedure training process in combination with a validated and reliable assessment tool are needed to reduce clinical performance variability, which negatively influences the quality and cost of patient care. Recently, Helm et al[6] reinforced the idea that PIVC insertion success was a collectively more complex process involving 3 interdependent issues: "1) the technology used, such as the catheter, connector, and dressing; 2) the caregiver technique applied, including all aspects of insertion, use, and care; and 3) the body's response to this technology and technique." Numerous clinician PIVC knowledge and insertion skill deficits have been identified, including patient assessment, insertion site selection, catheter selection and insertion, catheter securement, complication identification and treatment, and compliance with best practice guidelines.[5,6,25-32]

This article describes the development and evaluation of the PIVC Insertion Skills Checklist. Based on recognized standards and best practices provided by the Infusion Nurses Society and the Association for Vascular Access,[33,34] the PIVC Insertion Skills Checklist was developed as a skills assessment tool for use during a 6-month comprehensive PIVC simulation-based blended learning study involving medical/surgical and surgical nurses at a midsize teaching hospital in the United States.[35] The checklist was designed to measure the steps involved in a best practice PIVC insertion. The insertion steps assessed included the entire process from reading the prescriber's orders to documentation, and if the first attempt was unsuccessful, a second attempt option.

Methods

This checklist development and testing was part of a larger study approved by the hospital's institutional review board. The checklist underwent content validity review during the development process. Response process validity was considered throughout its use. Internal consistency and interrater reliability were also evaluated during its use in a simulated clinical environment.

Checklist Development

An original 30-step version of the PIVC Insertion Skills Checklist had been used since 2009 as part of an internal