

Central Venous Catheterization Curriculum Development via Objective Performance Metrics

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INTRODUCTION: Ultrasound-guided (USG) central venous catheterization (CVC) is an invasive procedure with significant potential for complications. Thus, it is ideally mastered in a simulated setting before attempted on patients. In the past, training curricula for CVC and other USG needle interventions have been developed using subjective measures of competence. In this work, we have used objective performance metrics to follow novice learning curves to determine the amount of practice required to reach expert procedural competency in CVC.

METHODS: Over the course of six weeks, eight PGY2 emergency medicine and anaesthesiology residents each engaged in three dedicated CVC training sessions. Training sessions were performed on simulation phantoms and were closely monitored by CVC experts, who provided specific guidance, feedback, and drills for each resident (Fig. 1). Before and after each training session, each resident performed one CVC insertion that was tracked for the purposes of hand motion analysis (HMA) and objective performance metric computation using the Perk Tutor software (www.perktutor.org). Specifically, the number of discrete motions associated with each hand, as well as total procedure time were captured [1]. Resident learning curves were established by comparing, over time, their motion efficiency metrics with expert benchmarks.

RESULTS: At baseline, all metrics were significantly different between the novice and expert groups. After three training sessions (approximately 85 procedure attempts), residents' learning curves for total number of hand motions approached or surpassed the expert baseline (Fig. 2), and therefore simulated training was considered complete. Learning curves were similar for total procedure time. Direct expert observation revealed that residents had the most difficulty with needle tip visualization and were thus assigned specific drills to reinforce this skill.

CONCLUSIONS: We have shown that objective performance metrics are a valuable tool that can be incorporated into a procedural task curriculum. Our study was able to reliably identify the quantity of training required to reach competency in CVC: 85 simulated procedure attempts over three training sessions. Although the precise amount of required training will vary between trainees and be influenced by the simulation setup, these values can serve as a guideline for medical educators designing competency-based curricula.

ACKNOWLEDGEMENTS: This work was in part funded by Cancer Care Ontario through Applied Cancer Research Unit and Research Chair in Cancer Imaging grants.

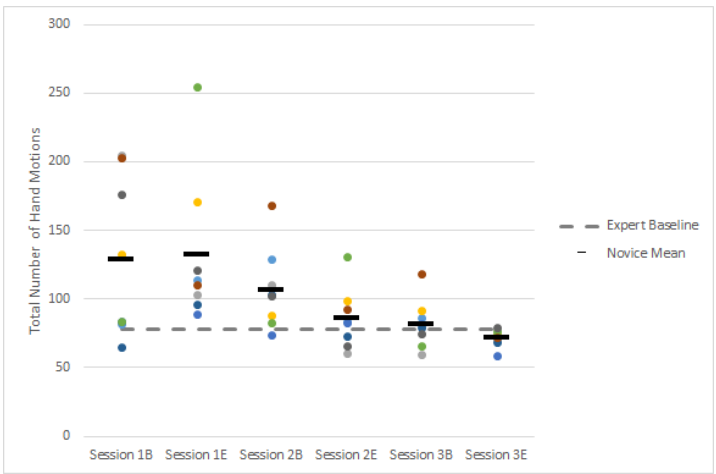


Figure 1: Photograph of novice performing an ultrasound-guided CVC with hand tracking setup. Figure 2: Novice learning curves for total number of hand motions versus session number (B = beginning; E = end).

[1] D. Clinkard, *et al.*, "The Development and Validation of Hand Motion Analysis to Evaluate Competency in Central Line Catheterization," *Academic Emergency Medicine*, vol. 22, no. 2, pp. 212-218, 2015.