Research Brief

Avstick: An Intravenous Catheter Insertion Simulator for Use with Standardized Patients

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Abstract

An overwhelming majority of hospitalized patients undergo intravenous (IV) catheter insertion in order to receive hydration and necessary medication. Current IV insertion training techniques include manikins that are unable to react or give feedback to the trainee. The Avstick® is a realistic training device that can be worn by an actor, allowing a nurse trainee to perform an IV catheter insertion on a live patient without causing the person harm. The purpose of this study is to demonstrate the effectiveness of the Avstick in nursing education to increase nurse-patient communication and trainee self-efficacy.

KEY WORDS Health Care Theatre – IV Training – Nursing Education – Simulation – Avstick – Standardized Patient

An overwhelming majority of hospitalized patients undergo intravenous (IV) catheter insertion in order to receive hydration and necessary medication. The task of performing IV catheter insertion falls to nurses and is one of the most common procedures they perform (Dychter, Gold, Carson, & Haller, 2012). Even with the routine nature of an IV catheter insertion, in a study of 339 IV insertions performed by new and experienced nurses, nearly one quarter of insertions (23 percent) failed to locate the insertion site properly, requiring a second or even third insertion to be performed (Jacobson & Winslow, 2005). This amounts to time and equipment wasted as well as undue pain on the part of the patient, along with decreased confidence about receiving the proper care. A patient's confidence in the nurse is greatly influenced by the manner in which the nurse interacts with the patient. Reassurance and effective communication are important aspects of nursing practice. However, it has been reported that nurses struggle with patient communication when performing their set tasks (McCabe, 2004).

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Two years after the completion of this study, the University of Delaware has supported a spin out company that has licensed the product from the University. The PIs for the research study now have a vested interest in the success of the company.

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BACKGROUND

Several IV training systems exist that succeed in varying degrees to train nursing students in both IV catheter insertion procedure and interpersonal skills. Traditional nursing education programs rely on human patient simulators (HPS), or manikins, for hands-on training. The HPS can simulate procedures spanning the full body or focus on specific procedures with detached segments such as an arm or hand. These systems can simulate the venous network of the human arm with very high anatomic and physiologic fidelity. However, minimal training in interpersonal communications is inherent in training with manikins.

The main alternative to HPS is the standardized patient (SP) or live actor who takes on the role of the patient. A wearable device allows the patient, in this case an SP, to respond to the nursing student's questions and instructions and react to pain and discomfort. However, such devices lack anatomical and physiological fidelity. While providing opportunities for nursing students to communicate while performing IV procedures, they fail to accurately represent the IV insertion environment anatomically, physiologically, and visually.

The Avstick® (formerly SimUStick), a new simulation device that combines the benefits of the HPS and wearable IV arms currently

on the market, is a wearable sleeve that is capable of safely and accurately simulating the procedure of inserting an IV catheter on an SP using standard hospital IV equipment. Sensors embedded in the sleeve prompt the SP to react when the needle is inserted into the sleeve. The device is arranged into three independent modular layers that separate for easy cleaning and maintenance. A protective sheath comprises the innermost layer; a fat layer containing channels that hold simulated veins in their correct anatomical position comprises the middle layer; and a skin layer embedded with sensors to alert the SP to react comprises the outermost layer. The veins are connected to a collection reservoir to allow for the draining of the simulated blood and the injection of drugs. Before a simulation, the system is preloaded with simulated blood so the nursing trainee will see a flashback when inserting the IV into the SP.

The goal of this study is to validate the Avstick against an industry-standard manikin as a viable option for training nursing students to perform IV needle insertions. This study aims to quantify the effect of the Avstick and a manikin on students' self-measured efficacy and student-patient interaction when performing IV insertions. The clinical implications are twofold: to provide data on nurse communication during IV catheter insertion training and to potentially provide clinical validation of the Avstick's capabilities as an accurate IV catheter insertion simulator for promoting interpersonal skills during nursing education.

METHOD

Educational Study Design

The study was approved by the University of Delaware Institutional Review Board. Twenty-five junior- and senior-year nursing students (trainee) in an accredited 4-year baccalaureate program were recruited through flyers and word of mouth to perform IV insertion procedures on both the Avstick and a static manikin. The trainees had no IV insertion experience prior to their day of trials. Before beginning the trials, the trainees were given instruction in IV catheter insertion technique using the manikin, but not the Avstick. Three students were recruited as SP Avstick patients to wear the Avstick during trials and to react to the procedure. The trainees were randomized for testing first with either the manikin or Avstick patient followed by the other training device.

Measurement

Outcome measures for this study included a validated survey to measure changes in self-reported efficacy as well as quantifiable observations of clinical behavior during simulation sessions. The Self-Assessment of Self-Efficacy (α = 0.96; Cheraghi, Hassani, Yaghmaei, & Alavi-Majed, 2009) was administered to every trainee immediately after the initial practice period as well as immediately after each device trial. This constitutes three survey results for each trainee: 1) Baseline: after practice period; 2) Survey 1: posttraining survey with the first system, either Avstick patient or manikin; and 3) Survey 2: posttraining survey with the second system.

The number of times a trainee interacted with the Avstick patient or manikin was recorded by one of six research assistants observing the trials. Interrater reliability for all observers was determined through the repeating (two trials) of two recorded clinical simulations of IV needle insertion (kappa = 0.84). These simulations were used only to establish interrater reliability and were not included in the final dataset of the validation study.

Trainee-patient interactions were categorized as follows: explaining elements of procedure to the patient, offering reassurances to the patient, asking the patient questions, and general interactions not already described in the previous three categories. Interactions were tallied within the assigned event categories as well as a lump total of all interactions. The number of interactions of each device was compared within each of the four event categories as well as the total number of interactions. This was done using a paired *t*-test ($p < .05$) in each scenario.

RESULTS

Survey results indicate no significant difference in self-efficacy between Avstick patient and manikin ($p > .05$, ANOVA). The posttraining survey showed significant increase in trainee self-efficacy from the baseline survey in both the Avstick patient ($p = .035$, *t*-test) and manikin ($p = .002$, *t*-test). An analysis of the self-efficacy results with respect to order reveals that the order in which trainees completed the trials had no significant effect on self-efficacy results ($p > .05$).

Measurements of trainee-patient communication demonstrate a significant increase in interactions between trainees and the Avstick patient over the manikin. This was demonstrated across all event categories ($p < .001$, all instances), namely, explaining procedure, offering reassurance, asking questions, and interaction with the patient.

DISCUSSION

These results suggest that the new, wearable IV trainer Avstick is as effective as a manikin in improving trainee self-efficacy, and it better reinforces communication during clinical practice. The interaction data confirm that trainees are much more willing to engage in conversation with an SP wearing the Avstick than with a manikin. These results are in line with the motivation for using SPs: A human patient is innately more responsive than a manikin. Nursing students were more likely to respond to and interact with a living human patient than a static representation of a human patient.

From a procedural standpoint, trainees were observed correcting their own mistakes more frequently when participating in the Avstick simulation than the HPS. When performing the procedure on the HPS, students tended to remain quiet, in some cases completely silent or asking the minimal required procedural questions to complete the simulation. A patient's experience is directly influenced by the way in which a clinician communicates his or her thoughts and intentions during a procedure. Therefore, these communication skills are important for reassuring or explaining a procedure to a patient (Person & Finch, 2008).

In terms of confidence, there have been studies that indicate that high-fidelity medical simulations, similar to what can be provided with the Avstick, promote and increase confidence and self-efficacy of students (Berragan, 2011; Paige et al., 2014). The results of this study are consistent with these findings. It was found that trainees experienced an increase in self-efficacy from baseline after completing the Avstick patient simulation. Similarly, it was found that, after completing IV insertion on the manikin, students also reported an increase in self-efficacy. Currently, there does not exist a study exclusively dedicated to studying the effects of IV needle insertion simulation on the interaction of nursing students. However, because interactions are integral in the standard workday of a nurse, to see an increase in this communication from HPS, the current standards of education indicate a more well-rounded educational tool.

The major limitation of this study is the control group used. The Avstick was compared to a static manikin used in nursing education. It would be beneficial to include alternative HPS in this comparison, such as high-fidelity manikins or hybrid devices used to incorporate SPs into IV training. For the purpose of this study, the goal was to quantify and compare the Avstick with standard training device (the static manikin) on self-efficacy and student-patient interactions.

CONCLUSION

The results of this study demonstrate that the Avstick matches the standard manikin in building trainee self-efficacy. This implies that the Avstick could replace HPS and still maintain the same level of procedural education in simulation labs. However, as a viable replacement, the Avstick carries the added benefit of increasing the capabilities for teaching interpersonal skills to nursing students learning IV catheter insertion.

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