Outcomes of a structured inter-professional ultrasound guided vascular access workshop: a program evaluation report analyzing structure, participation and satisfaction

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Abstract
This article was migrated. The article was marked as recommended. Ultrasound-guided vascular access procedures are increasingly performed, particularly in the hospital setting, by a variety of health care professionals. Adequate teaching of the skills required for these procedures is important for all clinicians conducting these procedures. We created an inter-disciplinary workshop to teach these skills to anyone interested at our institution. This was a half-day workshop that combined pre-workshop teaching materials with didactic lectures and simulation based learning, which was followed by deliberate practice. Enrollment was on a first come first serve basis. We retrospectively reviewed the enrollment and performance of this workshop at our institution over 18 months. The workshop proved equally attractive to trainees and staff. Participants spanned a variety of healthcare disciplines, with the most common being intensive care (27%) and diagnostic imaging (23%). Participants indicated high satisfaction with the workshop, with a mean score of 4.7 on a 5-point Likert scale given to measure overall satisfaction. A long-term impact survey indicated regular use of skills learned in the workshop and a perceived improvement in clinical practice. This study helps demonstrate the efficacy of this inter-professional workshop structure in helping multidisciplinary healthcare professionals acquire unique skillsets for everyday clinical practice.

Keywords
Vascular access, ultrasound guidance, simulation based learning, deliberate practice, inter-professional workshop

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1. Gert Van Zyl, University of the Free State
2. Ken Masters, Sultan Qaboos University

Any reports and responses or comments on the article can be found at the end of the article.
Introduction
The ability to perform ultrasound-guided vascular access by a variety of medical and surgical disciplines is becoming an increasing need in highly complex hospitals. Indications are diverse and expanding, including nutrition, drug delivery, hydration and blood sampling (Chait et al., 2002; Westergaard, Classen and Walther-Larsen, 2013). Use of ultrasound guidance helps to reduce complications from vascular access procedures. Central venous line placement has a complication rate ranging from 5-26%, which include infection, pneumothorax, arterial puncture, deep vein thrombosis and bleeding (Chait et al., 2002; Westergaard, Classen and Walther-Larsen, 2013). These vascular access procedures are particularly challenging in the pediatric population due to factors such as small veins and poor visualization (Westergaard, Classen and Walther-Larsen, 2013). Ultrasound guidance is therefore particularly useful in this population. Though image guidance has placed interventional radiologists at the forefront of performing these procedures, particularly in complex cases, other specialties such as emergency medicine physicians and critical care physicians commonly perform vascular access procedures (Barsuk and Wayne, 2009; Barsuk et al., 2009). Due to the increasing prevalence of ultrasound-guided vascular access procedures in the hospital setting and lack of standardized training in this skill across disciplines, a needs assessment was performed at our pediatric institution. This assessment concluded across a variety of specialties that a formal training opportunity should be provided to those interested in refining this important skill.

Studies have revealed that, compared to traditional clinical education, simulation-based learning (SBL) with deliberate practice (DP) is significantly more effective toward acquiring specific clinical skills (McGaghie et al., 2011). SBL put participants into lifelike experiences where they are required to use the skill being taught (McGaghie et al., 2011; Cohen et al., 2013). DP involves a task with well-defined goals that learners are equipped to meet, and are motivated to focus on and repeatedly practice while receiving feedback and evaluation both during and following the practice (McGaghie et al., 2011). SBL has been demonstrated to be successful, specifically in helping learners acquire central venous catheter insertion skills (Barsuk and Wayne, 2009; Barsuk et al., 2009, 2010). SBL improved skills, decreased the number of attempted needle passes, and increased self-confidence for residents in an intensive care unit setting (Barsuk and Wayne, 2009; Barsuk et al., 2009). Moreover, learners exhibited high retention rates (82.4-87.1%) one-year following the SBL experience for central venous catheters (Barsuk et al., 2010).

The demonstrated efficacy of SBL interventions coupled with the results of our institution’s needs assessment resulted in the creation and implementation of an SBL workshop. This is a retrospective evaluation of the workshop, including its structure, participation, satisfaction and impact over 18 months.

Description
This was a retrospective review of a structured, half-day ultrasound-guided vascular access workshop offered at The Hospital for Sick Children. Sessions were analyzed over an 18 month period. The maximum number of participants per session was 6. Sessions were advertised and made available to any interested health care professional that was affiliated with our institution. Enrollment occurred on a first come-first serve basis. Discipline and level of training of enrolled participants were recorded. An online teaching module and pre course reading material were delivered to the participants as a prerequisite. The module provided an interactive review of the basics of vascular access, including ultrasound orientation, aseptic technique, a step-by-step checklist of the procedure, and possible complications.

The workshop itself began with didactic lectures, covering ultrasound basics, the technique of ultrasound guided vascular access, types of central venous catheters, and finally an introduction to the use of the ultrasound machine. The didactic lectures were given by an interventional radiologist, ultrasound technologist, and vascular access nurses. Following this, participants were divided into groups of 2 and began the simulation based learning on task trainers (ultrasound compatible vascular access models). The groups rotated through three stations - a “Needle Guidance” station, a “Neck Jugular Access” station, and a “Baby Jugular and Femoral Access” station. Time was given for deliberate practice and final debriefing. Following the debrief, all participants completed a course evaluation. Participant satisfaction was measured using a validated Likert scale of 1 to 5. Parameters asked about included overall outcome, design, facilitator, and overall satisfaction. A long-term impact survey was delivered to participants 6-18 months after their participation in the course.

Results
In the 18 month period reviewed, a total of 30 participants registered for the workshop. The majority of participants were from intensive care (27%) and diagnostic imaging (23%). Other disciplines represented in the workshop included pediatrics, general surgery, emergency medicine, and anesthesia (Figure 1).

Of the enrolled participants, 50% were staff and 50% were trainees. Based on the satisfaction survey, participants demonstrated high levels of satisfaction (Figure 2).
Mean score given for overall satisfaction was 4.7 on the 1-5 Likert scale. The long term impact survey was completed by 11 participants. Of the participants who responded, 90.9% indicated that they used the skills learned in the workshop and 90.9% indicated that their clinical practice improved as a result of the workshop (Figure 3).

Discussion
This retrospective review of our institution’s ultrasound-guided vascular access workshop demonstrates the success of this inter-professional and simulation based learning model. Central venous catheter insertion procedures are commonly performed. Advances in imaging techniques and employment in the procedural setting have increased accuracy and safety, leading to significantly fewer infections, associated costs, and line misplacements when compared to the traditional technique of surgically placed lines (Chait et al., 2002). Moreover, in children, these procedures, albeit potentially life-saving, can be very technically challenging and dangerous, owing to their small size (Chait et al., 2002; Westergaard, Classen and Walther-Larsen, 2013). Therefore, improved visualization using ultrasound is of particular pertinence (Westergaard, Classen and Walther-Larsen, 2013).

With the increasing use of ultrasound guidance for central venous catheter placement, interventional radiologists are performing an increasing number of these procedures (Chait et al., 2002). However, central venous catheterization is commonly performed at the bedside in a variety of settings, such as the intensive care unit and the emergency department (Barsuk and Wayne, 2009). Trainees and staff members from a variety of disciplines perform such procedures at the bedside, and as such require training on ultrasonic guidance and vascular access - a requirement that our institution concluded wasn’t optimally taught based on a needs assessment. This workshop effectively bridged this gap and was attractive to a diverse group of participants across multiple medical specialties (Figure 1). It was also equally attractive to both trainees and staff. Moreover, the high satisfaction and long-term impact scores reinforce the success of a workshop for a multidisciplinary audience that is taught by a diverse set of health care professionals (i.e. trained technologists, nurses, physicians). We acknowledge that a limitation of this study is the subjective nature of the self-reported outcome measures of experience satisfaction and perceived skill improvement.
Furthermore, in addition to this workshop validating an interprofessional approach, it also helped to positively augment the literature on the success of SBL, which has been demonstrated in a variety of settings, including for teaching central venous catheterization skills (Barsuk and Wayne, 2009; Barsuk et al., 2009, 2010). In addition to pure SBL, our workshop’s structure of pre-experience modules and readings, multidisciplinary didactic lectures, SBL and deliberate practice, and debriefing helped lead to high participant satisfaction and long-term skill retention and clinical improvement (Figures 2 and 3). This workshop is now offered 2-4 times per year at our institution.

**Conclusion**

This study describes the success of an inter-professional ultrasound-guided vascular access workshop within our organization. We attribute such success to the multidisciplinary group of educators, mirroring the variety of specialties who registered for the course, as well as the combination of teaching methods, such as pre-workshop independent learning, didactic lectures, SBL, and deliberate practice. Participants had high levels of satisfaction with the workshop both immediately after and in a long-term impact survey.

**Take Home Messages**

- Vascular access is increasingly being performed with ultrasound guidance by a number of different health care professionals who require this skill for daily practice.
- Ultrasound guided vascular access workshops appeal to trainees and staff in a variety of disciplines.
- An inter-professional workshop is effective in engaging and educating an inter-professional audience.
- Combining pre-workshop learning material, didactic lectures and simulation based learning with deliberate practice is an effective strategy.
- Our workshop led to participant satisfaction and long-term skill acquisition.

**Figure 3.** Graph illustrating the results of the long term impact survey. Eleven participants responded.
Notes On Contributors
Taryn J. Rohringer is a medical student at the University of Toronto involved with a variety of research projects. She contributed to the data analysis of the study and she developed the manuscript. ORCID ID: https://orcid.org/0000-0002-8425-0036.

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Appendices
Not Applicable.

Declarations
The author has declared that there are no conflicts of interest.

Ethics Statement
This review was discussed with the clinical research services of our hospital and according to our current policies this report falls into the category of a program evaluation activity / evaluation of a course, within normal educational requirements and it is used exclusively for assessment, management or improvement purposes. Based on this, it does not constitute research for the purposes of our Policies, and do not fall within the scope of Research Ethics Board review.

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Ken Masters
Sultan Qaboos University

This review has been migrated. The reviewer awarded 3 stars out of 5

An interesting brief report on the outcomes of a structured inter-professional ultrasound guided vascular access workshop. The authors begin well by clearly outlining the need for the skills to be taught in the workshop. I also liked the fact the workshops were restricted in number of participants. Although this does lessen the numerical impact of each workshop, it increases the ability of the individual participants to learn; repeating the workshop (as the authors have done) compensates for the small number of attendees in each run of the workshop. (It also lessens the burden on the departments who have to cope without their staff while they attend the workshop).

Some points requiring addressing:
• Although the authors do give a brief description of the workshop, there is little to go on (remember that part of the value of such a paper is that others may wish to implement the same). As a result, the value of the paper would be greatly enhanced if the authors could supply (as an Appendix or Supplementary File), a more detailed account of the workshop.
• When numbers are given, it would be useful if raw numbers (followed by percentages in brackets) could be given, rather than percentages only.
• Figure 2 is probably not necessary – the data could rather be expressed in a simple table. This would allow for a more accurate reading of the data (and also save space).
• Similarly for Figure 3, especially as the data are given anyway. (And using the 3-d chart might look nicer, but is actually harder to read than a 2-d chart)

I look forward to a Version 2 of this paper that addresses these points.

Competing Interests: No conflicts of interest were disclosed.

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This review has been migrated. The reviewer awarded 4 stars out of 5

A very important contribution to participate in the debate of improving skills. It is good to see results that indicated regular use of skills learned in the workshop and a perceived improvement in clinical practice. The number over 18 months might be small at this stage to determine a trend. Surprised that the number of attendees is equal between students and staff. Expected it to be higher for staff - but perhaps it was so in the beginning of the 18 months! I am of the opinion that the study needs to continue to try and determine a trend.

*Competing Interests:* No conflicts of interest were disclosed.