ST VINCENT'S HOSPITAL MELBOURNE

Assessment Task 5:

My Lesson Plan for a Simulation-Based Teaching Session

'Ultrasound Guided Intravenous Cannula Insertion'

Dino Druda

Student ID. 35091169

Monash University

HCS5100 – Foundations of health professions education: Clinical Simulation - S1

2024

Prof. Debra Nestel

5th June 2024

Word Count: 2962 words

Ultrasound Guided IV Cannulation Lesson Plan

Time required	2 hours
Faculty no.	6
Participant no.	24

Session Overview

Ultrasound Guided IV cannulation

Insertion of peripheral intravenous cannulae (IVC) is a critical skill involved in the management of hospitalised patients. Difficult intravenous (IV) access can be problematic for several reasons, including obesity, previous IV drug use, renal and haematological disease. Use of ultrasound (US) to locate veins and facilitate access under direct vision in real time increases the first-pass success of peripheral IVC insertion in difficult patients (1).

This learning package is aimed initially at junior medical staff and will be facilitated by more senior medical staff. There is future scope to offer the package to nursing staff when US becomes part of their scope of practice.

The two-hour practical teaching session should follow completion of a pre-learning online video package (see appendix 1). This format is consistent with other ultrasound guided IVC insertion learning packages, with some didactic learning followed by practical sessions, including the use of simulation (2). The session will involve instruction in use of the ultrasound machines to guide IVC insertion, including how to optimise images. There will be practice in identifying veins and arteries on fellow learners, followed by insertion of IVCs on the Blue Phantom part-task trainers for vascular access.

The session should be hands-on focussed with as much time for practice as possible. All participants should have ample opportunity to gain familiarity with the use of ultrasound in acquiring images of veins and using ultrasound to insert IVC on the part-task trainer in real time under direct vision. The participants will then be assessed in demonstrating these skills to a faculty member prior to being able to go on to supervised practice on patients in clinical areas.

Needs Analysis

The needs analysis for this education session is two pronged, with needs expressed by health care practitioners, as well as the organisation. Firstly, there was specific interest expressed from junior medical staff (PGY 1-3) on the wards that they wanted practical experience and education in the use of ultrasound to assist in intravenous access. They felt that this was a gap in their medical training, having had no formal education provided in this skill. This was communicated directly to the Education and Learning Department of the hospital, with the request that the simulation department could design a simulation-based education session specifically for this purpose. Another driver for this education session was a recent change in hospital policy, limiting the number of attempts to obtain IV access to one per practitioner. As ultrasound increases first pass success in IVC insertion in difficult patients, junior doctors wanted to maximise their chance of success.

This expression of interest in education around US guided cannula insertion from medical staff coincided with the Engineering and procurement department having purchased eight portable Phillips ultrasound machines with the specific intention of having them available on the wards in the hospital for insertion of IVC. Currently, if ultrasound is required for IVC insertion, an ultrasound machine from the Intensive Care Unit (ICU) needs to be borrowed. Therefore, rolling out these new machines in the hospital will negate the need to remove ultrasound machines from ICU and improve efficiency. However, education around safe and correct use of these machines is required prior to them being rolled out. It was therefore felt that a session combining education around the technique of ultrasound guided IVC insertion with use of the specific

machines would be beneficial both to staff inserting IVCs under ultrasound guidance, and to the organisation in promoting safe use of this new equipment.

A pilot version of this teaching plan was carried out at the end of 2023, and the session was evaluated by means of a questionnaire delivered using Microsoft Forms. This led to some changes and improvements, based on responses from the learners involved in the pilot.

Target Learners

Initially the education session will be targeted at junior medical staff who are involved in insertion of IVCs on the wards. They will need to have demonstrated competence in insertion of IVCs using the traditional landmark method prior to progressing to use of ultrasound for insertion. It is foreseen that this same education program could be used to educate nursing staff in ultrasound guided IVC insertion. However, this use of ultrasound is currently considered out of the scope of practice of ward-based nursing staff in this organisation.

Faculty

Faculty members will be registrar or consultant level medical staff who are currently skilled in the insertion of IVC under ultrasound and have experience in demonstrating this skill to their junior medical staff. Ideally there should be a faculty-to-learner ratio of 1:4, as this has previously been shown to be an optimum instructor-to-student ratio for learning procedural skills (3).
Faculty will be provided with this lesson plan two weeks prior to the session and given opportunity to raise any questions. The faculty will have a short meeting (ten minutes), just prior to the session to clarify any remaining issues.

Learning Objectives

By the end of the two-hour practical session, participants should be able to:

- Demonstrate safe use of the ultrasound machine and probe, adhering to hospital infection control guidelines to minimise cross contamination.
- Demonstrate the ability to acquire and optimise images using ultrasound, to enable venous cannulation.
- Demonstrate the ability to correctly identify a vein using ultrasound and differentiate it from an artery.
- Demonstrate the ability to perform ultrasound-guided venous cannulation on a simulator model using needle-tip tracking technique in the transverse plane.
- Demonstrate the ability to perform ultrasound-guided venous cannulation on a simulator model in the longitudinal plane.

Pre-Session learning Activity

Three weeks prior to the practical session, a questionnaire will be sent to the learners, looking at student self-rating of experience, skill and comfort with using ultrasound and skill of insertion of IVC under ultrasound guidance. The questions on the form directly relate to the five main learning objectives described above (See Appendix 2). Accompanying this questionnaire will be a question around whether any of the learners have any specific needs, particularly around mobility and access etc.

Two weeks prior to the practical session, the participants will be sent links to videos for pre-learning (see Appendix 1). These videos outline the procedure of ultrasound guided IVC insertion, using both in-plane and out of plane techniques. There is also a video which discusses the difference between the appearance of arteries and veins on ultrasound. A

further video describes some more advanced tips and tricks and describes common mistakes and how to avoid them. A written summary from the New England Journal of Medicine, which accompanies their instructional video will also be sent to the learners (4).

Practical Learning Sesison

This section describes an ideal scenario where there is sufficient equipment and faculty available to teach 24 participants, with six faculty members, maintaining the 1:4 faculty-to-leaner ratio. Should there be fewer available machines or vascular access phantoms, then the learner and faculty numbers can be reduced to reflect this.

Equipment Required

Ultrasound machines:

- Ultrasound machine with high frequency linear probe x 6
- Conduction gel bottle x 6
- Sterile probe covers and gel – 1 per participant

Cannulation part task trainers

- CAE Blue Phantom branched vessel ultrasound training blocks (or equivalent part task trainer) x 6

IV cannulation equipment

- Selection of size 20 cannulae, long and short, enough for 2 per participant
- IV cannula dressings, enough for 2 per participant
- 10mL syringes

Session Delivery

The practical session delivery is based around Peyton's four step approach for skills acquisition – which will be modified as this was initially designed for 1:1 skill teaching, whereas this session will be in small groups(5). The original steps from Peyton's method are demonstration, deconstruction, comprehension and performance. In this modified approach, the faculty member demonstrates the skill to the small group in real time and then demonstrates it again but breaks the skill into steps and provides a commentary. The third step is when a student explains each small step to the faculty member, who performs the skill under instruction in front of the whole group. The final step will then be performance of the skill by the student, but with a second student giving instruction and the rest of the group giving feedback before the faculty member also gives feedback.
This pattern will cycle until the final student has performed the skill under peer instruction with feedback and will then perform the procedure again in real time with no instruction. This modification of Peyton's method has been demonstrated to be effective for teaching IVC insertion to small groups of three learners (5). Should there be any time remaining in the session, then it will be available for free practice by any students who wish to.

Prebrief

This can be conducted to the whole group by a single faculty member. Introduce the way the session will run, an outline of what is to come, and set the expectations of learners attending. Explain confidentiality, and that the session will run under the Basic Assumption™, i.e. that learners are "intelligent, capable, care about doing their best and want to improve" (6).
Orientate learners to the teaching lab – discuss location of toilets and that consumption of food and drink in the space is prohibited.

Explain about care of the equipment, in particular the Blue Phantom vascular part-task trainers, and not to inject air or fluid into them as it will distort the US view for following learners. Also encourage care of the US machine, in particular the probe and cables.

Discuss the fact that learners will be acting as simulated participants in the fact that they will be used as 'patients' in allowing their learner colleagues to scan their forearms and practice identifying vessels and differentiating arteries from veins. It is important to ensure that participants are comfortable with this and are given the opportunity to raise any concerns or objections. Also, it is important that confidentiality is discussed.
Introduce the concept that there will be opportunity for feedback from the faculty during the practical session, with ongoing instruction. However, it must be stressed that there will be a practical assessment component at the end of the session, to ensure that learners can be signed off, and deemed safe to use the ultrasound machines for IVC insertion and go on to demonstrate competence in their clinical practice.

Skill	Delivery
Introduction and Prebrief (15 minutes)	Check prior knowledge, pre-reading & comfort level Frame session outline Deliver Prebrief as above
Practical Session (90 minutes)	**Split into groups – 4 participants to each US machine and IV access phantom. Ensure each participant has ample opportunity for practical hands on practice**
Demonstration	***Familiarisation with US machine, controls, 'knobology'.*** • Introduce the learners to the Phillips US machines that will be based on the wards at the time of the rollout. • Demonstrate the controls required, such as the power control, how to select the correct scan preset (vascular access), and how to adjust the depth, gain and penetration. • Demonstrate how these settings can optimise the image to allow for successful IV cannulation. • Explain that they will get hands-on opportunities to practice image optimisation during the rest of the practical session, when learning to identify vessels on each other, and subsequently when inserting the IVC into the part-task trainer.
Skill 1	***Application of probe covers to maintain asepsis*** • Demonstrate the application of the sterile gel and probe cover to the ultrasound probe to maintain asepsis and minimise cross contamination. Use one of the learners to assist with the maintenance of asepsis. • Initially demonstrate in real-time, and then with commentary, before asking one of the students to talk you through the procedure. • Using the modified Peyton approach described above, allow all of the learners opportunity to demonstrate correct application of the probe cover. • Provide feedback to the learners, and allow fellow students to feedback to each other after the procedure. • At the conclusion of this section discuss cleaning the probe and ultrasound machine according to local infection control policy.

Skill 2	***Identification of venous anatomy using ultrasound*** • Demonstrate the venous anatomy of the forearm and arm using one of the learners as a simulated patient, particularly concentrating on the basilic vein, cephalic vein and the median cubital vein. • Demonstrate how to differentiate between veins and arteries in live arms. • Demonstrate identifying veins and arteries in both cross-sectional and longitudinal views. • Allow the learners ample opportunity to practice on each other, and ensure that they can each identify a vein and an artery on a fellow participant. • Provide feedback and to the learners as they are practising.
Skill 3	***Identification of needle tip and insertion of cannula using ultrasound guidance in the transverse plane*** • Using the Blue Phantom part task-trainer, demonstrate identification of a vessel in transverse plane. • Insert the cannula under the probe, and demonstrate identification of the needle tip, before advancing the probe and then the needle tip towards the vein, and then puncture the vessel and advance the cannula. • Initially demonstrate in real-time, and then with commentary, before asking one of the students to talk you through the procedure. • Using the modified Peyton approach described above, allow all of the learners opportunity to demonstrate insertion of the cannula under ultrasound guidance. • Provide feedback to the learners, and allow fellow students to feedback to each other after the procedure. • Allow opportunity for free practice if time allows.
Skill 4	***Insertion of cannula under direct vision using US in the longitudinal plane*** • Now demonstrate identification of a vessel in the longitudinal plane on the part-task trainer. • Insert the cannula under the probe, and advance into the vein under direct vision. • Initially demonstrate in real-time, and then with commentary, before asking one of the students to talk you through the procedure. • Using the modified Peyton approach described above, allow all of the learners opportunity to demonstrate insertion of the cannula under ultrasound guidance. • Provide feedback to the learners, and allow fellow students to feedback to each other after the procedure. • Allow opportunity for free practice if time allows.
Assessment	At the end of the session the participants will need to have demonstrated the following skills to a faculty member: • Correct application of probe cover preserving aseptic technique.

	• Image acquisition and optimisation on a live arm (faculty member or fellow participant) with correct identification of veins and arteries. • Demonstration of needle tip tracking technique in transverse plane to insert an IVC on the Blue Phantom part task trainer model. • Demonstration of IVC insertion on the Blue Phantom part task trainer model using direct vision in the longitudinal plane. These skills can be demonstrated to the faculty member during the sessions themselves, or at the conclusion of the practical session. This will depend on time and individual faculty preference. The assessment form to be used is attached in Appendix 3. Each participant will need to be successful in all these steps prior to being able to proceed to demonstrate competency, by way of supervised practice on patients. This will be performed after the session in clinical areas, and will be discussed later.
Summary (5 minutes)	Bring group back together, summarise the key points. Allow for follow up questions.

Evaluation of Session

At the conclusion of the session the participants will be given a QR code to scan which will take them to a post course evaluation survey on Microsoft Forms. This form will evaluate learners' satisfaction with the training program as per Level 1 of Kirkpatrick's model (7).
The form will also ask for self-rated scores for confidence in having attained the five main learning objectives of the program. Data from these post-session responses can be compared with the data from the responses to the pre-learning questionnaire, and the difference between the two analysed. This analysis, together with the assessment of competence, would give some data as to degree of learning after the program, and be considered as Level 2 of Kirkpatrick's evaluation model.
There is potential to gain some evaluation of behaviour change because of this education intervention (Level 3 of Kirkpatrick's model). This would necessitate data being collected prior to the roll out of the program. Data could be collected around frequency of use of ultrasound to guided IV cannulation. Once the program has been rolled out, and run for a few sessions, then similar data could be collected. This could be compared to the data from before the implementation of the program, to see the number of times ultrasound is used and the proportion of times compared to numbers of IV cannulations performed.
Finally, patient-based outcomes could be evaluated (Kirkpatrick Level 4) by looking at numbers of attempts per episode of IVC insertion in a defined period (e.g. 1-2 months) in patients on the wards. Once the program had been commenced, and sufficient iterations of it had been delivered, then similar data could be collected over a similar time period. This could then be compared, and see if there is any improvement, with fewer attempts per cannulation episode.

Demonstration of Competence

Following completion of this education session, in order to prove competency in the procedure of ultrasound guided IVC insertion, learners will need to perform 5 successful proctored procedures. These will need to be supervised by medical staff who have already been deemed competent in ultrasound guided IVC insertion, and have been trained by the Education and Learning department in the assessment and feedback of junior medical staff at this procedure. A systematic review of ultrasound guided IVC insertion training programs

found that anywhere between one and 30 supervised insertions were required in various programs before a learner was deemed competent, with a median number of five (2). Despite the authors' recommendations being that 10 supervised ultrasound guided IVC insertions are optimal, in the interest of staff and resource availability, it was decided that 5 would be sufficient.

References

1: Tada M, Yamada N, Matsumoto T, Takeda C, Furukawa TA, Watanabe N. Ultrasound guidance versus landmark method for peripheral venous cannulation in adults. *Cochrane Database of Systematic Reviews* 2022; Issue 12. Art. No.: CD013434. DOI: 10.1002/14651858.CD013434.pub2. Accessed 18 May 2024.

2: Hoskins, MJ, Nolan BC, Evans KL *et al.* Educating health professionals in ultrasound guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes. *Medicine* 2023; 102(16):p e33624, DOI: 10.1097/MD.0000000000033624

3: Dubrowski A and MacRae H. Randomised, controlled study investigating the optimal instructor: student ratios for teaching suturing skills. *Medical Education* 2006; 40: 59-63. https://doi.org/10.1111/j.1365-2929.2005.02347.x

4: Joing S, Strote S, Caroon L, *et al*. Ultrasound-Guided Peripheral IV Placement. *N Engl J Med* 2012;366: e38 DOI: 10.1056/NEJMvcm1005951

5: Nikendei C, Huber J, Stiepak J, et al. Modification of Peyton's four-step approach for small group teaching – a descriptive study. *BMC Med Educ.* 2014;14:1–10.

6: The Basic Assumption™ © 2004-2024 Center for Medical Simulation, Boston, Massachusetts, USA. www.harvardmedsim.org info@harvardmedsim.org

7: Frye AW & Hemmer PA. Program evaluation models and related theories: AMEE Guide No. 67, *Medical Teacher.* 2012; 34:5, e288-e299, DOI: 10.3109/0142159X.2012.668637

ST VINCENT'S HOSPITAL MELBOURNE

Appendix 1: Links to pre-learning videos sent to participants

Introductory video, introducing the techniques of finding a vein, preparing probe and skin, and then locating a vein and advancing the cannula into it.
https://youtu.be/41J9IU8a4To

Review of how to differentiate arteries from veins on ultrasound.
https://youtu.be/s1kp22FF_bk

NEJM introductory video
https://www.youtube.com/watch?v=4zQgi9HrG_o

Further Learning:
Tips and things to avoid - common mistakes and how to avoid them. This video runs for around 20 minutes.
https://www.youtube.com/watch?v=xBDOuUxBswo

ST VINCENT'S HOSPITAL MELBOURNE

Appendix 2: Pre-workshop self rating questionnaire

Ultrasound Guided IV Cannulation - Pre workshop Questionnaire

* Required

1. Please respond to the below statements regarding your confidence and experience in using ultrasound for placement of intravenous cannulae prior to commencing this learning program *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I can safely use the ultrasound machine for IV cannulation, using probe covers and adhering to aseptic technique	○	○	○	○	○
I am confident in my ability to acquire and optimise images on using ultrasound to perform venous cannulation	○	○	○	○	○
I can correctly identify a vein using ultrasound and differentiate it from an artery	○	○	○	○	○
I can perform ultrasound guided IV cannulation on a model in the transverse plane using the needle-tip tracking technique	○	○	○	○	○
I can perform ultrasound guided IV cannulation on a model in the longitudinal plane under direct vision	○	○	○	○	○

ST VINCENT'S HOSPITAL MELBOURNE

Appendix 3: Workshop Assessment Form

ST VINCENT'S HOSPITAL MELBOURNE

ULTRASOUND GUIDED INTRAVENOUS CANNULATION

Participant's name: ..... **Employee ID Number:** .....

Clinical area: ..... **Manager's name:** .....

All clinicians undertaking Ultrasound Guided Intravenous (IV) cannulation at St. Vincent's Hospital must be deemed competent in accordance with the criteria listed below. The clinician will already have satisfied the competency requirement for IV cannulation prior to embarking on this program. The clinician completing this program will be assessed when performing Ultrasound guided IV Cannulation during the workshop conducted in the Education and Learning Centre. The assessment form is attached.

Following successful completion of the workshop, supervised US guided IVC insertion needs to be completed 5 times in their clinical area. Clinicians must be assessed by a St. Vincent's Medical Officer who is deemed competent in this skill.

Supervised Insertion Assessment Criteria

To be deemed safe and competent in ultrasound guided IV cannulation, the clinician must, under supervision of the assessor, demonstrate knowledge and safe practice in Ultrasound Guided IV cannulation by:

- Collecting the appropriate equipment
- Preparing of patient prior to procedure
- Following correct insertion technique using ultrasound guidance
- Adhering to Aseptic Non Touch Technique (ANTT) throughout procedure

Note: Clinicians must have this skill **observed 5 times in their clinical area before deemed safe & competent.**

Please use table below to record this:

Insertion	Date	Time	Name of Assessor *Please print clearly full name*	Designation of Assessor	Clinical area of Assessor	Signature of Assessor
Workshop: *Simulation mannequin*					Education and Learning Practical Workshop	
Insertion 1:						
Insertion 2:						
Insertion 3:						
Insertion 4:						
Insertion 5:						

Competent: YES / NO (please circle) **Date:**

Revised June 2024

ST VINCENT'S HOSPITAL MELBOURNE

Appendix 3: Workshop Assessment Form

ULTRASOUND GUIDED INTRAVENOUS CANNULATION WORKSHOP ASSESSMENT

Ultrasound Guided Intravenous Cannulation Workshop Assessment	Successful
Procedure	
1. Gathers equipment necessary for the procedure (eg. US machine, probe cover, IV trolley with sharps container, IV Start Pack, sterile gloves, cannula, bung, saline flush)	YES / NO
2. Uses ultrasound to scan arm, employing correct presets for IV cannulation	YES / NO
3. Operates ultrasound machine to optimise images, including varying the depth and gain	YES / NO
4. Demonstrates how to identify a suitable vein for IV cannulation	YES/NO
5. Demonstrates how to differentiate between a vein and artery using ultrasound	YES / NO
6. Employs use of aseptic technique to apply probe cover, keeping scanning surface sterile	YES / NO
7. Demonstrates visualisation of vessel in phantom in transverse plane	YES / NO
8. Demonstrates identification of needle tip, and ability to track needle tip into vessel in transverse plane	YES / NO
9. Demonstrates advancement of cannula into vessel	YES / NO
10. Demonstrates visualization of vessel in phantom in longitudinal plane	YES / NO
11. Demonstrates visualization of cannula, and advances into vessel under direct ultrasound	YES / NO
12. Describes how to clean the ultrasound machine at the conclusion of the procedure	YES / NO

Assessor - Name: .....**Signature:** .....

Revised June 2024

ST VINCENT'S HOSPITAL MELBOURNE

Appendix 4: Post workshop Evaluation Form

Ultrasound Guided IV Cannulation Practical Workshop - Post workshop

* Required

1. Overall, how satisfied were you with the training? *
   - ◯ Extremely satisfied
   - ◯ Very satisfied
   - ◯ Somewhat satisfied
   - ◯ Not so satisfied
   - ◯ Not at all satisfied

2. How useful was the pre-learning package on Workday in preparing you for the practical session? *
   - ◯ Extremely useful
   - ◯ Somewhat useful
   - ◯ Neutral
   - ◯ Somewhat not useful
   - ◯ Extremely not useful

3. Do you have any suggestions to improve future training sessions? *

ST VINCENT'S HOSPITAL MELBOURNE

4. Please respond to the below statements: *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I can safely use the ultrasound machine for IV cannulation, using probe covers and adhering to aseptic technique	◯	◯	◯	◯	◯
I am confident in my ability to acquire and optimise images on using ultrasound to perform venous cannulation	◯	◯	◯	◯	◯
I can correctly identify a vein using ultrasound and differentiate it from an artery	◯	◯	◯	◯	◯
I can perform ultrasound guided IV cannulation on a model in the transverse plane using the needle-tip tracking technique	◯	◯	◯	◯	◯
I can perform ultrasound guided IV cannulation on a model in the longitudinal plane under direct vision	◯	◯	◯	◯	◯

5. Will attendance to this training session impact your clinical practice? If so, how? *

This content is neither created nor endorsed by Microsoft. The data you submit will be sent to the form owner.

Microsoft Forms