

## Low Cost Task Trainer for Neonatal Umbilical Catheterization

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### ABSTRACT:

**Audience:** The low cost neonatal umbilical catheterization task trainer is designed to instruct physicians in pediatrics, emergency medicine (EM) and pediatric emergency medicine (PEM).

**Introduction:** Umbilical catheterization can be a lifesaving technique in the emergent management of a critically ill neonate. Umbilical catheterization remains a common procedure in the neonatal intensive care unit (NICU) setting but is performed less frequently in the emergency department (ED). Given its infrequent nature in the ED, procedural simulation in umbilical catheterization is a necessary component of medical training to gain proficiency and competency in this important technique. Commercially available umbilical catheterization models are available but often represent an expensive investment upwards of a thousand dollars for a single trainer. The expense of these high-fidelity models may be unfortunately cost prohibitive for many departments seeking to offer this simulation training for their physicians. In an effort to diminish the cost associated with these models, a “home built” model was trialed. It was easily constructed with readily available items found in the hospital, the household setting, and the local home improvement and toy store. Each task trainer allows for identification of the umbilical arteries and vein with the ability to catheterize either vessel.

**Objectives:** By the end of this instructional session learners should: 1) Discuss the indications, contraindications, and complications associated with umbilical catheterization. 2) Competently perform umbilical catheterization on the task trainer. 3) Demonstrate proper securement of the catheter.

**Methods:** An umbilical cord was constructed using suction catheters to represent the umbilical arteries and nasal canula oxygen tubing was used to represent the umbilical vein. These tubes were suspended in a silicone base and rolled into a log form to simulate the umbilical cord. A small circular hole was cut into the hollow abdomen of a commercially available plastic toy doll and a section of the umbilical cord was inserted. Once assembled, the task trainer can be used in an instructional procedure session to teach umbilical vessel catheterization. The cord can be tied off and cut, allowing for identification of the umbilical vessels. The

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vessels (either artery or vein) can be cannulated using a variety of catheter sizes, and ultimately the catheter can be sutured or taped in place. The task trainers can be reused multiple times.

**Topics:** Neonatal resuscitation, umbilical catheter, umbilical catheterization, umbilical cannulation, instruction, simulation, emergency medicine, pediatrics, neonatal.



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## Learner Audience:

Medical students, interns, junior residents, senior residents, attending physicians

## Time Required for Implementation:

Building the task trainer will take approximately 30 minutes hands-on, 24 hours in total, including drying time. Procedural session should be about 30 minutes total. Approximately 5 minutes to introduce the procedure, 20 minutes hands-on, and 5 minutes on review of key concepts.

## Recommended Number of Learners per Instructor:

The ratio of learners to instructors should be 4:1, learners can be paired up in groups of two to take turns in the role of performing the procedure and assisting with supplies.

## Approximate cost of items to create this innovation:

All supplies in total cost approximately \$40.00. Once the items are purchased, there is enough material to create multiple task trainers, each trainer costing about \$10.

## Topics:

Neonatal resuscitation, umbilical catheter, umbilical catheterization, umbilical cannulation, instruction, simulation, emergency medicine, pediatrics, neonatal.

## Objectives:

By the end of this instructional session learners should:

1. Discuss the indications, contraindications, and complications associated with umbilical catheterization.
2. Competently perform umbilical catheterization on the task trainer.
3. Demonstrate proper securement of the catheter.

## Linked objectives and methods:

Before the procedure session, learners were expected to review pre-learning materials asynchronously. At the start of the procedure session, learners are quizzed as a group on the indications, contraindications, and complications of the procedure by the facilitator to gauge learner readiness. This fulfills objective 1 as listed above.

Learner will demonstrate performance of the procedure. Faculty will directly observe the performance of the procedure, complete the Umbilical Catheterization Checklist, and provide

real time feedback. This fulfills objectives 2 and 3 as listed above.

## Recommended pre-reading for instructor:

- Sobolewski B. Emergency umbilical venous catheter placement. Medical Resuscitation Committee at Cincinnati Children's Hospital Medical Center. <https://vimeo.com/35337127>. Published January 19, 2012. Accessed April 1, 2018.
- Magnan JP, Rowe VL. Umbilical vein catheterization. Medscape Drugs & Diseases. <https://emedicine.medscape.com/article/80469-overview>. Published March 26, 2018. Accessed April 1, 2018.
- Dagle J. Insertion of umbilical vessel catheters. University of Iowa Stead Family Children's Hospital. <https://uichildrens.org/health-library/insertion-umbilical-vessel-catheters>. Published September 20, 2010. Accessed April 1, 2018.
- Anderson J, Leonard D, Braner DA, Lai S, Tegtmeyer K. Videos in clinical medicine. Umbilical vascular catheterization. *N Engl J Med*. 2008;359(15): e18. doi: 10.1056/NEJMvcm0800666

## Learner responsible content (LRC):

- Sobolewski B. Emergency umbilical venous catheter placement. Medical Resuscitation Committee at Cincinnati Children's Hospital Medical Center. <https://vimeo.com/35337127>. Published January 19, 2012. Accessed April 1, 2018.
- Magnan JP, Rowe VL. Umbilical vein catheterization. Medscape Drugs & Diseases. <https://emedicine.medscape.com/article/80469-overview>. Published March 26, 2018. Accessed April 1, 2018.
- Dagle J. Insertion of umbilical vessel catheters. University of Iowa Stead Family Children's Hospital. <https://uichildrens.org/health-library/insertion-umbilical-vessel-catheters>. Published September 20, 2010. Accessed April 1, 2018.
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## Implementation Methods:

- This model is best used in small group sessions with faculty to learner ratio of 1: 4.
- Through group discussion learners are surveyed on their existing knowledge and comfort of performing umbilical catheterization.



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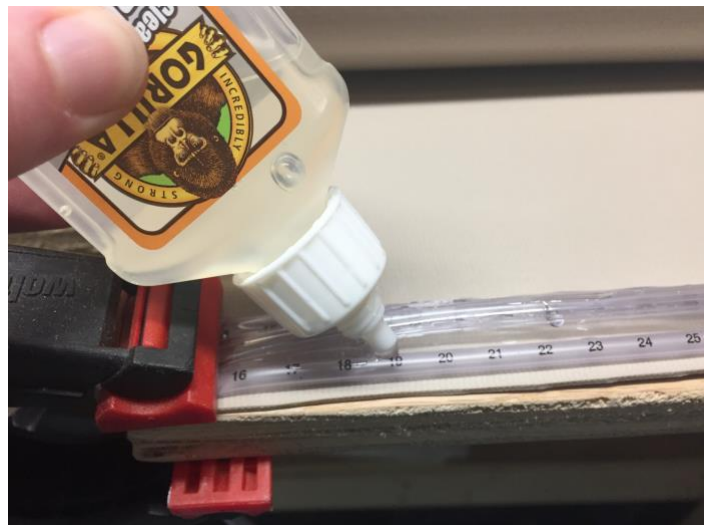
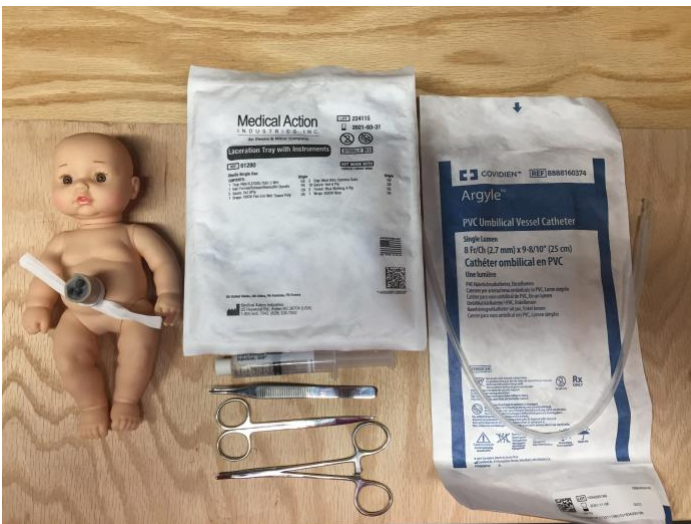
- Faculty facilitates discussion on indications, contraindications, and complications of the procedure.
- Faculty demonstrates procedure on the task trainer.
- Faculty observes learners performing procedure providing real time feedback.

### List of items required to replicate this innovation:

1. Duck™ 20-in x 18-ft Taupe Shelf Liner (\$13.00, home improvement store)
2. 14Fr Suction Catheters (hospital acquired)
3. Nasal canula oxygen tubing (hospital acquired)
4. GE™ Silicone Clear Kitchen & Bath Caulk (\$4.00, home improvement store)
5. Gorilla™ Glue, Clear (\$6.00, home improvement store)
6. Nylon cable ties (\$0.89, home improvement store)
7. Painter's tape (\$4.00, home improvement store)
8. Industrial clamps (\$3.00 each, home improvement store)
9. Scalpel (hospital acquired)
10. Plastic Toy Doll (\$5.00, toy store)



4. Apply Gorilla Glue to the shelf liner and to the tubes themselves so as to glue them to each other and allowed to dry for 2 hours. Once dry, cut the ends of the tubing distal to the cable ties.



### Approximate cost of items to create this innovation:

All supplies in total cost approximately \$40.00. Once the items are purchased, there is enough material to create multiple task trainers, each trainer costing about \$10.

### Detailed methods to construct this innovation:

1. Cut a 12" x 6" piece of shelf liner and lay it on a flat surface.
2. Secure the 2 suction catheters and single oxygen tubing together at both ends with cable ties.
3. Lay the group of three tubes on the shelf liner and clamp the ends to a flat surface using industrial clamps.



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5. Apply silicone over the catheters and tubing.



6. Roll the shelf liner into a log. Then secure it with painter's tape and allow to set for 24 hours.



7. Remove the tape and cut the log with a scalpel into 6" pieces.





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- Using a commercially available plastic toy doll with a hollow abdomen, cut a 1" circle into the abdomen using a scalpel.



- Insert the 6" section of cord into the cavity of the doll and the umbilical catheterization trainer is ready for use.

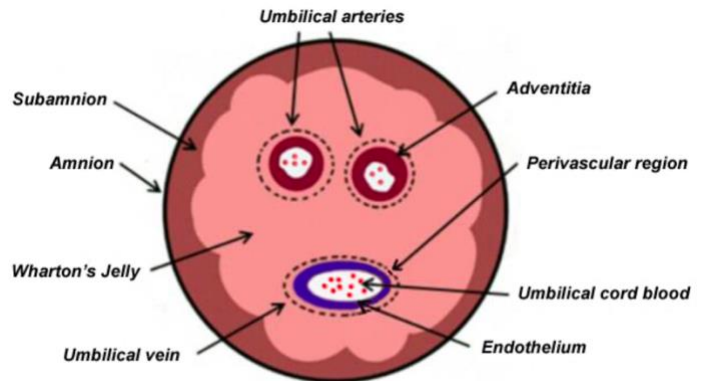


Image source: Cross-sectional diagram of human umbilical cord shows anatomical compartments, including Wharton's jelly. In: Kim DW, Staples M, Shinozuka K, Pantcheva P, Kang SD, Borlongan CV. Wharton's jelly-derived mesenchymal stem cells: phenotypic characterization and optimizing their therapeutic potential for clinical applications. *Int. J. Mol. Sci.* 2013;14(6):11692-11712. doi: 10.3390/ijms140611692. CC BY 3.0.

### Results and tips for successful implementation:

This session was originally run with a total of 40 resident learners; while there was no formal survey or evaluation used, verbal feedback from learners was very positive. Many learners expressed increased comfort in performing the procedure and ease of use of the simulation trainer.

This session is best implemented in smaller groups for hands-on sessions. This trainer and skill session was initially introduced to EM residents during a small group procedural session lead by Pediatric Emergency Medicine (PEM) fellows. The groups were 5 learners (EM residents ranging from PGY1-4) to 1 instructor (PEM fellows, PGY 4-6). From our experience we concluded that groups of 4:1 would be better suited to using this model as the learners can pair up and take turns being the performer of the procedure as well as the assistant providing supplies. The task trainer was modified after the initial session to make the cord slimmer in design to mimic a more life-like dimension of the umbilical cord. By using a range of catheter sizes (5-8 French) the learner is able to practice with larger (8Fr) versus more delicate (5Fr) catheters in the task of cannulating the umbilical vessels.

### References/suggestions for further reading:

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14. All images for methods to construct the innovation are authors' own images.



# INSTRUCTOR MATERIALS

## Umbilical Catheterization Checklist

The following should be demonstrated by the learner:  
(Check all that apply)

	Yes	No
Identification of umbilical arteries and umbilical vein		
Proper depth of insertion calculated		
Proper set-up of equipment including: 1. Flushing catheters 2. Use of stopcock		
Proper positioning of patient		
Sterile technique followed		
Demonstrates use of umbilical tape and cutting of cord		
Proper dilation of umbilical artery		
Demonstrated appropriate insertion technique of catheters		
Appropriate positioning of umbilical vein catheter		
Proper securement of catheters		

Comments, Debriefing and Discussion: \_\_\_\_\_

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