

# Umbilical Cord Model for Umbilical Vein Catheterization Training

– THE UMBILICAL TEAM –

## PROGRESS REPORT 11

*Friday, November 30 to Thursday, December 6, 2007*

### **Clients:**

#### ***Dr. Julie Kessel***

Department of Pediatrics  
608-417-6236 (office)  
608-265-7000 (pager; code: 6318)  
jmessel@pediatrics.wisc.edu  
jmessel@facstaff.wisc.edu

#### ***Sharon Blohowiak***

Neonatal research laboratory  
608- 417-5780/ sblohowiak@pediatrics.wisc.edu

### **Team Members:**

#### ***Ann Sagstetter***

Team Leader (Leadership & Progress Reports)  
507-951-8735 / sagstetter@wisc.edu

#### ***Songyu Ng (aka Kelvin)***

Communicator  
608-770-7855 / sng2@wisc.edu

#### ***Timothy Balgemann***

BWIG  
630-903-9811 / balgemann@wisc.edu

### **Advisor:**

#### ***Professor Brenda Ogle***

Department of Biomedical Engineering  
2144 Engineering Centers Building  
608-265-8267 / ogle@wisc.edu

#### ***Padraic Casserly***

Team Leader (Finance and Time Contributions)  
507-269-9901 / pcasserly@wisc.edu

#### ***Angwei Law***

BSAC  
310-804-7028 / alaw@wisc.edu

### **Initial Problem Statement:**

The American Academy of Pediatrics Neonatal Resuscitation Program (NRP) is required training for thousands of physicians and medical staff who attend the delivery of newborns. Placement of an intravenous catheter in the umbilical vein of the cord stump in a distressed newborn is one way to provide life saving medication and is a skill that is essential to the NRP course. Hands-on training in the placement of an umbilical venous catheter has received increased attention and emphasis since the 2005 update of the NRP course. Currently, two models for hands-on training are available. Some companies make newborn models for CPR that also have artificial umbilical cords (ex Laerdol). These models appear to inadequately mimic placement in a real cord and are very expensive. Alternatively, the American Academy of Pediatrics recommends using sections of an umbilical cord obtained after delivery. The cord section is placed in a glass baby bottle with part of the nipple cut off so the cord extends about 1/2 an inch from the top of the nipple. While this model has the advantage of using a real cord, the cord is secured poorly and thus does not adequately mimic placement in a newborn. My design idea is to make a support for real umbilical cords that would more closely mimic the umbilical stump of a newborn. The model could be made out of a material that might mimic the abdominal wall, such as ballistic grade gel, and might perhaps have two halves that clamp around a section of real cord. The model could mimic the curves of the umbilical vein after it enters the body, making placement more realistic. Ultimately, this model, which would best be quite inexpensive and disposable, could be marketed to the over 25,000 individuals in the US who teach NRP and would likely represent a vast improvement over the "baby bottle" model.

### **Revised Problem Statement**

To construct a model optimized for use in the umbilical vein catheterization training program, a suitable method is to be devised to firmly hold a fresh umbilical cord in place. In addition, the model needs to accurately mimic the external texture and internal structure of the human neonatal abdomen.

### **Last Week's Goals:**

- Construct the final prototypes using the information from previous experiments.
- We are meeting with Dr. Kessel at noon last Friday to present our final designs.
- Finish experiments, namely the tensile test for the cuff and baby bottle models and the side by side comparison tests.

### **Summary of Accomplishments:**

#### ***Experiment 1: Tensile Test for the Baby Bottle Model and the Cuff model***

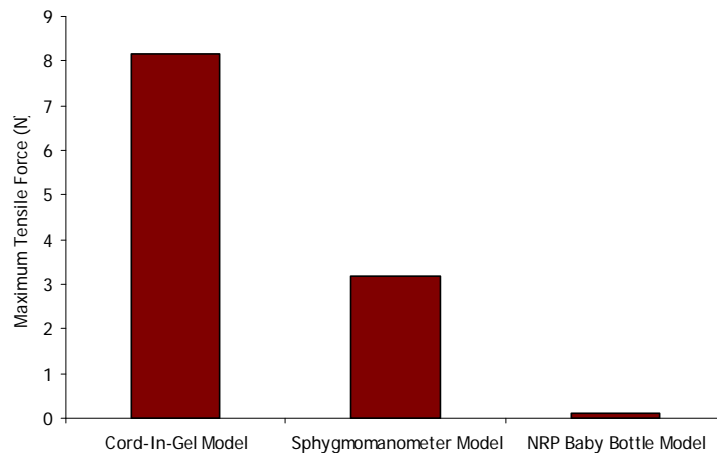
**Purpose:** To test the amount of force needed to pull the cord from the cuff, so that we can compare the cuff stability vs. the gel and baby bottle model.

**Procedure:** Thus, we performed the tensile test, using a Newton meter and string. The string was tied around the top portion of the cord very tightly. The other end of the string was looped about the spring gauge. After the set up was complete, the device was pulled downward until the cord was uprooted from the device. At that moment the record of the spring gauge reading was taken in Newtons, and the results were recorded (See Table A).

Model	Max Force required to uproot the cord from the device
Baby Bottle Model	0.122 N
Cuff Model	3.188 N

**Table A:** The tensile readings taken for the Cuff model and the Baby Bottle model.

**Results:** The gathered results shown in Table A were compared with the previously gathered data from the Gel model tensile test. The comparison is shown below in Figure B.



**Figure B:** The tensile testing results for all three models were compared. The Gel model had the highest maximum force required to uproot the cord from the device.

**Conclusions:** The cord demonstrated the highest force required to uproot the cord from the device, with the Cuff model second, and the Baby Bottle model demonstrating almost no resistance to tensile force. The Gel model does stabilize the cord the best; however, it also requires the most prep time. In the coming semester, we believe that we can optimize the cuff model to match the tensile force of the current gel model, because in the end the Cuff model has the greatest manufacturing potential.

## **Experiment 2: Side by Side Comparison Test**

**Purpose:** To test all three models side by side to see which model is really the most successful.

**Procedure:** To take out the cord variability as much as possible, we took three full length umbilical cords and cut each cord into three equal section lengths. One section from each cord was used for one of the three models. This way, the same cord could be used for each of the three models and reduce the different cord variability. Also, For each model, a group member did two of the catheterizations (mimicking trainee hands) and Dr. Kessel did the third (as a knowledgeable hand).

**Results:** The Baby Bottle model failed all three catheterizations. The Cuff model was a success two of the three catheterizations. The Gel model was a success all three catheterizations. See Table C.

<b>Model</b>	<b>Trial 1 (By Team member)</b>	<b>Trial 2 (by Team member)</b>	<b>Trial 3 (by Dr. Kessel)</b>
<b>Baby Bottle model</b>	Fail	Fail	Fail
<b>Cuff Model</b>	Fail	Success	Success
<b>Gel Model</b>	Success	Success	Success

**Table C:** The side by side testing was preformed and the Gel model was the most successful.

**Conclusions:** Both of our models were much more successful than the baby bottle model, which is in obvious need for improvement. In comparison of the gel and cuff models, the gel model was the most reliable in catheterization testing simulations. However, the gel model is the most work to prepare.

The Cuff model wasn't too far behind, and the cord that did fail, was rather twisted and coiled, unlike the other cords. Of our two models, the cuff is the most manufacturable and user friendly, requiring the least work of training- day preparations. We think that with some design tweaking, we could even get the cuff to the same tensile strength and success rate as the gel (Some future work for the continuation of the project next semester, along with anatomical mimicry and manufacturability designs).

### **This Week's Goals:**

- POSTER PRESENTATION FRIDAY!!!!!! 12-2PM
- Paper due next Wednesday along with notebooks!

**Difficulties:** There have been no difficulties to date.

## Activities:

*Ann Sagstetter:* Team Meetings – 10.5 hours

Gel/Cuff experiment preparations - 2 hours

Experiments- 3 hours

Football coverings- 5 hours

Progress Report – 1 hour

**Total: 21.5 hours**

*Padraic Casserly:* Team Meetings – 8.5 hours

Finance/Activities- 1.5 hours

Experiments- 3 hours

**Total: 13.0 hours**

*Songyu Ng:* Team Meetings - 10.5 hours

Sceduling and Communications- 1.5 hours

Experiments- 3 hours

Experiment Preparations- 2 hours

Poster work- 3 hours

**Total: 19 hours**

*Angwei Law:* Team Meetings -- 10.5 hours

BSAC Meeting - 1 hour

Experiment Preparations - 2 hours

Experiments: 3 hours

**Total : 16.5 hours**

*Tim Baglemann:* Team Meetings –10.5 hours

Cuff experimental preparations –7 hours

Experiments- 3 hours

**Total: 20.5 hours**

## Projected Time Line:

**September 21:** Form teams

Select project

Meet with client

Literature Search

**September 28:** Finish required tissue training modules

Write PDS

Post preliminary PDS on web site

Start Brainstorming

**October 5:** Brainstorm

Work out possible designs

Design Matrix

**October 12:** Choose Design

Start ordering materials if needed

Prepare oral presentation

**October 19:** Oral Presentation

Put PowerPoint presentation on team web site by 10:00 am

Hand in written report at time of presentation

**October 26:** Commence prototype design

**November 2-9:** Designing process finish

Stabilization testing, evaluation, and adjustments

**November 16-30:** Final prototype construction, Final tests

Begin final paper and poster preparations

**December 7:** Poster presentation

**December 12:** Written report due.

KEY: Green Highlight: Completed

Yellow Highlight: In progress

Blue Highlight: Goal for coming week

## **Finances:**

### *Dorn True Value Hardware*

5pk Med Alo Sandpaper: 2.49

2pk 2x4 HD Velcro Strip: 2.99

Mp 1-1/2 x 15 in Plastic Tub: 3.99

5/8 x 7/8 in Plastic Tubing: 1.58

5/16 x 1/2 in Plastic Tubing: 1.59

Sub-Total: \$14.21

### *The Home Depot*

Adhesive Grip Spray Paint: 4.92

1/3 F Sandpaper: 2.47

Plastic tubing: 6.36

Rubber Gloves: 3.97

Epoxy Glue: 2.97

6x24 Strips: 5.97

Grade 36 Sandpaper: 2.17

Sub-Total: \$33.55 (with tax)

### *Target*

Two Nerf Footballs: 19.78

Material for Football Cover: 39.98

Sub-Total: \$63.05 (with tax)

### *College Library Printing*

Poster: \$35.00

Sub-Total: \$35.00

### *Wal-Mart*

Three-Pack Foam Balls: 3.54

2.00 Yards sq. Vinyl: 4.88

Sub-Total: \$8.88

### *Capital Centre Foods*

Knox Gelatin pack x 8: 12.72

Ziploc Storage: 3.39

Pam: 3.29

Sub-Total: \$19.59

**Total: \$ 174.68**

***Note: The client contributed \$60.00 on October 12.***

***The client contributed \$60.00 on November 2.***

***The client contributed \$60.00 on December 4.***