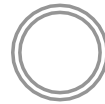


# Transfusion Device



**CLIENT: JULIE KESSEL, MD  
DEPT. OF PEDIATRICS, MERITER HOSPITAL**

**ADVISOR: PAUL THOMPSON**

**CLARA CHOW  
RACHEL O'CONNELL  
ASHLEY MULCHRONE**

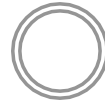
# Introduction



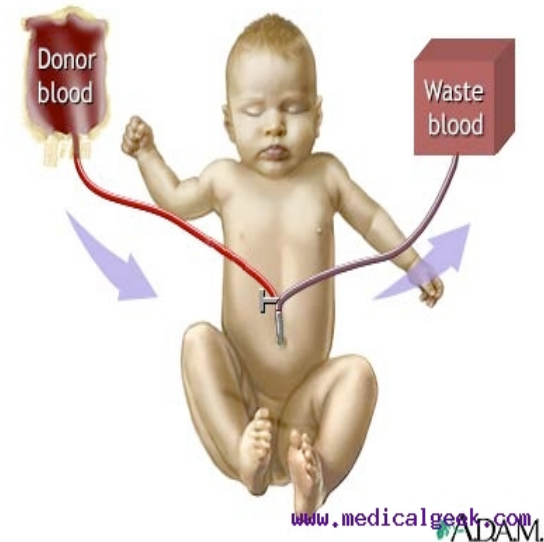
- Bilirubin: produced when red blood cells get old
- Red blood cells of babies have shorter lives than those of adults
- Premature babies do not have fully developed organs
- High levels of bilirubin can cause brain damage
- Common treatment: Phototherapy
- Double Volume Exchange Transfusion



# Double Volume Exchange Transfusion



- Procedure is done infrequently
- Procedure requires 3 medical personnel
- Twice the baby's total blood volume is exchanged (240 mL total in baby)
- 5-10 mL at a time
- Can take up to 4 hours
- Setup is not intuitive

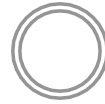


# Design Criteria



- **Increase safety of the transfusion**
- Device ensures accurate use
  - ✦ Eliminate incorrect use of 4-way stopcock
- If not disposable, autoclave compatible
- Handheld
- Budget: less than \$500

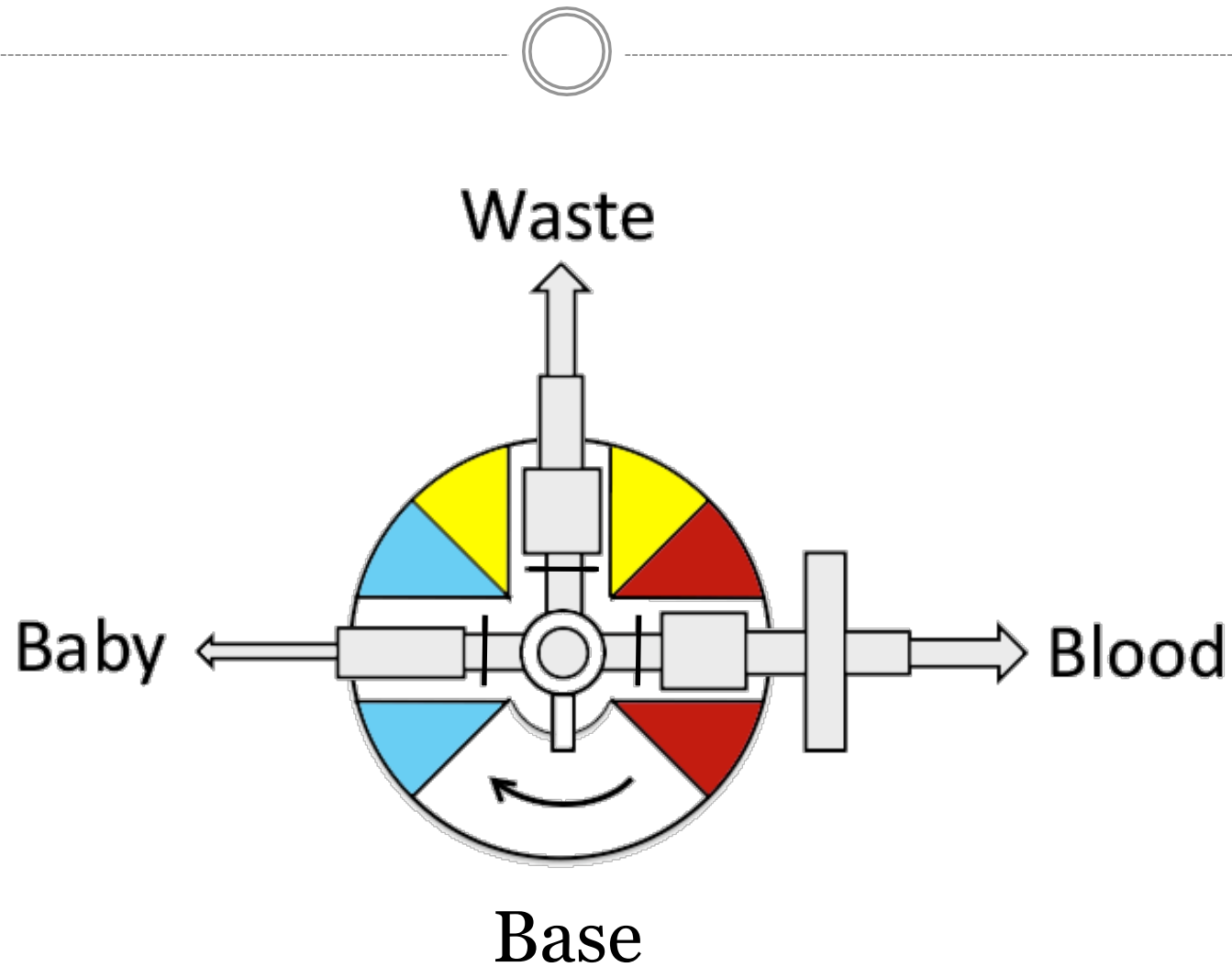
# Proposed Components



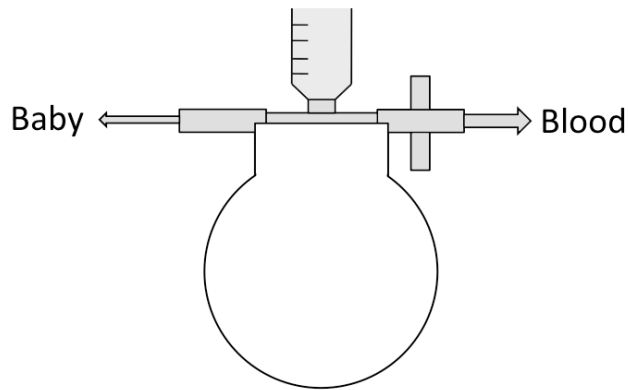
- Stopcock base
  - Ports easily identifiable
  - Increase comfort for user
- Counting system
  - Help track the amount of blood withdrawn
- Air embolus detector
- Blood clot filter



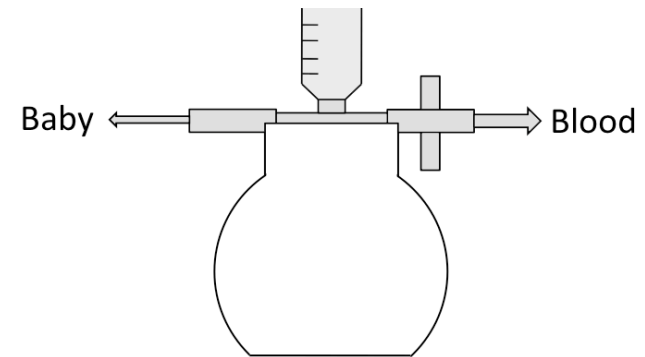
# Proposed Designs - Base top view



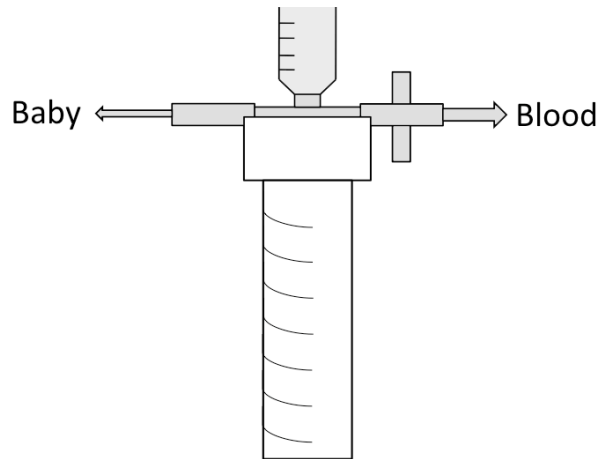
# Proposed Designs - Base side view



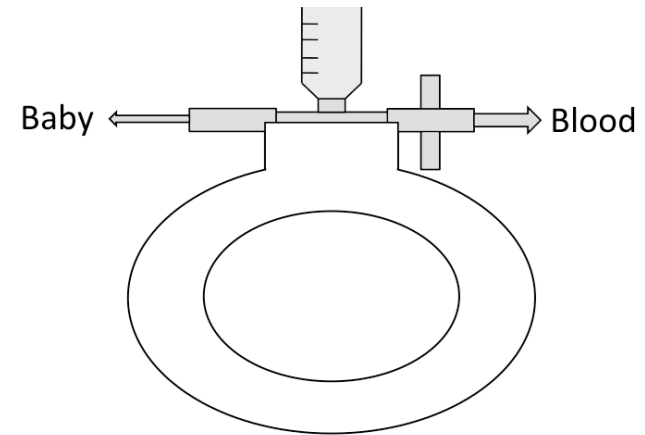
Design #1: Round-bottom base



Design #2: Flat-bottom base



Design #3: Vertical handle



Design #4: Loop handle

# Design Matrix - Base



Criteria	Weight	Round-bottom	Flat-bottom	Vertical handle	Loop handle
Comfort	30	25	20	17	16
Stability	25	14	21	9	12
Versatility	20	16	15	5	18
Weight	10	2	4	9	6
Occupied space	10	7	8	5	3
Ease of fabrication	5	4	4	5	1
<b>Total</b>	<b>100</b>	<b>68</b>	<b>72</b>	<b>50</b>	<b>56</b>



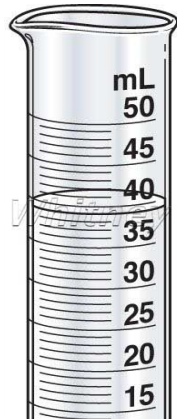
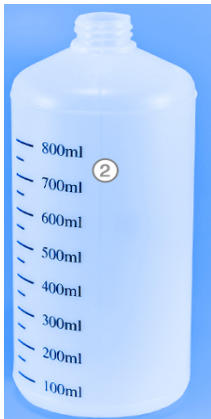
# Proposed Designs - Counter system



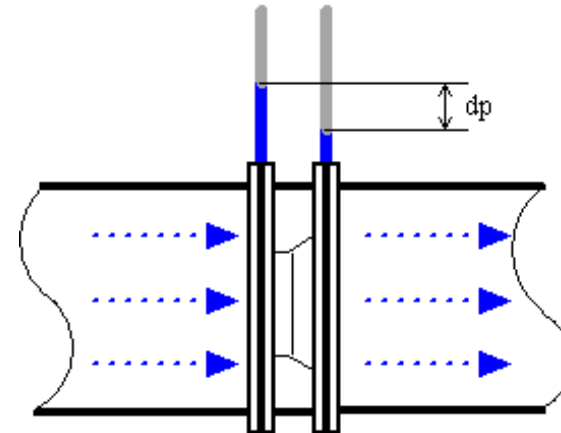
Design #1: Mechanical counter



Design #2: Waste bag scale



Design #3: Waste container



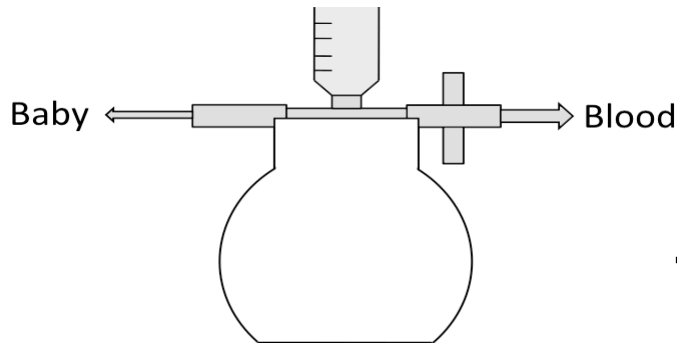
Designs #4 & 5: Flow meter

# Design Matrix - Counter system



Criteria	Weight	Mechanical Counter	Waste bag scale	Waste container	Injection Counter	Flow Meter
Accuracy	25	22	20	18	12	23
Sterilization	25	8	23	23	8	15
Size	20	10	15	16	13	18
Feasibility	10	6	9	8	5	3
Shelf Life	10	6	8	9	4	5
Ease of Fabrication	5	1	5	4	1	3
Cost	5	2	4	4	2	1
<b>Total</b>	<b>100</b>	<b>55</b>	<b>84</b>	<b>82</b>	<b>45</b>	<b>68</b>

# Final Design



Flat-bottom base

+



18 micron blood filter

+



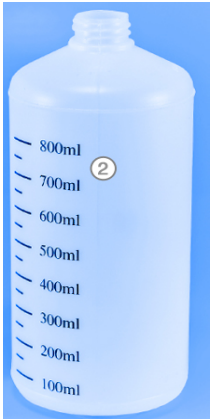
Air embolus detector

+



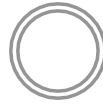
Waste Bag Scale

or



Waste Container

# Future Work



- SolidWorks design of the stopcock base
- Fabricate the base out of an autoclavable material
- Further research waste bag scale and waste container designs to make final decision on counter
- Construct final counter design
- Obtain the air bubble detector
- Build an alarm system for the air embolus detection sensor
- Test the counter and sensor alarm system
- Simulate procedure at Meriter's Simulation Center

# References



- <http://www.halkeyroberts.com/products/medical/needlefree-swabable-valves/needlefree-4-way-lever-stopcock.aspx>
- <http://www.medicalpointindia.com/child-phototherapy.htm>
- <http://www.medicalgeek.com/pediatrics/7679-neonatal-pathological-jaundice-management.html>
- <http://www.indiamart.com/sartorius-stedimindia/services.html>
- <http://www.sportline.com/img/prod/27.jpg>
- <http://www.hand-tools.us/images/pictures/pelouze-20lb.-capacity-industrialgrade-radial-dial-hanging-scale--model-7842.jpg>
- [http://www.pbms.co.za/images/products\\_large/chemical\\_light\\_weight\\_graduated\\_ribbed.jpg](http://www.pbms.co.za/images/products_large/chemical_light_weight_graduated_ribbed.jpg)
- [http://www.engineeringtoolbox.com/flow-meters-d\\_493.html](http://www.engineeringtoolbox.com/flow-meters-d_493.html)
- [http://www.janewhitney.com/img/graduated\\_cylinders.jpg](http://www.janewhitney.com/img/graduated_cylinders.jpg)
- <http://www.utahmed.com/neobloodfiltration.htm>
- [http://www.introtek.com/html/products.aspx?prod\\_id=1](http://www.introtek.com/html/products.aspx?prod_id=1)