BME Design-Fall 2023 - CLAIRE KRAMAR
Complete Notebook

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Jensen WEIK

on

Dec 13, 2023 @07:06 PM CST

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Team contact Information

MAYA NORNBERG - Sep 08, 2023, 1:37 PM CDT

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
Kreeger	Pamela	Advisor	kreeger@wisc.edu	n/a	3024 Engineering Hall
Elgin	Timothy	Client	telgin@wisc.edu	n/a	
Kramar	Claire	Leader	ckramar@wisc.edu	(608) 218 - 3656	n/a
Lawson	Jodi	Communicator	jlawson6@wisc.edu	(224) 292 - 9456	n/a
Wilhelmson	Molly	BSAC			
Weik	Jensen	BWIG	jweik@wisc.edu	715-820-3838	
Nornberg	Maya	BPAG	nornberg@wisc.edu	212-749-6553	
Lu	Emma	Team Member	elu22@wisc.edu	612-478-1480	

Project description

MAYA NORNBERG - Sep 14, 2023, 10:36 AM CDT

Course Number: BME 200/300

Project Name: Neonatal 22-23-week premature infant simulation manikin

Short Name: Neonatal manikin

Project description/problem statement:

There are currently no neonatal manikins on the market made to resemble infants that are born at 22-23 weeks gestation. Consequently, the first time many physicians, residents, or fellows use resuscitation techniques on an infant this premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of resuscitation on premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement.

About the client:

Dr. Timothy Elgin is a neonatologist in the UW School of Medicine and Public Health Department of Pediatrics. He specializes in the care of extremely low birth weight infants. He worked with a design team of graduate students at the University of Iowa on this neonatal manikin project for a year before coming to Madison and starting to work with BME Design. This is Dr. Elgin's 3rd semester doing UW-Madison BME Design.

2023/09/15 - Team Meeting 1

CLAIRE KRAMAR - Sep 15, 2023, 1:02 PM CDT

Title: Team Meeting 1

Date: 09/15/2023

Content by: Claire Kramar

Present: whole team

Goals:

- establish goals, expectations, and deadlines for our project this semester
- assign sections for PDS

Content:

- Subsections of Design:
  - Mechanics of Intubation, IV Access, and Umbilical Cord Access
  - Skin
  - Mold of Manikin
- team is opting to work on skin and mold first; work on mechanics afterwards if we finish
- Research Sections:
  - Mold: Claire, Emma, Jensen, Molly
    - ribcage of neonatal infant
    - size of chest cavity, abdominal cavity, etc
    - specific anatomical difference between a neonate at 22-23 week gestation vs full term (40 weeks)
    - competing designs - differences b/w premature anne and our intended prototype
  - Skin: Jodi, Maya
    - PDMS
    - competing designs

Conclusions/action items:

- make 2 detailed sketches per member of design ideas, 1 of whole project, 1 of specific subsection
- complete sections of PDS assigned
- start research on subsections assigned

2023/09/22 - Team Meeting 2

CLAIRE KRAMAR - Sep 22, 2023, 1:58 PM CDT

Title: Team Meeting 2

Date: 09/22/2023

Content by: Claire Kramar

Present: Claire, Jodi, Emma, and Jensen

Goals: discuss design ideas

Content:

-Discussion of Design Ideas

1. Mold Ideas
    1. struggling to determine the categories of design matrices - should we have a design matrix for the head/body and one for the limbs?
2. Skin Ideas

Conclusions/action items: We were unable to decide on 3 design ideas per design matrix at this point but will work on this throughout the week and have our design matrix done by next Friday.

2023/09/29 - Team Meeting 3

Jensen WEIK - Oct 02, 2023, 4:05 PM CDT

Title: Team Meeting 3

Date: 09/28/2023

Content by: Claire Kramar

Present: whole team

Goals: discuss design matrix, split up preliminary presentation and report

Content:

- first finish design matrix
  - two design matrices: one for the skin material and one for the limb attachment
- split up preliminary presentation
  - Intro: Claire
  - Design 1 - Limbs: designs (Molly) and design matrix (Emma)
  - Design 2 - Skin Materials: designs (Jodi) and design matrix (Jensen)
  - Future Work, Acknowledgements: Maya
- split up preliminary report
  - focus on sections that correspond to what you're presenting for the preliminary presentations

Conclusions/action items: We will finish up the design matrix by Monday, finish the presentation by next Thursday (10/05) in order to practice that evening, and we will finish the preliminary report by Friday (10/06).

2023/10/13 - Team Meeting 4

CLAIRE KRAMAR - Oct 18, 2023, 1:11 PM CDT

Title: Team Meeting 4

Date: 10/13/2023

Content by: Claire Kramar

Present: Claire, Jodi, Emma, Molly, and Jensen

Goals: establish fabrication goals

Content:

- Jodi reached out to Angela (Dr. Tim's assistant) and the previous teams from Iowa to see if we could obtain any files
- Claire, Molly, and Emma would like to have STL files bought for the limbs by next Friday and start printing the mold
- Jodi, Maya, and Jensen will decide on a final skin material and order within the next week
- Ecoflex will be ordered to make the first layer of the prototype and we will adapt the Iowa team's protocol for that

Conclusions/action items: The subgroups will meet to start fabrication over the course of the next week. Research is mostly finished, so the next step is writing protocols and doing any research needed to complete those.

2023/10/27 - Team Meeting 5

Jensen WEIK - Oct 29, 2023, 8:50 PM CDT

Title: Team Meeting 5

Date: 10/27/2023

Content by: Claire Kramar

Present: Claire, Jodi, Jensen, Molly, Maya, and Emma

Goals: establish fabrication goals and determine what we want to talk to Dr. Elgin about in our meeting on Monday

Content:

- Ideas for fabrication
    - We don't have the chest or skull cavities, and we can use the chest 3D prints we already have, but for skull cavity we can try to find a skull-looking object. We don't need to spend the time/money 3D printing another skull, especially because right now we decided the skull cavity doesn't have to be extremely anatomically accurate.
    - Anticipated challenges: since the mold isn't flat on the body, we're going to have to figure out how to slice the arms so they attach well and look anatomically accurate.
- discussion points for Dr. Elgin
    - testing -
        - who should we get in contact with for testing
    - Update
        - We have the mold, plan is to paint the PDMS on afterwards.
    - Check in meeting before we get the materials so we can make sure we're on the right track.

Conclusions/action items: Team is on track for our two meetings this week with Dr. Kreeger and Dr. Elgin, and we are prepared for show and tell to show our mold. Make elevator pitch and list of questions for show and tell. Brainstorm ideas for chest cavity and skull cavity. Meet at 3:30 on Wednesday to start EcoFlex fabrication.

2023/11/10 - Team Meeting 6

CLAIRE KRAMAR - Nov 10, 2023, 1:47 PM CST

Title: Team Meeting 6

Date: 11/10/2023

Content by: Claire Kramar

Present: whole team

Goals: discuss progress goals, fabrication, and testing

Content:

- we should meet with Dr. Kreeger on Monday at 4pm
- skin team:
    - work on paper form (half sheet) for testing
    - have done by next Friday
    - how many additives are we going to test?
        - ideally test 3-5 additives
        - use ECB materials if needed
    - have them rank the materials best to worst 1-5 (or however many we have)
    - have section to elaborate if they would like but it is not necessary
    - have multiple choice section to figure out what was inaccurate/accurate about each material
        - brainstorm what these criteria should be over the next week
    - brainstorm what statistical tests we want to do with the information from the touch testing
- mold team:
    - limb molds in the process of printing by next Friday
    - find something else to be placeholder for skull and chest cavity

Conclusions/action items: We all have our part of the project to work on and are hoping to make significant progress on fabrication of the mold and testing prototcols by next Friday. Brainstorm statistical tests to perform on data acquired from Dr. Elgin.

2023/11/17 - Team Meeting 7

CLAIRE KRAMAR - Nov 17, 2023, 1:01 PM CST

Title: Team Meeting 7

Date: 11/16/2023

Content by: Claire Kramar

Present:

Goals: split up sections of final deliverables, talk about what statistical tests we want for our testing data, continue working on limb molds, talk about chest and skull cavities

Content:

- final deliverables were split up into sections for each team member
- Claire will format the poster - poster will be worked on after more of the final report is written
- clay will be used for the chest and skull cavities

Conclusions/action items: Over the next week, the team will work on the final report and try to figure out the limb molds before Thanksgiving so they can be 3D printed before or immediately following Thanksgiving break.

2023/20/11 Makerspace Limb Mold

Jensen WEIK - Nov 25, 2023, 3:26 PM CST

Title: Makerspace Limb Mold

Date: 11/20/2023

Content by: Jensen

Present: Jensen and Claire

Goals: Create limb molds for all four limbs

Content:

- We met at the Makerspace to complete the mold for the left leg
- We completed the molds for all 4 limbs with the help of the Makerspace
- We will have 8 molds to 3D print (halves for each of the 4 limbs)

Conclusions/action items: The Makerspace will 3D print the molds for us. STL files attached below.

Jensen WEIK - Nov 20, 2023, 12:44 PM CST

Download

LeftLegMold.SLDPRT (1.8 MB)

Jensen WEIK - Nov 20, 2023, 12:44 PM CST

Download

RightArmMold.SLDPRT (592 kB)

Jensen WEIK - Nov 20, 2023, 12:44 PM CST

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LeftArmMold.SLDPRT (2 MB)

Jensen WEIK - Nov 20, 2023, 12:44 PM CST

Download

RightLegMold.SLDPRT (579 kB)

2023/12/01 - Team Meeting 8

CLAIRE KRAMAR - Dec 03, 2023, 1:34 PM CST

Title: Team Meeting 8

Date: 12/01/2023

Content by: Claire Kramar

Present: Claire, Jodi, Maya, Jensen, and Emma

Goals: hold advisor meeting, make plan for skin and testing, finish EcoFlex fabrication

Content:

- plan for the next week:
  - Sunday: fabricate PDMS
  - Monday: attach limb halves and body halves, complete testing of EcoFlex and PDMS, finish poster (minus final prototype)
  - Tuesday: attach limbs to body, finish final prototype section of poster, print poster
  - Wednesday: print poster if not done on Tuesday, practice presentation
  - Thursday: practice presentation

Conclusions/action items: The plan for the next week is to finish fabrication, testing, the poster, and practice the presentation before Friday. Due to supply chain delays, this last week feels very rushed, and we are unsure if we will be able to finish everything in time.

2023/12/13 - Last Team Meeting

CLAIRE KRAMAR - Dec 13, 2023, 3:30 PM CST

Title: Last Team Meeting

Date: 12/13/2023

Content by: Claire Kramar

Present: whole team

Goals: finish final report, update LabArchives completely, edit final report, submit final report, download LabArchives PDF

Content:

TO DO:

1. add expense document to LabArchives
2. edit tensile testing section of LabArchives
3. add progress reports, final report, and presentation pdf to LabArchives
4. send final email to client, advisor, etc. to return all project materials
5. update citations for final report

Conclusions/action items: We will schedule a final meeting with our advisor soon to discuss the project and the semester. The last thing that needs to be added to LabArchives is the Final Report, and then it can be downloaded and submitted.

Progress Reports Attachments

CLAIRE KRAMAR - Sep 15, 2023, 11:13 AM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@wisc.edu (Team Leader)
Jodi Lawson jlawson6@wisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@wisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli27@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: September 8 to September 14, 2023

Problem Statement

There are currently no neonatal manikins on the market made to resemble infants that are born at 22-23 weeks gestation. Consequently, the first time many physicians, residents, or fellows use resuscitation techniques on an infant this premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of resuscitation on premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement.

Brief Status Update

The team has looked over progress made on this project in previous semesters and has begun preliminary research.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Met as a team for the first time, assigned team roles, and established weekly meeting times and weekly advisor times.
  - Familiarized selves with the project by reading through previous semesters' progress.
- Claire Kramar:
  - Read the reports of the previous two semesters and reflected on how improvements can be made, especially from the Fall 2022 semester I participated in. (1 hour)
  - Organized and set up progress report. (1 hour)

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Neonatal_Manikin-Progress_Report-1.pdf (107 kB)

CLAIRE KRAMAR - Sep 27, 2023, 3:41 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@wisc.edu (Team Leader)
Jodi Lawson jlawson6@wisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@wisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli27@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: September 15 to September 21, 2023

Problem Statement

There are currently no neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team has continued research, part of the team focusing on the mould for the manikin and part of the team focusing on the skin. Additionally, the first client meeting was held, and significant progress has been made on the first draft of the Product Design Specification (PDS).

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Delegated research focuses for each team member
  - Held first client meeting
- Claire Kramar:
  - Completed the function, client requirements, and accuracy and reliability sections of the PDS (1 hour)

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Neonatal_Manikin-Progress_Report-2.pdf (109 kB)

Jensen WEIK - Sep 28, 2023, 1:49 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: September 22 to September 28, 2023

Problem Statement

There are currently no neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team has decided to make two design matrices, one for how to attach the limbs to the mold and one for the skin materials, focusing on mainly those two aspects this semester. The mold for the body has been 3D scanned and the STL files for the limbs are being selected soon.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Met to talk about and decide on design matrices for the project
  - Got in contact with Dr. Elgin's administrative assistant who will be able to help us with funding and reimbursement for materials
- Claire Kramar:
  - Researched resuscitation of premature infants (30 minutes)

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Neonatal_Manikin-Progress_Report-3.pdf (104 kB)

Jensen WEIK - Oct 05, 2023, 1:18 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: September 29 to October 5, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team has finished design matrices for the mold and for the limb attachment, and has a preliminary design to start fabricating. The team has also been working on the preliminary presentation and preliminary report that are due within the next week.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Finished design matrices
  - Delegated sections for the preliminary presentation and preliminary report
- Claire Kramar:
  - Updated PDS (30 minutes)
  - Worked on preliminary presentation (3 hours)

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Neonatal_Manikin-Progress_Report-4.pdf (104 kB)

Jensen WEIK - Oct 13, 2023, 1:07 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwsc.edu (Team Leader)
Jodi Lawson jlawson6@uwsc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwsc.edu (BSAC)
Jensen Weik jweik@uwsc.edu (BWIG)
Emma Li eli22@uwsc.edu (Co-BPAG)
Maya Nornberg nornberg@uwsc.edu (Co-BPAG)
Date: October 6 to October 12, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team completed preliminary presentations this past Friday and has finished the preliminary report. Now that preliminary deliverables have been finished, it is time to start the fabrication of the prototype.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Completed and presented preliminary presentation
  - Finished preliminary report
- Claire Kramar:
  - Researched the anatomy of newborns (1 hour)
  - Finished sections of the preliminary report and revised whole report (3 hours)

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Neonatal_Manikin-Progress_Report-5.pdf (104 kB)

Jensen WEIK - Oct 19, 2023, 12:30 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwsc.edu (Team Leader)
Jodi Lawson jlawson6@uwsc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwsc.edu (BSAC)
Jensen Weik jweik@uwsc.edu (BWIG)
Emma Li eli22@uwsc.edu (Co-BPAG)
Maya Nornberg nornberg@uwsc.edu (Co-BPAG)
Date: October 13 to October 19, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team has reached out to the client's administrative assistant to figure out funding and has decided on materials to buy. The body mold is currently being 3D printed.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Chose limb STL files to order
  - Began printing of body mold
  - Chose skin materials
- Claire Kramar:
  - Prepared body mold 3D scan for printing and set up 3D printing with the help of the MakerSpace (2 hours)

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Neonatal_Manikin-Progress_Report-6.pdf (116 kB)

Jensen WEIK - Oct 26, 2023, 3:30 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: October 20 to October 26, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve aid to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team is still waiting on materials to begin fabrication. An email was sent to the client's administrative assistant with what we would like to order, so hopefully the materials will be here next week and we can begin fabrication.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Learned about the funding process
  - Scheduled an advisor meeting and client meeting
- Claire Kramar:
  - Met with Angela Gangstad to figure out funding (20 minutes)
  - Looked over and edited order list document (20 minutes)

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Neonatal_Manikin-Progress_Report-7.pdf (123 kB)

Jensen WEIK - Nov 02, 2023, 4:31 PM CDT

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: October 27 to November 2, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve aid to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team has ordered the initial materials needed for fabrication and was planning on beginning fabrication with EcoFlex on Wednesday, but the materials got lost in the mail and have not been delivered yet.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Held advisor meeting
- Claire Kramar:
  - Prepped elevator pitch and brainstormed questions for show and tell (20 minutes)
  - Looked at MicroMike and First Breath files that were sent by Iowa design teams to our team (20 minutes)

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Neonatal_Manikin-Progress_Report-8.pdf (124 kB)

Jensen WEIK - Nov 09, 2023, 4:53 PM CST

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jedi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: November 3 to November 9, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team is still working with Dr. Elgin's administrative assistant to find the missing materials and have not received them yet. Therefore, fabrication has not yet begun.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Attended and reflected on show and tell
  - Scheduled 2nd client meeting
- Claire Kramar:
  - Wrote reflection from show and tell (10 minutes)
  - Added Iowa group info and files to LabArchives (30 minutes)
- Jedi Lawson:

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Neonatal_Manikin-Progress_Report-9.pdf (123 kB)

Jensen WEIK - Nov 16, 2023, 7:25 PM CST

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jedi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: November 10 to November 16, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

We just received our first materials Thursday, November 16. We are hoping to do some fabrication before Thanksgiving, but the majority will likely have to be after the break.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Held client meeting
  - Held advisor meeting
  - Began working on final deliverables
- Claire Kramar:
  - Worked on limb molds in SolidWorks (1.5 hours)
  - Prepared final deliverable documents (30 minutes)

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Neonatal_Manikin-Progress_Report-10.pdf (126 kB)

Jensen WEIK - Nov 30, 2023, 3:30 PM CST

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: November 17 to November 30, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

3D molds for the arms and legs were created and printed at the MakerSpace. The team received most materials this week and began fabrication.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Began fabrication of prototype
  - Continued to work on final deliverables
- Claire Kramar:
  - Made and printed molds for arms and legs (3 hours)
  - Began fabrication of prototype (1 hour)
  - Created poster template (30 minutes)

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Neonatal_Manikin-Progress_Report-11.pdf (125 kB)

Jensen WEIK - Dec 07, 2023, 3:39 PM CST

Neonatal Manikin Group

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Kreeger
Team: Claire Kramar ckramar@uwisc.edu (Team Leader)
Jodi Lawson jlawson6@uwisc.edu (Communicator)
Molly Wilhelmson mwilhelmson@uwisc.edu (BSAC)
Jensen Weik jweik@wisc.edu (BWIG)
Emma Li eli22@wisc.edu (Co-BPAG)
Maya Nornberg nornberg@wisc.edu (Co-BPAG)
Date: December 1 to December 7, 2023

Problem Statement

There are currently no known affordable neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use the resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a ribcage and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Brief Status Update

The team completed fabrication of the prototype and received PDMS. While we were unable to attach the PDMS to the prototype, we were able to make a few samples to test for stickiness. The poster was completed and printed, and the team is preparing for presentations on Friday.

Summary of Weekly Team Member Design Accomplishments

- Team:
  - Fabricated prototype
  - Tested prototype
  - Fabricated skin
  - Tested skin
  - Completed poster template

Download

Neonatal_Manikin-Progress_Report-12.pdf (129 kB)

2023/09/18 - Client Meeting 1

JODI LAWSON - Sep 18, 2023, 6:46 PM CDT

Title: Client Meeting 1

Date: 9/18/2023

Content by: Jodi Lawson

Present: Whole Team, Client

Goals: Ask questions about the scope of the project and expectations. Outline specifications and goals for the semester.

Content:

- What do you want our focus to be on this semester? Skin? Mold? Intubation? IV?
    - Prefers lungs and skin to be progressed initially
        - Likes sub-group ideas
        - Skin is super subjective; not many literature values
            - Gelatinous; skin tears from adhesive
    - Can talk with nurses to get some more advice
        - Have people feel small samples
    - Us: model, skin, limbs
- Is skin pigmentation something you would like us to work on this semester?
    - Pigmentation varies based on genetics
    - Ethical and diversity considerations here
    - Easier to adjust, can focus on the rest of the model first.
        - Consider this with materials that we pick for skin
- How durable should the model be?
    - Accuracy vs durability – depends on how we want to “market” the manikin
    - Skin replacements could be an option

Things to confirm from last semester (i.e. is it all still the same):

- Weight = 400-500g
- Length = ~1 ft
- Breathing tube diameter = 2.0-2.5 mm
    - Client confirmed all values
- What is the target budget this semester?
    - Flexibility; some grant support
    - $500 - $2000
    - Can discuss if there’s something we really want to try
    - What is the best way to handle reimbursement?
        - Admin assistant!!
- How often would you like to meet with the group?

    - Mentioned setting up a second point of contact
    - Ask before he logs off for second point
    - Progress reports for sure, meet every couple weeks
    - Will get back on best way to schedule things
- Can we have access to the previous design teams' prototypes and Premature Anne? Is there a harddrive with files from the Iowa team?
    - Ask previous group and/or advisor
    - If so, where could we meet to pick up the materials?
        - Claire will contact previous team

Remaining Questions:

- How often will the model be used?
- How many IV access points would be ideal and where should they be located?
- What is the biggest difference you would like to see between this project and Premature Anne?

Conclusions/action items:

Dr. Elgin is open to focusing on the model and skin primarily while still taking into account future work, and ensuring the model can be expanded upon to include more features. The team should schedule another meeting with Dr. Elgin in the next couple weeks, and get in contact with his second point of contact to discuss budget, scheduling, and visiting the hospital. Additionally, the team should begin work on the PDS and further plan out the direction of the project.

2023/10/23 - Funding Meeting

CLAIRE KRAMAR - Oct 23, 2023, 3:22 PM CDT

Title: Funding Meeting with Angela Gangstad, Dr. Elgin's Administrative Assistant

Date: 10/23/2023

Content by: Claire Kramar

Present: Claire, Jodi, and Emma

Goals: figure out how to purchase the materials we need for fabrication

Content:

- there is an account at the MakerSpace called BME 200/300 with Dr. Timothy Elgin's name associated with it; we should be able to charge payments directly to this account
- when we need to order something, always email Angela
    - can be from ShopUW (BME Design prefers this but it doesn't always have what we need)
    - when ShopUW doesn't have what we need, we can find it on Amazon or anywhere else and when emailing Angela have to include screenshot proving ShopUW doesn't have it
- we should find a safe mailing address among the 6 of us for our materials to be sent to
- when emailing Angela about materials, include a short 1-2 sentence description of what it is for

Conclusions/action items: Next, we have to send Angela a follow-up email with a preferred mailing address and the first couple materials that we know we would like to purchase. Claire should also reach out to the MakerSpace in the next couple of days to get refunded for the 3D print.

2023/11/10 - Client Meeting 2

CLAIRE KRAMAR - Nov 10, 2023, 1:17 PM CST

Title: Client Meeting 2

Date: 11/10/2023

Content by: Claire Kramar

Present: whole team

Goals: discuss progress with client, get a contact for scheduling blind skin testing, schedule in person meeting for next week at UW Hospital, hopefully receive some clarity about the missing materials and what to do from here

Content:

Progress:

- materials are lost

Skin Testing

- contact: Dr. Elgin
- could get 20 some nurses, some physicians and residents to test
- make a form for testing for all of the nurses, physicians, etc.
    - paper could be faster but we will have to count up all the papers
    - but a Google quiz might be more difficult
    - maybe an excel sheet

In-Person Meeting

- date: potentially next Friday around 1-1:30pm

Conclusions/action items: We will be in touch with Dr. Elgin about meeting next week based on whether or not we receive materials. We will make a form for skin testing and print paper copies for testing.

2023/09/15 - Advisor Meeting 1

CLAIRE KRAMAR - Sep 15, 2023, 1:04 PM CDT

Title: Advisor Meeting 1

Date: 09/15/2023

Content by: Claire Kramar

Present: whole team

Goals:

- talk about hardships with client not responding
- figure out next steps for funding

Content:

- Dr. Kreeger is going to try to reach out to Dr. Elgin
- PDS - SMART Goal System
    - give specific quantities and errors
- in favor of divide and conquer
- Trello - online app that you can do project management charts
- use template LabArchives gives for entries

Conclusions/action items:

- start PDS even if we cannot get in touch with our client
- hopefully our client will be able to provide insight as to what we should focus on this semester
- be detailed in our notebook entries as much as possible

2023/09/22 - Advisor Meeting 2

CLAIRE KRAMAR - Sep 22, 2023, 1:26 PM CDT

Title: Advisor Meeting 2

Date: 09/22/2023

Content by: Claire Kramar

Present: Claire, Jodi, Jensen, Emma, and Maya

Goals: discuss first client meeting

Content:

- discussed first client meeting
    - Jodi is going to reach out to Angela (the admin contact from Fall 2022)
- talked about options for the molds
    - planning to 3D scan the Iowa mold on Monday if possible
- talked about the design matrix
    - it's okay if we don't have CAD drawings of all design ideas - not a good use of time to make something that detailed if we're not moving forward with the idea
    - can just do chemical structure of materials - drawing for those isn't really possible
- advisor likes idea of neonatal physicians and nurses being the measure of accuracy for our skin since there is little literature on infants born at 22-23 weeks
    - advises that the test subjects do a blind feeling test
    - also advises making skin materials that are inaccurate

Conclusions/action items: Our next course of action is to 3D scan the Iowa mold and make the design matrices for next week.

2023/10/02 - Advisor Meeting 3

CLAIRE KRAMAR - Oct 02, 2023, 4:27 PM CDT

Title: Advisor Meeting 3

Date: 10/02/2023

Content by: Claire Kramar

Present: Claire, Emma, Molly, Jensen, Jodi, and Maya

Goals:

- talk about design matrices
- ask about looking over our preliminary report before we turn it in - if so, how early would she need it
- what to do about missing half of mold and hard drive from Iowa design team - how do we cite them if we know nothing about them

Content:

- maybe contact LifeCast Simulation about the Micro Preemie Manikin
- record even like spitball conversations in LabArchives which we haven't been doing so far
- mention fabrication plans in preliminary presentations
- use proportions off of premature anne if nothing from LifeCast Preemie
    - or approximate limb length from Micro Preemie if we know the full length
- stick to 10 minutes for preliminary presentations

Conclusions/action items:

- Jodi reach out to LifeCast Simulation to inquire about Micro-Preemie
- Claire email about previous design team and missing components of project
- make sure preliminary presentation is divided up equally and that it does not exceed 10 minutes
- record more of our thought processes in LabArchives

2023/10/30 - Advisor Meeting 4

CLAIRE KRAMAR - Oct 30, 2023, 4:00 PM CDT

Title: Advisor Meeting 4

Date: 10/30/2023

Content by: Claire Kramar

Present: whole team

Goals: touch base before show and tell

Content:

- what are we going to bring for show and tell?
  - mold of the baby, molds from past group, Premature Anne
- what are the questions we want answered?
  - how should we attach the outer layer of skin?
  - is there a better way than just painting a layer on?
- don't worry about presenting during show and tell; it's more of a participation thing
- in a waiting game with materials at the moment
- have we made a list of additives to try?
  - yes, Jodi has it and will add it in LabArchives
- when we meet with Dr. Elgin, ask who we can reach out to for testing even if it's not him
  - try to get through skin testing before Thanksgiving

Conclusions/action items: reschedule meeting with Dr. Elgin, get contact information for skin testing, prepare elevator pitch

2023/11/13 - Advisor Meeting 5

CLAIRE KRAMAR - Nov 13, 2023, 4:15 PM CST

Title: Advisor Meeting 5

Date: 11/13/2023

Content by: Claire Kramar

Present: Claire, Jensen, Emma, Molly, and Jodi

Goals: discuss progress and missing materials

Content:

- what to do while waiting for materials:
  - start working on final report and posters
- look for confirmation emails for amazon
- if we don't get a response in the next couple days, just order from Amazon
- let Dr. Kreeger know by tomorrow if we would like to just order materials from Amazon
- probably need some trial and error to figure out the skin material
  - make a fresh batch right after Thanksgiving to bring to the hospital
- make a plan to get as much end of the year stuff done right now as we can

Conclusions/action items: Email Dr. Kreeger by end of day tomorrow if we have not heard anything about materials, and we will make arrangements to order at least the EcoFlex from Amazon.

2023/12/01 - Advisor Meeting 6

CLAIRE KRAMAR - Dec 01, 2023, 12:57 PM CST

Title: Advisor Meeting 6

Date: 12/01/2023

Content by: Claire Kramar

Present:

Goals: discuss progress and final deliverables

Content:

- skin fabrication and testing
    - what to do with EcoFlex
        - tensile test it, discuss problems
    - if no EcoFlex, what to do for testing since we have no quantitative data
- Dr. Kreeger will inquire about PDMS in her lab and attempt to get us materials by early next week
    - we will then tensile test and bandaid test the PDMS - it will not be attached to the rest of the prototype

Conclusions/action items: We should email Dr. Puccinelli to see if he has any PDMS we can borrow and also email Angela to get an update.

2023/10/02 - Limb Attachment Design Matrix

Jensen WEIK - Oct 02, 2023, 4:23 PM CDT

Title: Limb Attachment Design Matrix

Date: 10/02/2023

Content by: Claire Kramar

Present: N/A

Goals: establish the first design matrix, list and explain criteria, present design ideas, and explain why each design received the score that it did

Link 1 (Designs 1&2): https://www.cgtrader.com/3d-print-models/science/astronomy-physics/realistic-baby-techino-parts-separately-3d-print

Citation 1: [1] "Realistic baby Techino parts separately 3d print | 3D Print Model," CGTrader. Accessed: Oct. 02, 2023. [Online]. Available: https://www.cgtrader.com/3d-print-models/science/astronomy-physics/realistic-baby-techino-parts-separately-3d-print

Link 2 (Design 3): https://www.cgtrader.com/3d-models/character/child/baby-t-pose-with-5-subdivision-levels-quad-mesh

Citation 2: [1] "Baby T Pose with 5 Subdivision Levels Quad Mesh | 3D model," CGTrader. Accessed: Oct. 02, 2023. [Online]. Available: https://www.cgtrader.com/3d-models/character/child/baby-t-pose-with-5-subdivision-levels-quad-mesh

Content:

As a team, we struggled to decide what to have our design matrices be titled because this project has so many components. One design matrix for the whole design would not suffice because there are decisions that need to be made within each of the components (electronics, limbs, body molds, skin materials, etc.). As a team, we decided that our main focus this semester would be attaching limbs to an already existing mold made by a previous design team and improving the skin material. First and foremost, you need a working manikin in order to add breathing mechanisms, electronics, intubation, IV access, etc.

Below is the design matrix for limb attachment. The categories we chose to rate the designs on were future usability, which refers to how easily future design teams can modify the design, reproducibility, which means how easy it would be to make the same prototype again and again, durability, which is how well the limbs will stay attached to the body and for how long, ease of fabrication because this is only a semester long project, accuracy, which is defined in this matrix as how closely the limbs function to actual human limbs, and safety and cost which must be considered in every design matrix but are not as important for this design matrix as they will be for the skin materials one. A more detailed description of each category and the reasons as to why we rated the designs the way we did can be found below the design matrix.

Limb Attachment Design Matrix

Criteria:	**Design 1:** Ball and Socket 		**Design 2:** Glued 		**Design 3:** Combined w/ Body Mold 	
Future Usability (20)	*4/5*	16	*5/5*	20	*2/5*	8
Reproducibility (20)	*3/5*	12	*4/5*	16	*5/5*	20
Durability (20)	*2/5*	8	*3/5*	12	*5/5*	20
Ease of Fabrication (15)	*3/5*	9	*4/5*	12	*3/5*	9
Accuracy (15)	*5/5*	15	*3/5*	9	*3/5*	9

Safety (5)	*4/5*	4	*4/5*	4	*5/5*	5
Cost (5)	*4/5*	4	*4/5*	4	*5/5*	5
Total: 100		**65**		**77**		**76**

Future usability was ranked one of the three highest-weighted categories in the limb attachment design matrix because this project has many components, and this semester's prototype should be designed in such a way that future design teams can easily add components. Design 2 (Glued) ranked the highest in future usability because if the limb molds are separate from the body mold, modifications to the limbs, such as adding bones and IV access, can be easily made before gluing the limbs to the body of the prototype. Design 3 (Combined w/ Body Mold) ranked the lowest in this category because adding the limbs to the existing body mold STL file would make the file more complicated and thus more difficult to modify. Reproducibility was also ranked one of the highest-weighted categories because although the client requires one prototype this semester, the ultimate goal is that it would be mass produced and available to any physician, resident, or fellow looking to improve their neonatal resuscitation techniques. Design 3 ranked highest in this category because one file used for the whole mold guarantees that the prototype will look the same each time it is produced, whereas Design 1 (Ball and Socket) ranked the lowest because each prototype might have a different sized hole for the ball and socket joint to lock into depending on how the skin material cures in the body mold. Durability was weighted heavily because the PDS states that the prototype must not lose functionality while remaining in storage for up to two years (see Appendix A). Design 3 has the highest ranking for durability because the whole prototype is one part, whereas Designs 1 and 2 both have multiple parts, thus increasing the chances of wear and tear where the limbs connect to the body. Ease of fabrication was weighted the next highest because this is a semester-long project, and only so much can be accomplished. Design 2 ranked the highest because it would be the easiest to fabricate, whereas Designs 1 and 3 would take a lot more CAD work. Accuracy in the prototype, which is defined in the design matrix as how close it functions to an actual neonatal infant, is weighted heavily because the client has requested it. For limb attachment, however, accuracy is not weighted as highly as other categories because whether or not the limbs function the way a neonatal infant would does not affect resuscitation. The main need for limbs is so that the prototype feels life-like and that there can be IV access in the hand, foot, and arm. Neither of these require that the limbs move in a realistic way. The safety and cost of each design was also considered, and Design 3 scored the highest in both categories because it has less components than the other two designs.

Conclusions/action items: While the combined body mold won in the most categories, the glued option won overall due to its ease of fabrication and future usability. This option is feasible for the semester project and will not take as much CAD work. We plan on buying an STL file of a baby and modifying it to fit our mold rather than starting to make limbs from scratch, which could take the entire semester. Citations for those sketches can be found above.

10/02/2023 Skin Material Design Matrix

Jensen WEIK - Oct 10, 2023, 2:48 PM CDT

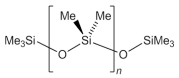
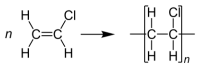
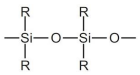
Title: Skin Material Design Matrix

Date: 10/02/2023

Content by: Team

Content:

Skin Material Design Matrix

Criteria:	**Design 1:** Polydimethylsiloxane (PDMS) 		**Design 2:** Polyvinyl Chloride (PVC) 		**Design 3:** Hand-Painted Silicone 	
Stickiness (20)	*5/5*	20	*4/5*	16	4/5	16
Elasticity (20)	*5/5*	20	*5/5*	20	5/5	20
Ease of Fabrication (20)	*4/5*	16	*4/5*	16	4/5	16
Safety (15)	*5/5*	15	*5/5*	15	3/5	9
Durability (10)	*3/5*	6	*4/5*	8	5/5	10
Cost (10)	*2/5*	4	*5/5*	10	5/5	10
Appearance (5)	*4/5*	4	*5/5*	5	5/5	5
Total: 100		**85**		**90**		**86**

In order to efficiently and effectively evaluate the materials used for the manikin, a design matrix was created with factors ranked of importance. These factors include stickiness, appearance, cost, durability, safety, elasticity, and ease of fabrication. The criteria were selected based on the client's requirements and the team's goals for advancement this semester. As such, the team chose stickiness, elasticity, and ease of fabrication to be weighted heavily. Stickiness is ranked highly because accurately replicating the feel of the skin of a neonate is important for clinicians to encounter before live experience with premature infants. Elasticity was also ranked highly because the material must conform and stretch not only for molding purposes, but also to accurately replicate resuscitation during simulated compressions. Ease of fabrication is an important consideration for producing the manakin and its replicability, as well as its life-span.

The material chosen for the manikin must have the proper stickiness of a neonate's skin. The stickiness is the texture of the skin and if it is similar to reality. For this criteria, PDMS scored the highest, followed by PVC and hand-painted silicone. PDMS scored the highest because of its inert stickiness; PVC and silicone followed because they can be made sticky with additives [1]. Elasticity is the ability for the fabricated skin to be stretchable and conformable similar to human skin. In this category, all materials scored full points; PVC and silicone because of their elastic properties, and the fact that additives can be used to influence this property [1]; PDMS scored full points because of its ability to achieve different moduli via mixture ratios. Ease of fabrication is how moldable and usable the material is for design and manufacturing purposes along with how easy the skin will be to replace when tearing occurs. For this criterion, PDMS, PVC, and Silicone scored the same because all are likely to involve a mixture that would need to be cured prior to use and would be applied to the torn area in similar processes [2].

Following the highest rated categories, safety was weighted next highest because the manikin must be safe to use in training applications. Since the skin will be the main layer of interaction, the material the skin is made of must be nontoxic and inert. Durability and cost are important to consider for future use in replicability; the durability of the material must reflect on how expensive the material is to reproduce. Finally, appearance was ranked lowest as the team is most focussed on an accurate simulation of texture and resuscitation than visual aesthetics, though pigmentation will be considered as future work.

For each of the materials, safety was evaluated based on if the material is nontoxic and inert. PDMS and PVC scored full points in this category because they are generally inert substances with no toxins [3], [4]. The hand-painted silicone, however, scored lower because silicone is not inert, and not as stable [5]. Additionally, hand-painted silicone raises issues with effectiveness for reproduction. Durability refers to the shelf life of the material and if the material will deteriorate. For durability, silicone scored the highest, with a typical shelf life of 20 years [5]. PVC scored next highest, with a shelf life of at least 10 years [6], and PDMS scored lowest because it has a shelf life of 24 months [3]. Cost is considered for the initial fabrication material and backup biomaterial for replacement skin due to tearing. For this category, PDMS scored the lowest due to its higher cost while PVC and silicone scored similarly since they are less expensive. Appearance is how accurate the material resembles neonatal skin in pigmentation and texture. While this factor is not a main focus for the team this semester, it is still taken into consideration for future work and how feasible it is to add pigmentation to the skin material. For evaluation, silicone and PVC scored highest since they are easily pigmented, and PDMS scored lower due to its hydrophobicity.

From evaluation of each of these skin materials, the team chose PolyVinyl Chloride (PVC) for the skin material. Additives and fabrication protocols will be determined for use, and the team will prepare skin samples for residents and clinicians to feel. With the feedback from medical workers, the team will re-evaluate the fabrication protocol, additives used, and possibly the material itself.

References

[1] “Polyvinyl Chloride PVC,” *British Plastics Federation*.
https://www.bpf.co.uk/plastipedia/polymers/PVC.aspx (accessed Oct. 02, 2023).

[2] “Plastic Fabrication: The Complete Guide,” *Wee Tect*.
https://www.weetect.com/plastic-fabrication-the-complete-guide/ (accessed Oct. 02, 2023).

[3] “Polydimethylsiloxane | PDMS | Cas 63148-62-9 | Connect Chemicals.”
https://connectchemicals.com/en/product-finder/polydimethylsiloxane (accessed Oct. 02, 2023).

[4] “Chemical resistance,” *ECVM*.
https://pvc.org/about-pvc/pvcs-physical-properties/chemical-resistance/ (accessed Oct. 02, 2023).

[5] H. Busch, “Silicone toxicology,” *Semin Arthritis Rheum*, vol. 24, no. 1 Suppl 1, pp. 11–17, Aug. 1994, doi: 10.1016/0049-0172(94)90104-x.

[6] “Shelf Life of Rubber Products - Interstate Specialty Products,” Mar. 29, 2019.
https://www.interstatesp.com/shelf-life-of-rubber-products/ (accessed Oct. 02, 2023).

Conclusions/action items: Although PVC was selected as the material, testing must still be done on if PVC can correctly function as a neonate's skin such as its fragility, stickiness, and ability to tear. If PVC cannot accurately replicate the characteristics of neonatal skin, testing will begin with the other selected materials.

2023/10/18 - Baby Mold Dimensions

CLAIRE KRAMAR - Oct 18, 2023, 2:02 PM CDT

Title: Baby Mold Dimensions

Date: 10/18/2023

Content by: Claire Kramar

Present: Claire and Molly

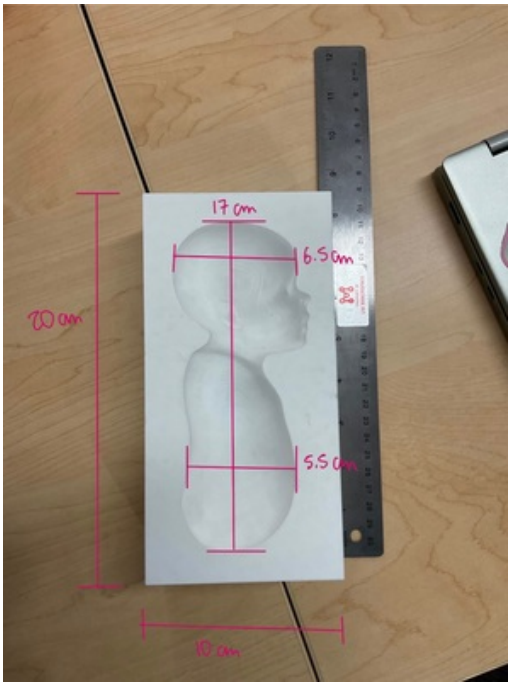
Goals: figure out the dimensions of the baby within the rectangular mold so that when we scale the mold down, we know what size the manikin will be

Content:

- overall length of mold: 20 cm
- overall width of mold: 10 cm
- length of baby in mold: 17 cm
- width of stomach: 5.5 cm
- width of skull: 6.5 cm
- desired length of whole prototype: 30.48 cm
- length of legs will be between 11-13 cm

Conclusions/action items: Initially, the client had stated that the Iowa prototype might be too big to represent a 22-23 week premature infant. Our measurements, however, show that even if we add 11-13 cm legs to the body mold, we would still be under or at the 30.48 cm length requirement, so we do not need to scale down the mold. This can be modified later on with feedback from the client.

CLAIRE KRAMAR - Oct 19, 2023, 9:46 AM CDT



Download

D8BE973E-0965-4364-AEE0-32DDF8E229B0.jpg (369 kB)

2023/11/16 - Limb STL Files

CLAIRE KRAMAR - Nov 16, 2023, 2:58 PM CST

Title: Limb STL Files

Date: 11/16/2023

Content by: Claire Kramar

Present: Jodi, Emma, and Claire

Goals: make cuts in the whole baby STL file to isolate an arm and a leg

Content:

(see files attached below)

Conclusions/action items: Now that we have an arm and a leg isolated from the whole body file, the goal is to make a mold out of the arm and leg, make a cut such that approximately half the arm or leg is in each half of the mold, and then mirror the molds over a plane to get both arms and legs. Finally, we will decide on the dimensions of the molds and 3D print them at the MakerSpace.

CLAIRE KRAMAR - Nov 16, 2023, 2:58 PM CST

Download

Baby_Left_Leg.SLDPRT (1.66 MB)

CLAIRE KRAMAR - Nov 16, 2023, 2:58 PM CST

Download

Baby_Left_Arm.SLDPRT (1.68 MB)

2023/11/01 - Initial Material Purchases

CLAIRE KRAMAR - Nov 01, 2023, 5:08 PM CDT

Title: Initial Material Purchases

Date: 11/03/2023

Content by: Claire Kramar

Present: N/A

Goals: record purchases from beginning of the project through November 1, 2023

Content:

[redacted]

Body Mold	3D printed mold for the body	Makerspace	N/A	N/A	N/A	10/18	1	$50.60	$50.60	N/A
Ecoflex 00-30	material for body and limbs	Smooth-On	ecoflex0030	Amazon	MFSOEcoflex30	10/25	1	$37.38	$37.38	Link
Flesh-Colored Silicone Pigment Coloring	pigment for the EcoFlex	Smooth-On	88552	Amazon	B005ZH0SFU	10/25	1	$37.69	$37.69	Link
Sylgard 527	material for life like skin	Dow Corning	N/A	Amazon	B0711LBBFG	10/25	1	$135.00	$135.00	Link
Petri Dishes	used to fabricate skin	Corning Life Sciences	70165-101	Neta Scientific Inc	70165-101	10/25	1	$104.48	$104.48	Link
3D Baby STL File	STL file of a baby, will be used to create limb molds	N/A	901910	CGTrader	N/A	10/25	1	$20.30	$20.30	Link
									$0.00	Link
									$0.00	Link
									$0.00	Link
									$0.00	Link
									$0.00	Link
									$0.00	Link
								TOTAL:	**$385.45**	

Conclusions/action items: We believe this is mostly what the team will need for fabrication. We will likely have to 3D print a chest cavity and skull cavity in the near future.

2023/12/03 - Final Expenses

EMMA LU - Dec 13, 2023, 1:35 PM CST

Title: Final Material Purchases

Date: 11/03/2023

Content by: Emma Lu

Present: N/A

Goals: record purchases from beginning of the project through November 1, 2023

Content:

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Body Mold	3D printed mold for the body	Makerspace	N/A	N/A	N/A	10/18	1	$50.60	$50.60	N/A
Ecoflex 00-30	material for body and limbs	Smooth-On	ecoflex0030	Amazon	MFSOEcoflex30	10/25	2	$37.38	$74.76	Link
Flesh-Colored Silicone Pigment Coloring	pigment for the EcoFlex	Smooth-On	88552	Amazon	B005ZH0SFU	10/25	1	$37.69	$37.69	Link
Sylgard 527	material for life like skin	Dow Corning	N/A	Amazon	B0711LBBFG	10/25	0	$149.90	$0.00	Link
Petri Dishes	used to fabricate skin	Corning Life Sciences	70165-101	Neta Scientific Inc	70165-101	10/25	1	$104.48	$104.48	Link
3D Baby STL File	STL file of a baby, will be used to create limb molds	N/A	901910	CGTrader	N/A	10/25	1	$21.42	$21.42	Link
Sylgard 527	material for life like skin	Dow Corning		Fisher			1	$134.81	$134.81	Link
clay	to make cavities in the body	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00	N/A
Limb Molds	3D printed molds for the limbs	Makerspace	N/A	N/A	N/A	11/27	1	$39.04	$39.04	N/A
glue	to glue on the limbs	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00	N/A
fishing line	to suspend aluminum foil to make cavities in the body	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00	N/A
Popsicle Sticks	used for leveling during fabrication	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00	N/A

Mold Release	used to coat mold for easy release	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00N/A
Aluminium Foil	to make cavities in the body	N/A	N/A	N/A	N/A	12/4	1	$0.00	$0.00N/A

TOTAL: $462.80

Conclusions/action items: This is everything we used to fabricate the manikin. Some things were reordered due to supply chain issues.

2023/10/11 - 3D Scanning of Micro Mike Mold

CLAIRE KRAMAR - Oct 11, 2023, 2:34 PM CDT

Title: 3D Scanning of Micro Mike Mold (Iowa Design Team)

Date: 09/27/2023

Content by: Claire Kramar

Present: Claire and Jodi

Goals: 3D scan the mold from the Iowa Design team to mirror, shrink in size, and print a new mold

Content:

A MakerSpace worker was able to help us scan the mold for Micro Mike. STL files are attached below.

We also ended up scanning the chest cavity of the Iowa prototype just in case it might be useful in the future.

Conclusions/action items: Now that we have an STL file of one half of the mold, we need to mirror the file to get the other half of the mold, scale it down to match the dimensions agreed on by the team in accordance with our research and client requirements, and 3D print the molds as soon as we can to begin fabrication.

CLAIRE KRAMAR - Oct 11, 2023, 2:34 PM CDT

Download

baby_mold_scan.SLDPRT (7.69 MB)

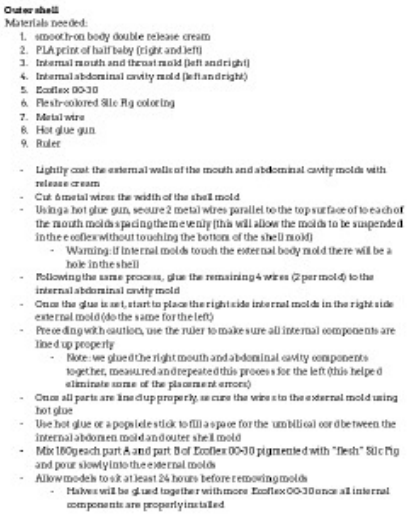
CLAIRE KRAMAR - Oct 11, 2023, 2:36 PM CDT

Download

baby_chest.SLDPRT (1.32 MB)

2023/10/11 - EcoFlex Protocol

JODI LAWSON - Oct 11, 2023, 5:55 PM CDT



Outer shell

Materials needed:

1. smooth-on body double release cream
2. PLA print of half baby (right and left)
3. Internal mouth and throat mold (left and right)
4. Internal abdominal cavity mold (left and right)
5. Ecoflex 00-30
6. Flesh-colored Silc Pig coloring
7. Metal wire
8. Hot glue gun
9. Ruler

- Lightly coat the external walls of the mouth and abdominal cavity molds with release cream
- Cut 6 metal wires the width of the shell mold
- Using a hot glue gun, secure 2 metal wires parallel to the top surface of to each of the mouth molds spacing them evenly (this will allow the molds to be suspended in the ecoflex without touching the bottom of the shell mold)
    - Warning: if internal molds touch the external body mold there will be a hole in the shell
- Following the same process, glue the remaining 4 wires (2 per mold) to the internal abdominal cavity mold
- Once the glue is set, start to place the right side internal molds in the right side external mold (do the same for the left)
- Proceeding with caution, use the ruler to make sure all internal components are lined up properly
    - Note: we glued the right mouth and abdominal cavity components together, measured and repeated this process for the left (this helped eliminate some of the placement errors)
- Once all parts are lined up properly, secure the wires to the external mold using hot glue
- Use hot glue or a popsicle stick to fill a space for the umbilical cord between the internal abdomen mold and outer shell mold
- Mix 180g each part A and part B of Ecoflex 00-30 pigmented with "flesh" Silc Pig and pour slowly into the external molds
- Allow models to sit at least 24 hours before removing molds
    - Halves will be glued together with more Ecoflex 00-30 once all internal components are properly installed

Download

Ecoflex_Protocols.pdf (31.3 kB)

2023/10/18 - 3D Printing of Shell for Body Mold

CLAIRE KRAMAR - Oct 18, 2023, 1:43 PM CDT

Title: 3D Printing of Shell for Body Mold

Date: 10/18/2023

Content by: Claire Kramar

Present: Claire and Molly

Goals: mirror the shell to create two halves, pick a material to 3D print with, and begin 3D printing once we figure out funding

Content:

Molly and I went to the MakerSpace and received help mirroring our 3D scan. The 3D scan was made into a mesh part, and then mirrored in assembly over one of the planes. Then, the two halves were saved as different parts and saved as STL files so that they can be printed. The STL files are attached below.

Conclusions/action items: Our next course of action is to figure out funding with Angela, Dr. Elgin's administrative assistant, so that we can pay for the 3D printing. We also have to decide what dimensions to make the mold and then we can print.

CLAIRE KRAMAR - Oct 18, 2023, 1:43 PM CDT

Download

baby_mold_scan_Mirror.STL (6.04 MB)

CLAIRE KRAMAR - Oct 18, 2023, 1:44 PM CDT

Download

baby_mold_scan.STL (6.04 MB)

2023/11/29 - Fabrication

Jensen WEIK - Dec 07, 2023, 6:08 PM CST

Title: Beginning Fabrication

Date: 11/29/2023

Content by: Maya Nornberg

Present: Maya, Claire, Molly

Goals: Begin fabrication with ecoflex in molds. Test one leg, create chest, head, and tummy cavities.

Content:

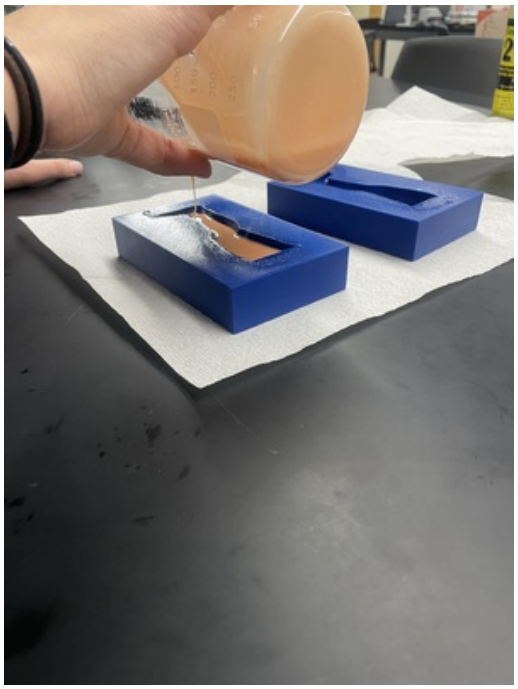
Fabrication of ecoflex mold: Stirred part A and part B thoroughly with seperate stirrers. Pours 25mL of part A and 25mL of part B into beaker. Stirred thoroughly. Added small amount of Flesh colored silicone pigment and stirred throroughly. Sprayed leg molds with "ease release" spray. Poured ecoflex into the molds until the top and patted mold on table to remove air bubbles.

Fabrication of cavities: Formed cavities manually out of activa supreme clay.

Conclusions/action items:

The mold will require at least 4 hours to set at room temperature. We used this as a test to know how it will look and see if any changes need to be made to the protocol, including pigmentation.

CLAIRE KRAMAR - Dec 13, 2023, 12:04 PM CST



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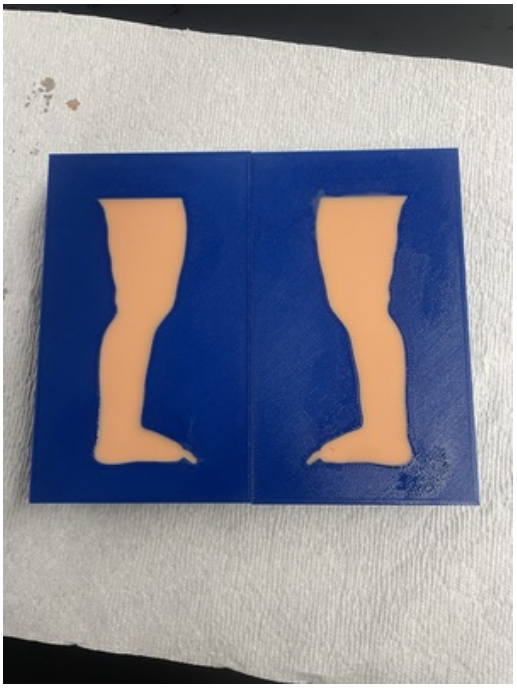
CLAIRE KRAMAR - Dec 13, 2023, 12:04 PM CST



Download

IMG_7225.jpg (3.93 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:05 PM CST

Download

IMG_7226.jpg (3.24 MB) Note the clay cavities did not end up working and we had to impromptu use tinfoil, fishing line, and a hot glue gun to create the skull cavities and chest cavities. This method should be improved in the future.

2023/12/07 - Updated Fabrication Protocol

Jensen WEIK - Dec 13, 2023, 1:11 PM CST

Title: Updated Fabrication Protocol

Date: 12/7/2023

Content by: Jensen

Present: N/A

Goals: Complete the fabrication protocol.

Content:

Materials:

- Ecoflex
- Sylgard 584 and 527
- Silicone Pigment
- Molds
- Beaker
- Tinfoil
- String
- Hot glue
- Heat Gun
- Release spray
- Popsicle stick
- Ethanol

Protocol

Filling Molds

- In a beaker, mix equal parts of Ecoflex Part I and II
- Stir in silicone pigment
- Ball tinfoil in the size and shape of the desired body cavities-- be sure to check that when the tinfoil rests in the cavity, it is below the height of the mold so it won't rest on the bottom during fabrication
- Spray the molds with release spray
- Pour Ecoflex mixture into the molds and tap gently to remove bubbles-- ensure the mixture completely fills the appendages
- Hot glue string on one face of the tinfoil and suspend the tinfoil gently in the Ecoflex by using hot glue to bind the strings to the top surface of the mold
- Wait for 24 hours for the Ecoflex to cure before removing from the molds

Once the limbs and body molds are finished curing, limb attachment can begin.

- Use ethanol to wipe the exterior of the Ecoflex and remove the release spray
- Mix the Ecoflex together using the preexisting protocol
- Use a popsicle stick to apply a thin coat of Ecoflex on each half of the limbs and body and stick together
- Wait 24 hours to cure
- To attach the limbs, follow the same protocol of using uncured Ecoflex and hold the limbs in place until solidified.
    - When attaching the limbs, curing the Ecoflex with heat speeds up the process as someone needs to hold the limbs in place until the Ecoflex is solid enough to hold independently.

Conclusions/action items: The limb attachment method could be reevaluated as holding the limbs was extremely inefficient and may lead to error with slipping.

CLAIRE KRAMAR - Dec 13, 2023, 12:06 PM CST

Download

IMG_7245.jpg (3.02 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:06 PM CST

Download

IMG_7250.jpg (3.39 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:06 PM CST

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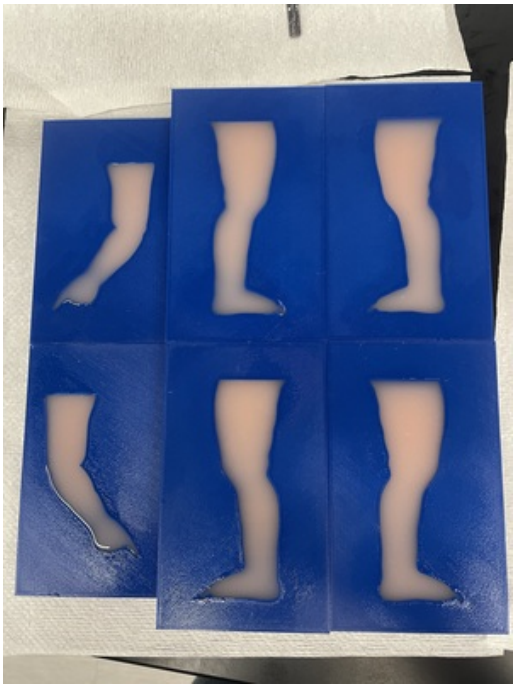
72307669235__84285BB1-B982-4EE4-BCD6-3C21E84092D9.fullsizerender.jpg (3.19 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:06 PM CST



Download

IMG_7233.jpg (3.73 MB)

2023/11/30 PDMS Fabrication Protocol

JODI LAWSON - Dec 12, 2023, 9:10 PM CST

Title: PDMS Fabrication Protocol

Date: 2023/11/30

Content by: Jensen, Jodi

Present: n/a

Goals: Outline the fabrication protocol for PDMS to create the skin material.

Content:

Materials

- Petri dishes
- Plastic Cups
- Glass Stir Rod
- Scale
- Sylgard 527
- Sylgard 184

Procedure

- Mix equal parts of Part A and Part B of Sylgard 527
- Stir for 5 minutes with stir rod to ensure well-mixed
- Mix Sylgard 184 base and curing agent in a 10:1 ratio
- Stir for 5 minutes with stir rod to ensure well-mixed
- Mix appropriate amounts of Sylgard 527 and 184 mixtures to acheive desired substrate stiffness:
    - 5 kPa
        - 100% Sylgard 527
    - 10 kPa
        - 98.125% Sylgard 527
        - 1.875% Sylgard 184
    - 20 kPa
        - 95.66% Sylgard 527
        - 4.33% Sylgard 184
- Stir for 5 minutes with stir rod to ensure well-mixed
- Pour 3.5 grams of the mixture into petri dish
- Tilt petri dish to coat uniformly
- Cure in oven for 12 hours at 60℃

Ratios have been adapted from literature on PDMS (see Jodi Lawson's Folder > Research Notes > Biology and Physiology > Skin Material Research).

Conclusions/action items: This protocol will be used to create the different skin samples of different stiffnesses. With the addition of additives, the protocol is subject to change.

CLAIRE KRAMAR - Dec 13, 2023, 12:07 PM CST

Download

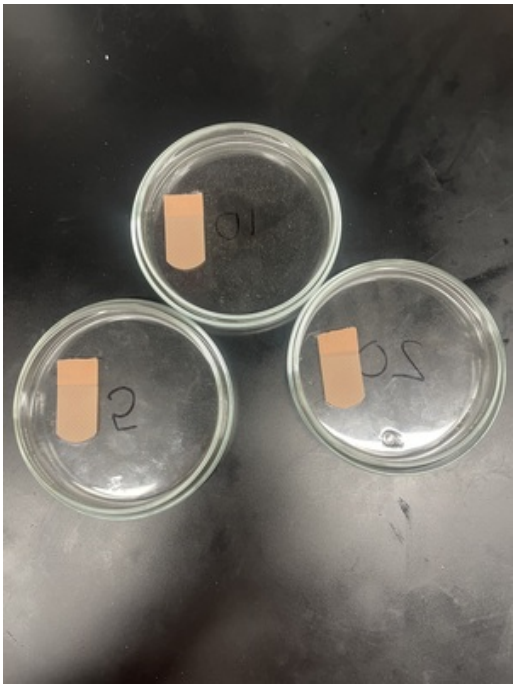
IMG_7249.jpg (2.67 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:07 PM CST

Download

IMG_7250.jpg (3.39 MB)

CLAIRE KRAMAR - Dec 13, 2023, 12:07 PM CST



Download

IMG_7251.jpg (4.6 MB)

2023/11/01 - Skin Tape Testing Protocol

CLAIRE KRAMAR - Dec 13, 2023, 1:23 PM CST

Title: Skin Tape Testing Protocol

Date: 11/01/2023

Content by: Claire Kramar

Present: N/A

Goals: write up a protocol to test how easy it is for the outer layer of skin to tear on the prototype

Content:

Protocol:

Materials:

- petri dishes
- 3 skin samples
- 9 bandaids

Steps:

1. Acquire 3 samples of PDMS skin in separate petri dishes.
2. Take a bandaid and apply it to the skin sample.
3. Wait 30 seconds, and then carefully remove the bandaid, observing whether or not the skin tears.
4. Repeat steps 2-3 for all skin samples.

Conclusions/action items: This protocol should be modified as we learn more about PDMS and decide on a final fabrication protocol for the outer layer of the skin.

2023/11/02 Blind Testing Neonatal Professionals

Jensen WEIK - Nov 17, 2023, 1:28 PM CST

Title: Blind Testing Neonatal Professionals

Date: 2023/11/2

Content by: Jensen

Goals: Write the protocol for testing the material of the manikin's skin to determine the accuracy compared to a true neonate.

Content:

Materials:

-3-5 petri dishes of skin samples

-Form for ranking/reviewing skin

1. Create molds of the skin in petri dishes along with a material as the control

2. Schedule separate times with neonatal professionals so that they are not together when feeling the skin molds which could create bias.

3. Have the professional touch the material.

4. Provide the professional complete a short form describing the accuracy of the synthetic skin.

5. Repeat the process with multiple professionals.

6. Average the scores and rank the material samples.

Conclusions/action items: This protocol is to be adapted once we have finished fabrication and have established times with professionals to meet. The form will also need to be created.

2023/11/25 - Skin Material Ratio

Jensen WEIK - Nov 25, 2023, 4:09 PM CST

Title: Skin Material Ratio

Date: 2023/11/25

Content by: Jensen

Present: n/a

Goals: Test ratios of PDMS agents to determine most realistic material

Content:

Materials

- Petri dishes
- Sylgard 527
- Non-stick teflon spray

Procedure

- Coat petri dishes with the non-stick spray
- Mix Part A and B of Sylgard 527 beginning at 1:1 ratio
- Paint mixture onto petri dish in an even coating approximately 3 to 5 mm thick
- Create 5+ petri dishes of altering ratios
- Allow the petri dishes to cure

Conclusions/action items: This is to be followed by blind testing professionals. Ratios will be adjusted during testing.

2023/12/06 - Usability Testing Protocol

CLAIRE KRAMAR - Dec 06, 2023, 5:16 PM CST

Title: Usability Testing Protocol

Date: 12/06/2023

Content by: Claire Kramar

Present: N/A

Goals: create a protocol for usability testing for the final prototype

Content:

Materials needed:

- final prototype with limbs attached

Procedure:

1. Pick up the manikin from a flat surface 10 times as gently as you would handle a true infant.
2. Turn the manikin from front to back gently in hands 10 times, always supporting the neck.
3. Complete chest compressions 15 times in a row for at least three cycles.

Conclusions/action items: This test was completed to determine the effectiveness of the limb attachment method used (glue). Results can be found in the experimentation section.

2023/12/07 - Tensile Testing Protocol

JODI LAWSON - Dec 12, 2023, 9:14 PM CST

Title: Tensile Testing Protocol

Date: 12/07/2023

Content by: Jodi

Present: n/a

Goals: Compile a protocol for tensile testing samples.

Content:

- Open TW ELITE
- Under File name, select new test from template
- Choose Custom template, compression
- MTS EM Tensile simplified
- Open file
- Enter the thickness and width of the sample
- Zero load signal
- Activate kill switch, ensure machine is off
- Place sample in machine
- Turn on machine and unlock crosshead (light should be green),
- Raise until sample is at resting length, when load is small and non-negative
- Zero load and crosshead
- Lock the device
- Press start button on computer
- Run test until failure or slip
- Choose “Yes” when asked to return to zero
- Save file to correct folder by doing the following: Right click data>export raw data>export>OK> files
- Push red button to kill the machine
- Remove sample

Conclusions/action items:

Use this protocol to tensile test samples.

2023/12/10 - Blind Testing Survey

JODI LAWSON - Dec 12, 2023, 8:58 PM CST

Title: Blind Skin Material Testing Survey

Date: 11/10/2023

Content by: Jodi L.

Present: n/a

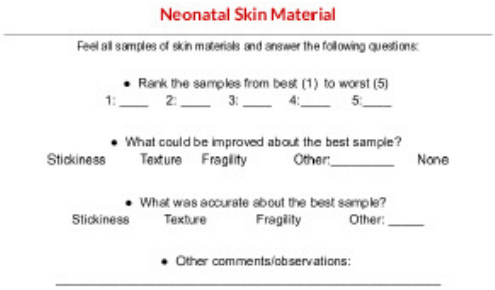
Goals: Create a form to provide healthcare professionals for the blind skin material test.

Content:

See attached file below for the pdf version of the form to be given to the client and their coworkers. The team wanted the form to be small and take the least amount of time to fill out as possible to get more clinicians to fill it out.

Conclusions/action items: With this form, the team will be able to receive feedback on their fabricated skin material and its accuracy in mimicking true neonatal skin.

JODI LAWSON - Dec 12, 2023, 8:58 PM CST



Neonatal Skin Material

Feel all samples of skin materials and answer the following questions:

- Rank the samples from best (1) to worst (5)

1: ____ 2: ____ 3: ____ 4: ____ 5: ____

- What could be improved about the best sample?

Stickiness Texture Fragility Other: _____ None

- What was accurate about the best sample?

Stickiness Texture Fragility Other: ____

- Other comments/observations:

_____

Download

Skin_Material_Form.pdf (31.1 kB) Form for blind skin testing.

2023/12/01 - Measurements

JODI LAWSON - Dec 01, 2023, 2:22 PM CST

Title: MTS Testing of Ecoflex

Date: 12/1/23

Content by: Jodi L

Present: Jensen, Claire, Emma, Jodi

Goals: Experimentally determine the Young's modulus of the EcoFlex

Content:

Sample 1:

- gauge length = 67 mm
- w = 10 mm
- t = 1.53 mm

Sample 2:

- gauge length = 45 mm
- w = 10 mm
- t = 0.87 mm

Sample 3

- gauge length = 57 mm
- w = 10 mm
- t = 1.21 mm

Conclusions/action items:

2023/12/06 - Usability Testing Results

CLAIRE KRAMAR - Dec 06, 2023, 5:21 PM CST

Title: Usability Testing Results

Date: 12/06/2023

Content by: Claire Kramar

Present: N/A

Goals: record the results from the Usability Testing Protocol

Content:

- the limbs stayed attached to the body through all of the usability testing
- superglue and hot glue did not work to attach the limbs to the body; they did not react and stick to the EcoFlex
- after a couple failed attempts, the best solution was to connect the limbs to the body using EcoFlex; because EcoFlex cures so slowly, it took a very long time to get the limbs to attach to the body, and they do not look as great as we would have hoped
- pictures of the testing are included below

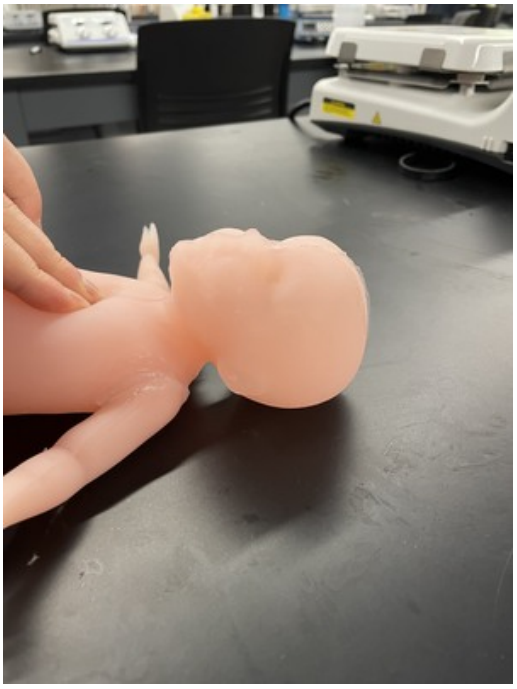
Conclusions/action items: While the prototype "passed" all of the tests in place, we would want to look into other options for attaching the limbs to the body in the future.

CLAIRE KRAMAR - Dec 06, 2023, 5:21 PM CST

Download

IMG_7256.jpeg (2.07 MB)

CLAIRE KRAMAR - Dec 06, 2023, 5:21 PM CST



Download

IMG_7259.jpeg (1.9 MB)

2023/12/06 - Band-Aid Testing Results

CLAIRE KRAMAR - Dec 06, 2023, 5:28 PM CST

Title: Band-Aid Testing Results

Date: 12/06/2023

Content by: Claire Kramar

Present: N/A

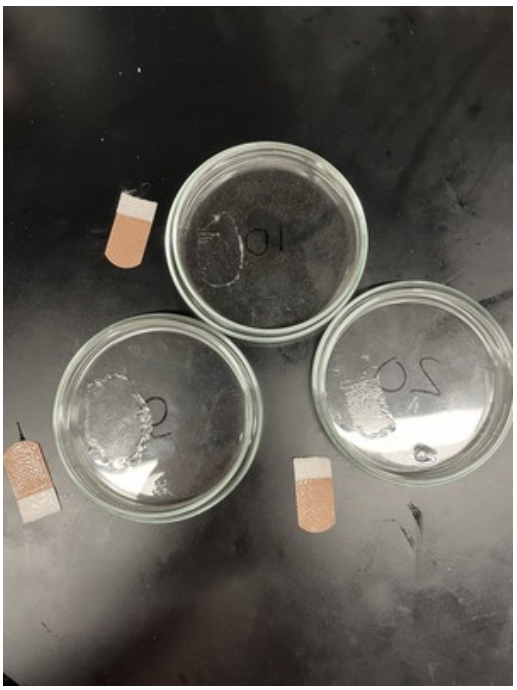
Goals: record the results of the Band-Aid testing

Content:

- there were three different types of skin samples, each with different amounts of Sylgard 184 to reduce the stickiness of the skin material
- three half Band-Aids were placed on each of the three samples and then taken off; the skin samples tore 100% of the time, which was expected and desired
- pictures of samples before and after the Band-Aid was taken off is shown below

Conclusions/action items: As expected, the skin materials tore when a Band-Aid was placed on them. Unfortunately, without literature values or the feedback of neonatal physicians and nurses, it is difficult to tell if any of the skin samples are accurate to a true 22-23 week premature infant.

CLAIRE KRAMAR - Dec 06, 2023, 5:28 PM CST



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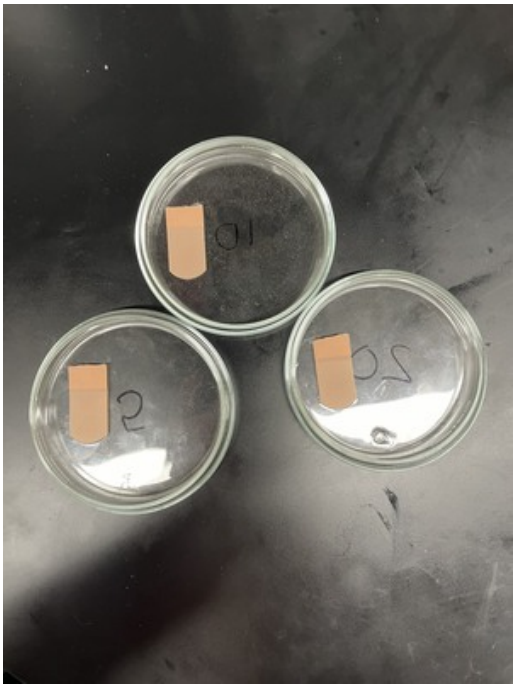
IMG_7253.jpeg (3.66 MB)

CLAIRE KRAMAR - Dec 06, 2023, 5:28 PM CST



Download

IMG_7252.jpeg (3.51 MB)

2023/12/12 - Tensile Testing

JODI LAWSON - Dec 13, 2023, 5:19 PM CST

Title: Tensile Testing

Date: 12/12/2023

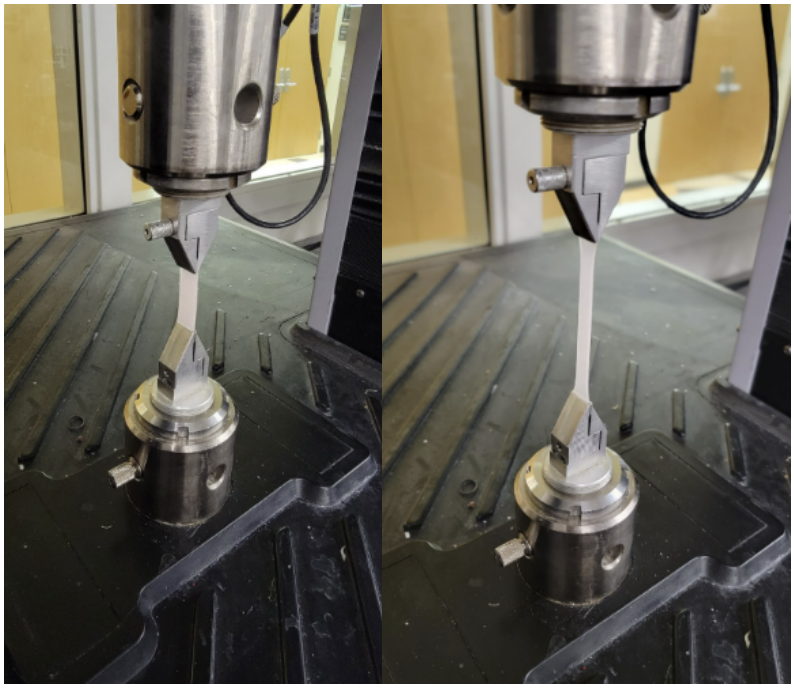
Content by: Jodi L.

Present: Jodi L.

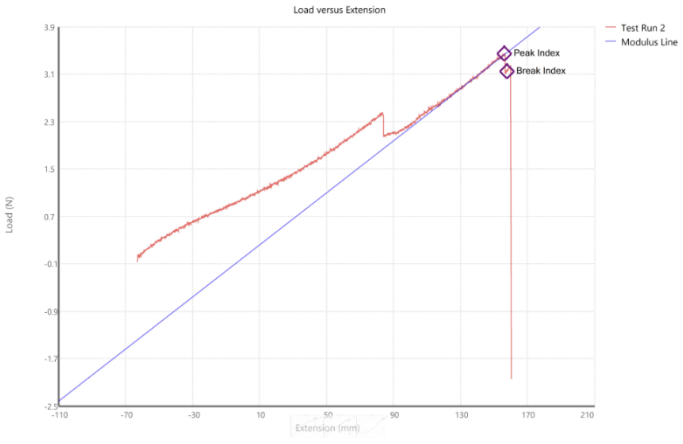
Goals: Perform Tensile testing on EcoFlex 00-30 samples to determine the Young's Modulus.

Content:

Experimental Setup:

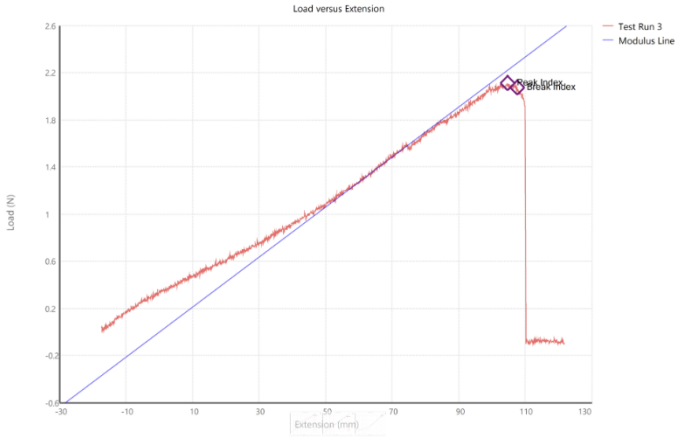


Test Run 1:



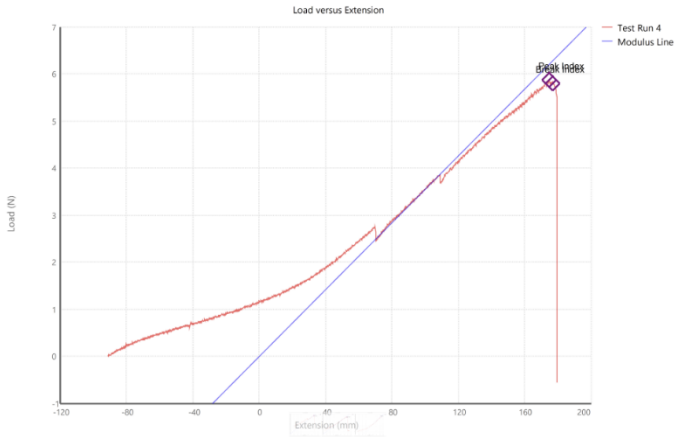
- Sample slipped
- Did not break; failure occured due to slippage from holders

Test Run 2:



- Sample did not break; failure was due to slippage from holder

Test Run 3:



- Sample slipped several times
- Sample did not break; failure was due to slippage from holder

Conclusions/action items:

From these tests, the team used the collected data to create stress vs. strain curves of the samples.

JODI LAWSON - Dec 13, 2023, 5:33 PM CST

Title: Tensile Testing

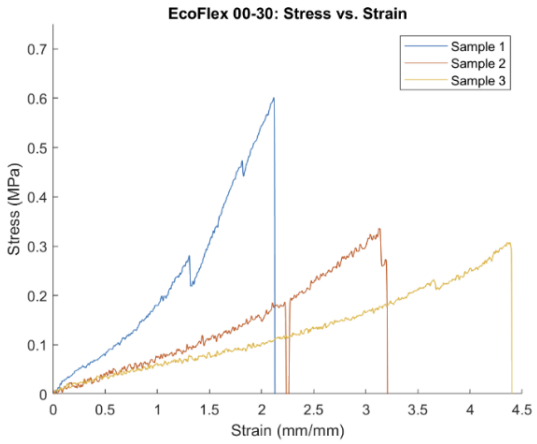
Date: 12/12/2023

Content by: Jodi L.

Present: Jodi L.

Goals: Experimentally determine the Young's Modulus of EcoFlex 00-30 from results of tensile testing.

Content:



Slope of the linear region (Young's modulus):

- sample 1: 0.5364 MPa
- sample 2: 0.1606 MPa
- sample 3: 0.1328 MPa

Mean Young's Modulus: 0.2766 MPa

Conclusions/action items:

The Young's Modulus of EcoFlex 00-30 is 0.2766 MPa, which is outside of the range of human skin (see PDS). Therefore, the team is justified in searching for a different skin material to represent neonatal skin.

Neonatal_Manikin_PDS_9/22/23

Jensen WEIK - Sep 22, 2023, 12:31 PM CDT

Neonatal 22-23-Week Premature Infant Simulation Manikin - PDS

Date: 09/22/2023

Client: Dr. Timothy Elgin
Advisor: Dr. Pamela Kreeger
Lab Section: 306

Team Members:
Claire Kramer ckramer@wisc.edu
Jodi Larson jlarson6@wisc.edu
Molly Wilhelmson mwilhelmson@wisc.edu
Jensen Weik jweik@wisc.edu
Emma Lu ehl22@wisc.edu
Maya Nornberg nornberg@wisc.edu

Function:

There are currently no neonatal manikins on the market made to resemble infants that are born at 22-23 weeks of gestation. Consequently, the first time many physicians, residents, or fellows use resuscitation skills needed to save an infant born extremely premature is during a real-life scenario. To provide a softer learning curve and to ultimately raise the rate of success of the resuscitation of premature infants, physicians are in need of a neonatal simulation manikin. The manikin must resemble an infant born at 22-23 weeks of gestation, have the capacity to be intubated, have IV access, and support central umbilical line placement. Ideally, the manikin would also have a thorax and chest cavity to allow physicians to practice the techniques needed for thoracentesis and pericardiocentesis procedures.

Client requirements:

1. The manikin should:
   - A. Have the ability to be intubated, have IV access, and support central umbilical line placement.
   - B. Have a thorax and chest cavity to allow users to train thoracentesis and pericardiocentesis procedures.
   - C. should resemble an infant born at 22-23 weeks of gestation in size, weight, appearance, and feel
     1. Manikin should be no more than 30.48 cm in length and should not weigh more than 400 g to 500 g (weight can be adjusted if electronics were to be added).
     2. The skin of the manikin should resemble that of a true premature neonate in texture, thickness, and pigmentation.

Download

Neonatal_Manikin-PDS_9-22-23.pdf (124 kB)

Preliminary_Presentation_10/06/2023

CLAIRE KRAMAR - Oct 11, 2023, 2:38 PM CDT

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Neonatal_Manikin_Preliminary_Presentation.pdf (840 kB)

Preliminary_Report-Neonatal_Manikin_10/11/2023

CLAIRE KRAMAR - Nov 03, 2023, 11:42 AM CDT

Neonatal 22-23-Week Premature Infant Simulation Manikin

Preliminary Report

Date: 10/11/2023

Client: Dr. Timothy Elgin
Advisor: Prof. Pamela Krueger

Team Members (BME 200/300, Lab 306):
Claire Kramar (Team Leader)
Jadi Lawson (Communicator)
Molly Wilhelmson (BSAC)
Jensen Weik (BWIG)
Emma Lu (Co-BPAG)
Maya Nirnberg (Co-BPAG)

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Preliminary_Report-Neonatal_Manikin.pdf (1.85 MB)

Final_Poster

Jensen WEIK - Dec 13, 2023, 1:12 PM CST

Download

Neonatal_Poster_Presentation.pdf (4.59 MB)

Final_Report

Jensen WEIK - Dec 13, 2023, 7:04 PM CST

Neonatal 22-23-Week Premature Infant Simulation Manikin

Final Report

Date: 12/13/2023

Client: Dr. Timothy Elgin
Advisor: Dr. Pamela Kreeger

Team Members (BME 200/300, Lab 306):
Claire Kramar (Team Leader)
Jodi Lawson (Communicator)
Molly Wilhelmson (BSAC)
Jensen Weik (BWIG)
Emma Lu (Co-BPAG)
Maya Nornberg (Co-BPAG)

Download

Neonatal_Manikin-Final_Report_Draft.pdf (5.74 MB)

2023/11/03 - Show and Tell Elevator Pitch and Questions

CLAIRE KRAMAR - Nov 03, 2023, 11:48 AM CDT

Title: Show and Tell Elevator Pitch and Questions

Date: 11/03/2023

Content by: Claire Kramar

Present: N/A

Goals: document a summary of our project and what design issues we are stuck on

Content:

Elevator Pitch:

- Project: making a 22-23 week premature infant manikin
- Requirements: accurately represents an infant born at 22-23 weeks gestation:
    - 1 foot long
    - Weighs about a pound
    - Wet, sticky gelatinous skin that can tear easily
    - Pigment of skin not as important this semester; ideally can be added in future work
- Plan of fabrication
    - 3D print molds for the body, arms, legs, and chest and skull cavities
    - Fill arm and leg molds with EcoFlex
    - Fill body mold with EcoFlex minus cutouts for the chest and skull cavities
    - Paint layer of PDMS with additives on top of EcoFlex to give the real skin feel
- Testing plans
    - Blind touch test with medical personnel who work closely with extremely premature infants
    - MTS testing of EcoFlex and PDMS to make sure they match the lower end of skin values
    - Testing how easily the outer layer (PDMS) tears by putting bandaids on the skin and pulling them off to see if the skin tears

Questions to ask other BME Design students:

- Do you have any ideas as to how we can add an outer layer of skin to an existing prototype?
- To simulate a more real-life scenario, the skin of an EPI is very thin and can tear easily. This means that the skin of our prototype must also tear easily but then will have to be replaced. How can we make the skin easily replaceable?

Conclusions/action items: Hopefully, our fellow BME students will have some different ideas to help us with skin fabrication. We will write reflections based off of Show and Tell after it occurs.

2023/11/03 - Show and Tell Notes

CLAIRE KRAMAR - Nov 04, 2023, 10:57 AM CDT

Title: Show and Tell Notes

Date: 11/03/2023

Content by: Claire Kramar

Present: whole team

Goals: document the advice we received during show and tell

Content:

Advice Received:

- separate the limbs at the elbows and knees for ease of modification in SolidWorks
- make a mold that is slightly bigger for the outer layer of skin
- make skin water dissolvable so it can be taken off easily and replaced by painting or spray paint
    - issue is PDMS is not water soluble
- dip EcoFlex portion in skin (kind of like how you spray paint water then dip something in it and the spray paint molds to the item)
- put PDMS on in sections
- flip mold while curing PDMS - maybe twice, one flipped and one right side up
- make a sheet of PDMS, then mold/lay over to the body
- paper mache PDMS
- heat PDMS to make it more viscous/half cure
- cure PDMS, then place in mold and cure onto EcoFlex

Conclusions/action items: The advice we received was very helpful and stimulated new creative thoughts about ways to attach the outer layer of skin to the inner EcoFlex. A lot of these ideas will have to be trial and error, and unfortunately we don't have a ton of time for trial and error in a one semester project. Hopefully, once materials are found, we will be able to try at least a couple of these ideas.

2023/09/22 - Textbook of Neonatal Resuscitation

CLAIRE KRAMAR - Sep 29, 2023, 7:21 AM CDT

Title: Textbook of Neonatal Resuscitation

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

Goals: gain an understanding of the resuscitation procedure of an infant born extremely premature

Citation: [1] J. Kattwinkel, R. S. Bloom, American Academy of Pediatrics, and American Heart Association, Eds., *Textbook of neonatal resuscitation*, 6th ed. Elk Grove Village, Ill.?] : [Dallas, Tex.? American Academy of Pediatrics ; American Heart Association, 2011.

Content:

1. Lesson 8 - Resuscitation of Babies Born Preterm
    1. causes of risk for premature babies:
        1. thin skin & large surface area compared to body mass = lose heat quickly
        2. tissues not fully developed can be damaged by excessive oxygen
        3. chest muscles are weak and may not allow them to take effective breaths
        4. nervous system may not stimulate them to breathe
        5. lungs deficient of surfactant, which causes difficulty ventilating and greater risk of injury from ventilation
        6. immune systems weak = greater risk of infection
        7. can rupture fragile capillaries in brain
        8. small blood volume makes them susceptible to blood loss
    2. how to prepare for preterm births as medical personnel:
        1. have a warming pad ready
        2. increase temp of delivery room
        3. have oxygen blender and oximeter ready
2. Lesson 9 - Ethics and Care at the End of Life
    1. As the survival rates stand now, it is unlikely that an infant born at 22-23 weeks of gestation will survive. As a result, many physicians will have to face telling the parents that resuscitation was unsuccessful. There is a proper way to do this, including:
        1. showing compassion and empathy
        2. treating the parents and infant with care
        3. allowing the family to process and ask questions about why resuscitation failed
        4. identifying a funeral home
        5. scheduling an office visit about a month out to answer any lingering questions and examine autopsy
    2. Ethical principles of neonatal resuscitation:
        1. autonomy - respecting decisions one makes about their life
            1. have to have a surrogate decision maker - aka the parents
        2. beneficence - acting to benefit others
        3. nonmaleficence - avoiding harm
        4. justice - treating people truthfully and fairly

Conclusions/action items: This textbook stimulated a couple of questions about our project. Should our manikin's skin be able to withstand heat so that physicians can practice heating the infant properly? Further, should the electronics portion of the project include simulations that result in failed resuscitation and simulate interactions with the parents?

2023/09/28 - Infant Anthropometric Measurements

CLAIRE KRAMAR - Sep 29, 2023, 7:31 AM CDT

Title: Infant Anthropometric Measurements

Date: 09/28/2023

Content by: Claire Kramar

Present: N/A

Goals: understand the proportions of infant segment lengths to the determine the proportions of arms to body, legs to body, head to body, etc. of our manikin

Citation: [1] B. SİYah BİLgİN *et al.*, "Reference values of anthropometric measurements in healthy late preterm and term infants," *Turk J Med Sci*, vol. 48, no. 4, pp. 862–872, Aug. 2018, doi: 10.3906/sag-1712-44.

Link: https://journals.tubitak.gov.tr/cgi/viewcontent.cgi?article=2027&context=medical

Content:

- most infant anthropometric measurements that have been recorded are for the weight, length, and head circumference; not a lot of literature on measurements for premature infants
    - can't measure the baby as easily while it is in the womb
    - could maybe have more success looking at autopsies of extremely premature infants
- table attached below of some measurements but the youngest gestational age is 35-36 weeks, and the measurements given do not include limb length

Conclusions/action items: Infant segment lengths are different proportions than adult segment lengths, but for now, due to a lack of research and ability to measure premature infants, we may have to use adult anthropometric segment lengths when determining the body length and limb lengths of the prototype. Ideally, these lengths would be able to be easily changed by future design groups when given feedback by the clients.

CLAIRE KRAMAR - Sep 29, 2023, 7:36 AM CDT

Table 2. Comparison of anthropometric measurements based on gestational age[a].

	Gestational age (weeks)			Statistics	
	35–36 (n: 237)	37–38 (n: 476)	39–42 (n: 484)	χ^2	P
Chest circumference (cm)	30 (29–32)	33 (32–34)	33 (32–34.2)	281.727	<0.001[1]
Ear length (mm)	33 (31–35)	34 (33–36)	35 (33–37)	97.440	<0.001[1]
Foot length (mm)	70 (67–74)	75 (72–78)	76 (74–79)	218.297	<0.001[1]
Palmar length (mm)	33 (31–35)	35 (33–37)	36 (34–38)	85.265	<0.001[1]
Middle finger length (mm)	26 (24–27)	27 (26–29)	28 (27–30)	143.353	<0.001[1]
Philtrum distance (mm)	8 (7–9)	9 (8–10)	9 (8–10)	53.463	<0.001[1]
Inner canthal distance (mm)	19 (18–20)	20 (19–21)	20 (19–21)	93.051	<0.001[1]
Outer canthal distance (mm)	58 (54–64)	63 (59–68)	64 (60–68)	98.144	<0.001[1]
Palpebral fissure length (mm)	20 (17–22)	22 (20–23)	22 (20–24)	78.481	<0.001[1]

[a]Data are presented as median (25th percentile–75th percentile). Bonferroni's post-hoc tests were performed.
[1]P value was significant for pairwise comparisons of all 3 groups.
[2]P value of pairwise comparisons was significant between the groups except for 37–38 and 39–42 weeks for each variable.

Download

Screenshot_48_.png (194 kB)

2023/10/02 - Adult Anthropometric Table

CLAIRE KRAMAR - Oct 02, 2023, 11:21 AM CDT

Title: Adult Anthropometric Table

Date: 10/02/2023

Content by: Claire Kramar

Present: N/A

Goals: record an adult anthropometric table to gather measurements from for the size of our prototype

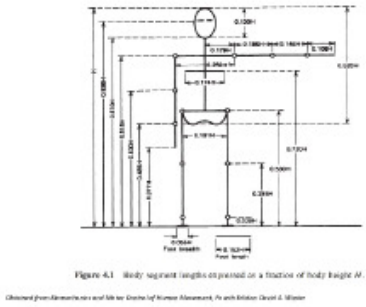
Citation: obtained from Biomechanics class (BME 315)

Content:

(tables attached below)

Conclusions/action items: Although infant proportions are different than grown adult proportions, there is not any literature on anthropometry tables for neonates, so this may be what we have to use to decide how long to make the body mold and how long to make the limbs when we 3D print the shells. Hopefully, our client would be able to tell us what looks right and what doesn't, and modifications can easily be made to the dimensions.

CLAIRE KRAMAR - Oct 02, 2023, 11:19 AM CDT



Download

AnthropometryTables.pdf (582 kB)

2023/10/04 - Physicians' Attitudes on Resuscitation of Extremely Premature Infants

CLAIRE KRAMAR - Oct 05, 2023, 4:03 PM CDT

Title: Physicians' Attitudes on Resuscitation of Extremely Premature Infants: A Systematic Review

Date: 10/04/2023

Content by: Claire Kramar

Present: N/A

Goals: understand the survival rate of extremely premature infants and whether or not doctors are willing to attempt resuscitation below a certain age

Link: https://publications-aap-org.ezproxy.library.wisc.edu/pediatrics/article/143/6/e20183972/76833/Physicians-Attitudes-on-Resuscitation-of-Extremely

Citation: [1] A. Cavolo, B. Dierckx de Casterlé, G. Naulaers, and C. Gastmans, “Physicians’ Attitudes on Resuscitation of Extremely Premature Infants: A Systematic Review,” *Pediatrics*, vol. 143, no. 6, p. e20183972, Jun. 2019, doi: 10.1542/peds.2018-3972.

Content:

I. Introduction

- extremely premature infants (EPIs): infants born before the 28th complete week of gestation
- in highly developed countries, survival rates for EPIs are
  - <10% at 22 weeks GA
  - 1%-64% at 23 weeks GA
  - 31%-78% at 24 weeks GA
  - 59%-86% at 25 weeks GA
- EPIs at higher risk of having moderate or severe disability
- decision then has to be made about whether or not to attempt resuscitation of EPIs, which is a very ethically complex decision that differs from physician to physician, and parent to parent

II. Results

- only 0%-4.4% of physicians said they would resuscitate infants born at 22 weeks GA
- 4%-47% said they would attempt resuscitation at 23 weeks GA
- at 24 weeks GA, it is more common to attempt resuscitation than to not
  - our project aims at lowering this age

Conclusions/action items: This article was accepted for publication in 2019. Have attitudes changed since then? This design project is needed because a simulation manikin would soften the learning curve and equip physicians with the skills needed to attempt resuscitation of EPIs, specifically those at 22-23 weeks GA.

2023/10/08 - Global Burden of Preterm Birth

CLAIRE KRAMAR - Oct 08, 2023, 4:23 PM CDT

Title: Global Burden of Preterm Birth

Date: 10/08/2023

Content by: Claire Kramar

Present: N/A

Goals: understand how often preterm births affect people in the world

Link: https://obgyn-onlinelibrary-wiley-com.ezproxy.library.wisc.edu/doi/pdfdirect/10.1002/ijgo.13195

Citation: [1] S. R. Walani, “Global burden of preterm birth,” *International Journal of Gynecology & Obstetrics*, vol. 150, no. 1, pp. 31–33, 2020, doi: 10.1002/ijgo.13195.

Content:

- preterm births is defined as any live birth that occurs before 37 completed weeks of pregnancy
- ~ 15 million babies are born preterm annually worldwide, with is a rate of about 11% overall
- preterm birth is leading cause of death in children, accounting for 18% of all deaths of children under 5 years old and 35% of all deaths among newborns
- extremely preterm births defined as those born before 28 weeks gestation
    - only about 5% of the preterm births fall into the extremely preterm birth category
- 6 countries make up 50% of preterm births: India, China, Nigeria, Pakistan, Indonesia, and the US
- income rates can affect this rate per area
- preterm birth rate 12% for low-income countries compared to 9.4% to 9.3% for middle-income to high-income countries respectively
- disparities exist by geographic location, maternal education, race, ethnic origin, etc.

Conclusions/action items: Preterm birth is a major and prevalent medical concern. Only 5% of preterm births, however, are before 28 weeks gestation and even a smaller percent at 22-23 weeks gestation. This does not mean, however, that attention should not be given to this age range. Neonatology is a field that is advancing quickly, and this project aims to lower the age that neonates can be resuscitated at and ultimately raise the survival rates of extremely premature infants. Ethical consideration: can we make our prototype in such a way that is cost available to as many countries as possible? Will our prototype be able to be representative of all races and ethnic origins that are affected by preterm births?

2023/10/11 - Newborn Anatomy

CLAIRE KRAMAR - Oct 11, 2023, 2:22 PM CDT

Title: Newborn Anatomy

Date: 10/11/2023

Content by: Claire Kramar

Present: N/A

Goals: understand how newborn anatomy differs for adult anatomy

Link: https://onlinelibrary.wiley.com/doi/epdf/10.1002/ca.23774

Citation: [1] J. A. Vilensky and C. A. Suárez-Quian, “Newborn anatomy,” Clinical Anatomy, vol. 35, no. 1, pp. 15–18, 2022, doi: 10.1002/ca.23774. [Online]. Available: https://onlinelibrary.wiley.com/doi/10.1002/ca.23774. [Accessed: Oct. 11, 2023]

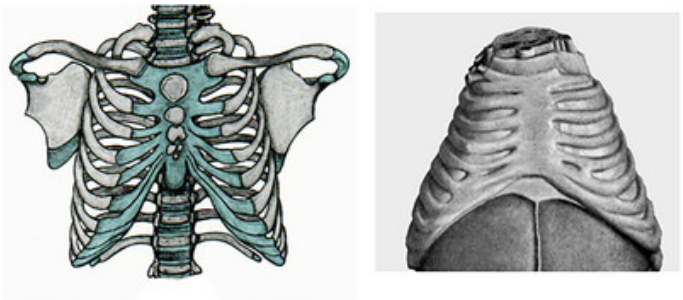
Content:

- teach less content in anatomy relating to newborns - don't have newborn cadavers
- shape of thoracic cavity in newborn is much more cone-shaped than cylindrical-shaped as in the adult
- thorax of newborn has shape of truncated cone with a broad base that is slightly flattened anteroposteriorly
- ribs are less curved and their position is more horizontal than adult

(image attached below: on left is adult ribcage, on right is newborn)

Conclusions/action items: Ultimately, the final prototype will contain a thoracic cavity to house the lungs and allow for the practice of thoracentesis and pericardiocentesis procedures. It is helpful to know that the shape of the ribs will be more cone-like than cylindrical and helps to have a figure to base the design off of.

CLAIRE KRAMAR - Oct 11, 2023, 1:55 PM CDT



Crelin Atlas, Plate 3 *Scammon 1923, Figure 121*

Download

Adult_vs_Newborn_RibCage_Photo.jpg (324 kB)

2023/09/20 - Premature Anne

CLAIRE KRAMAR - Sep 20, 2023, 3:34 PM CDT

Title: Premature Anne

Date: 09/20/2023

Content by: Claire Kramar

Present: N/A

Goals: explore the designs already on the market for premature infant mannequins

Citation: [1] "Premature Anne," *Laerdal Medical*. https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/premature-anne/ (accessed Sep. 20, 2023).

Link: https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/premature-anne/

Content:

1. Description of Premature Anne:
    1. anatomically correct representation of a baby born at 25 weeks of gestation
    2. created by Laerdal Medical
    3. has option to come with SimPad PLUS that allows teams to train with different scenarios
2. Skills to practice:
    1. Airway Management
        1. allows for suctioning, intubation, and ET/NG/OG tube insertion
    2. Respiration
        1. chest rises and falls
        2. manikin w/ SimPad PLUS allows practice identifying cyanosis and hearing heart, lung, and vocal sounds
    3. Vascular Access
        1. supports umbilical line placement
        2. blood flashback upon cannulation of umbilical vein
    4. Dry pre-ported IV sites
        1. IV sites located in the right saphenous vein, dorsum of the left hand, and left antecubital fossa
3. Cost
    1. Premature Anne Task Trainer - $2999.00
    2. Premature Anne, Standard - $6,899.00

Conclusions/action items: The techniques able to be performed on Premature Anne are very similar to what our client is asking us to design. Premature Anne, however, resembles an infant at 25 weeks of gestation rather than 22-23 weeks of gestation. Further, the skin is not realistic, and the price is very high. Our client would like a simulation manikin that is smaller, has more gelatinous, realistic skin, and is more affordable.

CLAIRE KRAMAR - Oct 05, 2023, 4:15 PM CDT

Download

Premature_Anne_Photo.jpg (127 kB)

2023/09/20 - Lifecast Body Simulation

CLAIRE KRAMAR - Sep 20, 2023, 3:26 PM CDT

Title: Lifecast Body Simulation Competing Design

Date: 09/20/2023

Content by: Claire Kramar

Present: N/A

Goals: find and record competing designs on the market both to gain inspiration and to understand what has already been made

Citation: [1] “Lifecast Body Simulation | Surgical Manikin.” https://www.lifecastbodysim.com/micro-preemie-manikin (accessed Sep. 20, 2023).

Link: https://www.lifecastbodysim.com/micro-preemie-manikin

Content:

1. Description:
    1. anatomically represents a baby born at 22-23 weeks of gestation
    2. skin is hand painted silicone - looks realistic
    3. weighs about 500 g, which is accurate
    4. developed w/ neonatologists
2. Skills the can be performed:
    1. both nasal and oral intubation and ventilation
    2. ventilation has normal volumes and pressures
    3. tension pneumothorax function
    4. umbilical line placement and flashback when UVC is placed
    5. nasogastric tube placement
3. Cost:
    1. no information provided about the cost

Conclusions/action items: This manikin is also similar to what our client is asking us to design. Lifecast's manikin, however, does not have IV access, the price is unknown, and while the skin looks realistic, it may not feel realistic, which is very important to our client. While there are premature infant mannequins beginning to make their way to the market, none fully satisfy our client's desires.

CLAIRE KRAMAR - Oct 05, 2023, 4:16 PM CDT

Download

Screenshot_56_.png (323 kB)

2023/09/22 - ISO13485:2016

CLAIRE KRAMAR - Sep 22, 2023, 10:09 AM CDT

Title: ISO 13485:2016

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

Goals: figure out what standards and specifications our prototype should adhere by

Citation:

[1] 14:00-17:00, “ISO 13485:2016,” ISO, Jun. 02, 2021. https://www.iso.org/standard/59752.html

(accessed Sep. 21, 2023).

Link: https://www.iso.org/standard/59752.html

Content:

This standard states that quality devices are required from the design phase all the way to the distribution phase. This is done by including ethical considerations in all stages of the deign process, adhering by the standards that apply to the design, and by properly and thoroughly maintaining documentation of the complete design process.

Conclusions/action items: This is a very general standard for quality management of medical devices. A neonatal manikin is not necessarily a medical device, but it could be argued that this standard still applies. While this design will not be used directly to cure a disease or illness, it will be used indirectly to improve the resuscitation techniques of physicians, thus increasing the rate of survival in infants born very premature.

2023/09/22 - ISO14971:2019

CLAIRE KRAMAR - Sep 22, 2023, 10:15 AM CDT

Title: ISO 14971:2019

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

Goals: discover the ISO standards that will apply to our prototype

Citation:

[1] 14:00-17:00, “ISO 14971:2019,” ISO, Jul. 14, 2020. https://www.iso.org/standard/72704.html

(accessed Sep. 21, 2023).

Link: https://www.iso.org/standard/72704.html

Content:

ISO 14971:2019 states that risk management procedures must be implemented to identify potential risks and hazards and accommodate for them with proper labeling, warnings, or changes to the design if necessary.

Conclusions/action items: The two main aspects of our project that come with risk factors include the chemicals used to make the skin and the electronics that will eventually be implemented to provide the user with feedback on their techniques. Warning labels for the chemicals and electronics will be included where needed. The team should also do everything possible to minimize the risks involved, such as making sure the chemicals used to make the skin are not hazardous to humans and that all electrical components are contained and ideally in a waterproof compartment.

2023/09/22 - OSHA 1910.1000

CLAIRE KRAMAR - Sep 22, 2023, 11:19 AM CDT

Title: OSHA 1910.1000

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

Goals: find the room temperature standard to determine what temperature/humidity our prototype would be stored at

Citation:

[1] "Reiteration of Existing OSHA Policy on Indoor Air Quality: Office Temperature/Humidity and Environmental Tobacco Smoke | Occupational Safety and Health Administration."

https://www.osha.gov/laws-regs/standardinterpretations/2003-02-24 (accessed Sep. 21, 2023).

Link: https://www.osha.gov/laws-regs/standardinterpretations/2003-02-24#:~:text=Air%20treatment%20is%20defined%20under,range%20of%2020%25%2D60%25.

Content:

OSHA recommends a temperature range of 68-76°F and a humidity range of 20-60%.

Conclusions/action items: While we cannot ensure that the area where the prototype will be kept will abide by these recommendations, we can design our prototype in such a way that it could be stored at these temperatures and with these percentages of humidity in storage without losing physical properties and functionality. It could also be included in an instruction manual that the manikin must be stored within these temperature and humidity recommendations.

2023/09/22 - Design Idea for the Mold for Limbs

CLAIRE KRAMAR - Sep 22, 2023, 11:37 AM CDT

Title: Design Idea for the Mold for Limbs

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

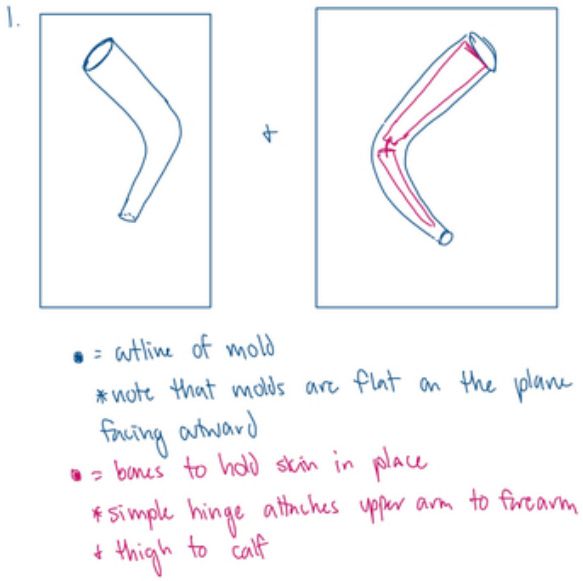
Goals: express my design idea in both drawing and words

Content:

- sketches attached below
- 2 ideas for the molds for arms and legs
    - 1: separate molds for the arm/hand and leg/foot
        - hands and feet are going to be more difficult to 3D model and are not as symmetric; ideally, the arms and legs without the hands and feet could be split down the middle to make two halves that will later be glued together
        - bones could be 3D modeled that have holes for an IV already designed into them
            - would hold the skin in place and allow for IV access
            - idea inspired by Premature Anne
    - 2: arm/hand and leg/foot are in the same mold
        - you could still but the arm or leg down the middle, and it might not matter where the hand is cut (i.e. if it's not in the middle) as long as when you glue the two halves together, it looks like a full hand
            - a disadvantage of this method is that it would make having an IV access point in the hand more difficult
            - ideally would still have "bones" to hold the skin in place

Conclusions/action items: A conclusion on this idea will be made when we talk as a team and decide on the best course of action. Further, CAD drawings should be made of this design idea if it is one we will include in the design matrix.

CLAIRE KRAMAR - Sep 22, 2023, 11:39 AM CDT



Download

Mold_Sketch.jpg (561 kB)

2023/09/22 - Design Idea for Whole Prototype

CLAIRE KRAMAR - Sep 22, 2023, 12:09 PM CDT

Title: Design Idea for Whole Prototype

Date: 09/22/2023

Content by: Claire Kramar

Present: N/A

Goals: describe through words and drawing my design idea for the whole prototype

Content:

- ideally have a whole silicon manikin, combining the mold from the Iowa group for the head and body with our own molds for the arms and legs
- hollow cavities available throughout to allow for a ribcage, chest cavity, stomach with umbilical cord access, a skull to hold electronics, places for bones in the arms and legs, etc.
- a zipper along the length of the back to allow for maintenance of internal components
- on top of the mold there would be skin replacements to make the simulation manikin realistic
    - infants born at 22-23 weeks gestation have very thin skin that is easy to tear; medical personnel practicing on this manikin are likely to tear the skin while learning, so skin replacements would be necessary
    - the skin could be painted on in layers to simulate skin of a premature infant

Conclusions/action items: This design idea is inspired by Laerdal Medical's Premature Anne. All components of this manikin are what the client is looking for except for the skin could be more realistic and the size needs to be smaller. Ideally, a CAD drawing of this idea would be made in the future if we were to move forward with this design idea.

2023/10/05 - Separate Skin Layer Discussion

CLAIRE KRAMAR - Oct 05, 2023, 4:22 PM CDT

Title: Separate Skin Layer Discussion

Date: 10/05/2023 (entered on this day but discussed on 09/22/2023)

Content by: Claire Kramar

Present: Claire and Jodi

Goals: figure out how to have an outer layer of skin that is more realistic on top of more durable shell

Content:

- two ideas considered
  - 1: paint the skin on
    - benefits: could control color and thickness, reusable over and over
    - disadvantages: would involve the buyer having to repaint the skin each time it tears, which takes time
  - 2: make two shells for the mold, one a cm or so bigger than the other; make the durable material one in the smaller shell, and then coat the bigger shell with realistic skin material, placing the durable skin material (maybe silicon) model inside of it so that when it cures, it is attached
    - benefits: realistic and doable this semester
    - disadvantages: would be difficult to add a zipper to access the inner components; wouldn't be easy for buyers to add new skin when it tears; could add instructions as to how to put on new skin?

Conclusions/action items: The option that we are leaning towards right now is option 2. Both have advantages and disadvantages, but option 2 is possible for us to accomplish this semester by printing two of the molds.

2023/09/15 - TEAMLab Training

CLAIRE KRAMAR - Sep 15, 2023, 11:25 AM CDT

Title: TEAMLab Training/Certifications

Date: 09/15/2023

Content by: Claire Kramar

Present: N/A

Goals: documentation and proof of permits earned in UW-Madison Engineering Labs

Content:

(picture attached below)

Conclusions/action items: I most likely have the training I will need to build our prototype this semester. There is a chance I will have to take a class for some upgrades, though, depending on how we decide to fabricate the manikin.

CLAIRE KRAMAR - Sep 15, 2023, 11:26 AM CDT

Download

Green_Permit_Training.pdf (50.4 kB)

Tong Lecture Notes

CLAIRE KRAMAR - Nov 10, 2023, 12:34 PM CST

Title: Tong Lecture Notes

Date: 11/10/2023

Content by: Claire Kramar

Present: N/A

Goals: take notes on Tong Lecture

Content:

- Speaker: Travelle F.F. Ellis, MD, PhD
- what is an engineer?
    - a skillful contriver or originator of something
- found a pump that bypassed the heart so blood could still pump while the heart healed and found this really cool, but to do things like this, you have to take calculus, dynamics, thermodynamics, etc.
- found she thrived working with teams and in problem solving settings
- ultimate goal: to help people using cool technology
- high school to college to grad school was pretty linear: after grad school life took some nonlinear turns but also made her more resilient
- 3 words of encouragement
    - 1. find your people
        - your people don't have to all be engineers and maybe they shouldn't be; people in other disciplines open your eyes to more opportunities and more parts of the world
        - have a pacing partner
        - your people can connect you to jobs
    - 2. do things that scare you (at least a little bit)
        - if things are too comfortable, they're too easy and don't tap into your passions
        - the same people that support you now will support you in the future
    - 3. laugh until you cry, cry until you laugh
        - lots of sacrifices you have to make to have a work life balance
        - after med school, she didn't match for residency - taught her to pivot and lean on her strengths
        - a no is redirection because someone is counting on you
- initial goal was to help people using science and technology
    - even though the trajectory wasn't what she had expected, she is now the health equity director at exact sciences and living the goal she set out to do
- lean into the practice here at UW-Madison because it's okay to fail here

Conclusions/action items: This lecture spoke to me because I do not yet know the trajectory of my career. It has affirmed that it is okay to not know where you're headed as of right now and you will figure it out in the future. It also inspired me to reach out to more people in the field and make connections. I cannot find opportunities I'm not actively looking for. As of right now, I wouldn't even know who to ask to write me an academic reference. At UW Madison, I have access to incredible scientists, engineers, and people in general in my professors, advisors, etc., and I should do more to get to know them and learn from their stories. In doing so, I will find my own.

2023/10/02 - Skin Materials Research

JODI LAWSON - Oct 02, 2023, 12:40 PM CDT

Title: Silicone Rubbers Research

Date: 10/02/2023

Content by: Jodi Lawson

Present: n/a

Goals: Learn about properties and uses of silicone rubbers in order to determine if this is the best option for a skin material.

Content:

Liquid Silicone Rubber (LSR)

https://www.simtec-silicone.com/blogs/medical-grade-liquid-silicone-rubber/

- bio-inert, complies with ISO 10993
- low viscosity, will fill all parts of mold
- low compression set
- self-adhesive; sticks to plastics without priming
- maintains resiliency, flexibility, and mechanical properties
- can achieve different surface textures
- can come into contact with skin without being harmful
- stable and water repellent
- non-allergenic
- flexible and soft
- excellent transparency
- remains elastic at low temperatures
- wouldn't tear… elongation break of 1000%
- low compression set
- 10 durometer; soft, gum-like quality

High Consistency Rubber (HCR)

https://www.simtec-silicone.com/blogs/liquid-silicone-rubber-injection-molding-vs-high-consistency-rubber-which-is-right-for-you/

- heat cured
- resilient/recoverable after elongation/compression
- resistant to heat/cold, high viscosity
- can mix with additives to modify physical properties
- mainly used for compression molding
- typical tear strength of solid silicone rubber is around 9.8 kN/m

Conclusions/action items:

These rubbers alone woud not suit our purposes, but there are additives that can be used to alter physical properties to be closer to what we are looking for.

JODI LAWSON - Oct 02, 2023, 12:42 PM CDT

Title: PVC

Date: 10/02/2023

Content by: Jodi Lawson

Present: n/a

Goals: Learn about PVC and what properties it has in order to determine if it is the best choice for our skin material.

Content:

https://advancedplastiform.com/using-pvc-in-medical-supplies-and-applications/

- plastic; can be soft, highly flexible by using plasticizers
    - e.g. phthalates
- high biocompatibility
    - inert w/ tissue, skin, blood
- holds strength and durability
- additives and plasticizers can transform material to be transparent and clear (e.g. IV bags)
- doesn't break down; maintains structural integrity
- easily sterilized
- high elasticity
- water resistant
- affordable

https://www.bpf.co.uk/plastipedia/polymers/PVC.aspx

- tensile strength: 2.6 N/mm^2
- can add pigments to the PVC
- plasticizers
    - makes plastic flexible, resilient, easier to handle
    - most commonly used are phthalates
    - low molecular weight phthalates
        - eight or less carbon atoms in backbone
    - high molecular weight phthalates
        - 7 to 13 carbon atoms in backbone
    - specialty plasticizers can be used to increase flexibility
- easy to process, long lasting, tough, light
- small carbon footprint (comparatively)
- fully recyclable
- been used in the past for artificial skin (burn treatment application)

Conclusions/action items:

Like with Silicone Rubber, additives can be used to get different properties that would allow us to get closer to the properties we are looking for in our skin material.

Title: Plasticizers

Date: 10/02/2023

Content by: Jodi Lawson

Present: n/a

Goals: Explore additives that could be used with silicone/pvc in order to get different physical properties.

Content:

https://www.plasticisers.org/

- acetates
  - glyveryl triacetate (Triacetin)
    - clear, colorless
    - used in adhesives and sealants in construction, paint and coating additives
- adipates
  - colourless, odorless
  - coating, adhesive and sealants, polishes and waxes
  - thermal stability
- azelates
  - liquid compound; used in adhesives and sealants, polishes and waxes
- benzoates/dibenzoates
  - mainly used in flooring/film and adhesives/sealants
  - fast fusing
  - monobenzoates; low viscosity agents
  - also used in sheet and film products for cars
- citrates
  - used in paints, coatings and inks, cling wrap, medical applications
- cyclohexanoates
  - sensitive applications; e.g. medical, food contact
  - low temp performance, reduced viscosities, stability to UV
- epoxy esters
  - improves heat stability
  - used in rubbers, epoxy resins, paints and coatings
- glycerol esters
  - low molecular weight; improved compatibility and processability
  - e.g. teething rings, cling film, tubes in medical/food
- ortho-phthalates
  - most commonly used plasticizer
  - used to make flexible PVC
  - used in medical devices; tubing, blood bags
  - divided into low and high molecular weight categories (different properties, applications, classifications)
- other esters
  - good compatibility with many polymers
  - with PVC, good gelling and saponification resistance
- phosphate esters
  - fire retarding
  - in PVC, good gelling and low temp performances
- polymeric
  - low migration
  - in PVC, rquire higher fusion and processing temperatures
- sebacates
  - good mechanical properties at low temperatrion
    - extraction resistance
  - in high temp, good resistance to evaporation loss
  - used in lubricants and greases, adhesives and sealants, polishes and waxes
- succinate
  - used as coating and in cosmetics (nail polish solvent)
- sulfonamide

    - used in nylon 11/12
    - automotive applications; tubes, hoses, pipes
- terephthalates
    - low temperature performance
    - low volatility
    - lower inititial viscosity, better stability (needs higher fusion and processing temp)
    - lower compatibility with PVC; not used if durability is a need
- trimellitates
    - low volatility
    - used in isulation or sheathing of electrical cables for high temperature
    - low mighration rate and extraction resistance
- valerates
    - balanced plasticiser with combo of high plasticising efficiency and low volatility
    - smoke suppression properties
    - aliphatic structure
    - suspension and emulsification applications (e.g. molded parts, films and sheets)

Conclusions:

There are many options for additives that can be used with silicone rubber and PVC in order to get closer to what we are looking for. More exploration will need to be done in order to determine which additive to use.

JODI LAWSON - Oct 02, 2023, 12:51 PM CDT

Title: Synthetic Biomaterials

Date: 10/02/2023

Content by: Jodi Lawson

Present: n/a

Goals: Determine if synthetic biomaterials could be used as a skin substitute for the manikin.

Content:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7863571/

- Synthetic biomaterials

  lack cell-interaction moieties (not necessary for our purpose)

    - PolyLacticAcid (PLA)
        - aliphatic, biodegradable
        - slow degradation rate, exhibits shrinkage, low elongation, and hydrophobicity
    - Poly(ε-Caprolactone)
        - slower degradation rate than PLA

Conclusions/action items:

As our project does not involve any in vivo applications, we are not looking for a material that is biocompatible in the human body, but rather a material that is inert with the silicone used for the mold, and inert in day-to-day use. As such, we won't use biomaterials because they are more prone to degradation.

2023/09/18 - Premature Infant Manikins

JODI LAWSON - Sep 18, 2023, 10:06 PM CDT

Title: C.H.A.R.L.I.E. Neonatal Resuscitation Simulator

Date: 09/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Understand what other neonatal manikins are on the market. See what training procedures the manikins can support, and what the models are made of; see if the materials used could be useful in our design.

Content:

Link to page: https://shop.nascohealthcare.com/products/lf01420

- Nasco Healthcare
- expensive ~$2k - $3k
- models a full-term newborn
- 19.5 inches long, weighs 8.5 lbs
- interactive ECG simulator; can deliver defibrillation shock, connect to external pacer
- has 6 waveforms
- includes airway, breathing, intubation, IV skin and bag, and several other features
- visually, the skin doesn’t represent that of a 22-23-week premie
- 5-year warranty (points towards durability; durable for up to five years?)
- couldn’t find material specifications for product; below is sku for hand/foot replacement (I/O skin)
  - SKU: LF01411

Conclusions/action items:

This competing product doesn't represent a 22-23-week premature infant. Many of the procedures it supports are similar to what we want our manikin to support. If possible, finding the material used for the skin could be helpful.

Title: Prestan Infant Ultralite

Date: 09/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Understand what other neonatal manikins are on the market. See what training procedures the manikins can support, and what the models are made of; see if the materials used could be useful in our design.

Content:

Link to page: https://www.prestan.com/products/cpr-training-manikins/infant-ultralite-manikin/

- used for CPR training
- allows head-tilt and visible chest rise
- has sensor to assess compression rate
- has clicking sound when 2.0-2.4 chest depth is reached
- “durable”, “quality and realism”
- 3-year warranty
- light-weight, portable
- not meant to resemble a true newborn outside of chest, head, and mouth/airway
- seems more like a newborn CPR dummy; not on the realistic side, save for chest and airway

Conclusions/action items:

This product appears to be concerned only with CPR training on newborns; a much smaller scope than what our project hopes to accomplish. However, the product reinforces the importance of head-tilt mobility for CPR administration.

JODI LAWSON - Sep 18, 2023, 10:16 PM CDT

Title: Premature Anne

Date: 09/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Understand what other neonatal manikins are on the market. See what training procedures the manikins can support, and what the models are made of; see if the materials used could be useful in our design.

Content:

Link to page: https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/premature-anne/

- 25-week, anatomically correct premie
- airway management, respiration, vascular access, IV sites

Link to page: https://laerdal.my.site.com/HelpCenter/s/article/Baby-Anne-material-specifications

Baby Anne material composition (not an extensive list)

- PVC (Polyvinyl chloride) plastisol
- PVC
- PP (polypropylene)
- PPC (polypropylene copolymer)
- Polyester; fiber stuffing
- LDPE for rib plate (low density polyethylene)
- no natural rubber latex “intentionally added”

Conclusions/action items:

Premature Anne appears to be the closest to what we want our manikin to be like, though Baby Anne resembles a 25-week premie. The materials that Premature Anne could give an idea to what materials to explore for our own design.

JODI LAWSON - Sep 18, 2023, 10:20 PM CDT

Title: PreemieNatalie

Date: 09/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Understand what other neonatal manikins are on the market. See what training procedures the manikins can support, and what the models are made of; see if the materials used could be useful in our design.

Content:

Link to page: https://shop.laerdalglobalhealth.com/product/preemienatalie/

- low-cost, $80
- 1.6 kg, 32-week gestation
- manikin filled with water, air, or dry rice
- durable and “realistic”
  - limbs are not realistic looking…
- made to help with feeding practice and “kangaroo mother care”
- materials used: vinyl, silicone, POM (polyoxymethylene), PVC, PP, TPU (thermoplastic polyurethane)

Conclusions/action items:

PreemieNatalie is not physically identical to a premature infant; the mouth area seems to be the only anatomically accurate area, as the manikin is used for practice with nursing mothers. The materials used could be useful for design ideas.

2023/10/11 - MicroPremie Evaluation

JODI LAWSON - Oct 11, 2023, 5:19 PM CDT

Title: Life Cast Micro Premie

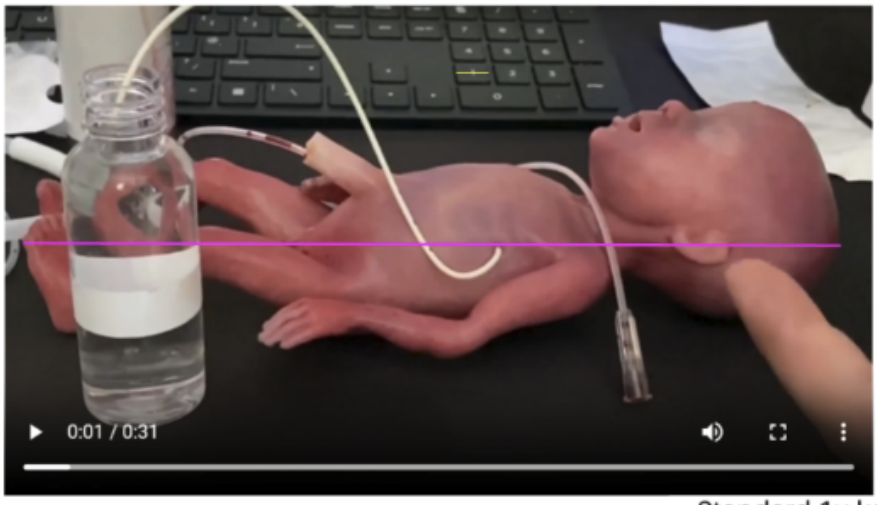
Date: 10/11/2023

Content by: Jodi Lawson

Present: n/a

Goals: Learn about the Life Cast Micro Premie

Content:



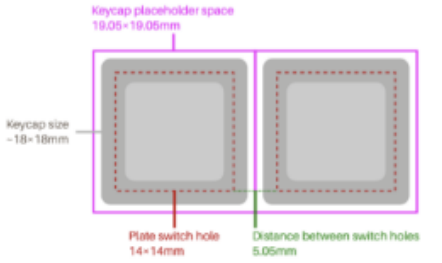
Via google search by image: HP Lifestyle TPC-POO1K USB Wired PC Black Keyboard

Standard 1u keyboard: 18mm
Line length for keycap: 0.28 in
Manikin line length (pink): 7.13 in

$$\frac{0.33\text{in}}{7.13\text{in}} = \frac{0.018\text{m}}{x\ \text{m}}$$

x = ~0.39 m = 39 cm

Standard 1u keycap size diagram



Conclusions/action items:

From this analysis, we can determine that the LifeCast Micro Premie is around 39 cm long, which is longer than the goal of 30.5 cm for our manikin.

2023/09/18 - TEAMLab Training

JODI LAWSON - Sep 18, 2023, 7:38 PM CDT

Title: TEAMLab Training

Date: 9/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Present proof of training documentation for TEAMLab equipment.

Content:

See image below.

Conclusions/action items:

Should need be, I am able to use the Lathe and Mill machines in TEAMLab.

JODI LAWSON - Sep 18, 2023, 7:40 PM CDT

Download

201_Green_Permit.png (236 kB)

2023/09/18 - Biosafety Training

JODI LAWSON - Sep 18, 2023, 7:43 PM CDT

Title: Biosafety Training

Date: 09/18/2023

Content by: Jodi Lawson

Present: n/a

Goals: Present relevant training documentation.

Content:

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Jodi Lawson has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2023	5/21/2023	
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	4/14/2023	No Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	4/14/2023	No Expiration
Biosafety 107: Centrifuge Safety	Biosafety 107: Centrifuge Safety Verification Quiz	4/15/2023	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2023	1/29/2023	1/29/2028
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/30/2023	

Data Last Imported: 09/18/2023 07:35 PM

Conclusions/action items:

I have training that may come to use for fabricating skin that may be used for the manikin.

9/20 Research

EMMA LU - Sep 22, 2023, 4:18 AM CDT

Title: Anatomy and Intubation Research

Date: 9/20

Content by: Emma Lu

Present: n/a

Goals: research more on infant anatomy to sketch a design

Content:

- - neonates at 22-23 weeks typically need intubation at birth and mechanical ventilation
- - survivors of extremely preterm birth have higher rates of bronchopulmonary dysplasia and have reduction in lung volumes and function
-

- - "Most premature infants born at 22-23 weeks gestation at our center are intubated with 2.0 mm internal diameter endotracheal tubes (ETTs) due to the small size of the trachea"
- - "Between 16 and 26 weeks, the lungs are in the canalicular period. During this period, the lumen of the bronchi and terminal bronchioles become larger and the lung tissue becomes highly vascularized."

-

- - An appropriate initial depth of endotracheal tube insertion for infants ≤23 weeks may be closer to 5.5 cm to the lip
- - a total body water content of close to 90% with the relative excess held mostly in the extracellular fluid compartment
- - an epidermis consisting of only 3-4 cell layers covered by a thin (a few microns) stratum corneum
- - "insensible water loss can be estimated to range from 50 mL/kg/d in a maximally humidified incubator (~90% relative humidity) to approximately 170 mL/kg/d during care under a radiant warmer with the use of plastic wrap to promote a humid microenvironment (~40% relative humidity)"

- - abdominal circumference 183-195mm
- femur length 38-41mm
- head circumference 198-210mm

Conclusions/action items:

look into if there are any specifics on lungs size/capacity and other products on the market

9/19 Standards and Specifications

EMMA LU - Sep 21, 2023, 1:32 PM CDT

Title: ISO

Date: 9/18/23

Content by: Emma Lu

Present: N/A

Goals: research standards and specifications we have to follow

Content:

ISO 13485

- frames criteria for a quality management system to ensure the quality of the product(link)

ISO 14971

- addresses risk management to patient, operator, external equipment and/or the environment(link)

ISO List(link)

- cleanliness of medical devices: 8250(Under Development)

- symbol labeling: 15223

- software: IEC 62304

- usability(manufacturing?): 62366

ANSI Standards(link)

- ISO/TR 16982:2002: ergonomics and usability of design

- Product Design, Lab Safety, Electronic Component Standards

Conclusions/action items:

The two main standards are ISO 13485 and ISO 14971. There are a couple that start to lean towards manufacturing that could possibly apply to us. I will look into these and some other more manufacturing focused ones.

9/26 Competing designs

EMMA LU - Sep 28, 2023, 2:16 PM CDT

Title: Competing designs

Date: 9/26

Content by: Emma Lu

Present: n/a

Goals: research what is on the market

Content:

Premature Anne

- manikin of a 25 week preterm baby
- three IV sites, right saphenous vein(ankle), dorsum on left hand and left antecubital fossa(wrist)
- accurate airways to practice suctioning, intubation, and ET/NG/OG tube insertion
- vascular access to practice vein catheterization

Source: https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/premature-anne/

SimNewB

- manikin of a full term new born
- a lot more airway, cardiovascular and vascular features compared to Premature Anne

Source: https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/simnewb/

PreemieNatalie

- 32-week preterm baby
- more target towards parents to role play care

Source: https://shop.laerdalglobalhealth.com/product/preemienatalie/

Micro-Preemie Baby Manikin

- 22-23 week preterm baby, ~ 500 grams, 24cm
- nasal and oral access, ventilation, tension pneumothorax function, umbilical cord access
- chest IV
- silicone skin

Source: https://www.lifecastbodysim.com/micro-preemie-manikin

Conclusions/action items:

There are a couple preterm baby manikins on the market but most are preterm baby's >25 weeks. The manikin closest to what we are designing is the Micro-Preemie Baby Manikin by Lifecast Body Simulation and there isn't much information about it online. Additionally, it doesn't seem like it is currently being sold or used.

10/11 Iowa Group Design

EMMA LU - Oct 12, 2023, 2:28 PM CDT

Title: Iowa Group Design

Date: 10/11

Content by: Emma Lu

Present: n/a

Goals: understand Iowa group's design and to know how we will incorporate parts from their project into our manikin

Content:

- used Ecoflex 00-30 for the manikin
  - chosen from a selection of Ecoflex 00-20, Ecoflex 00-30, Ecoflex 00-35, Dragon Skin 10 Fast, and Dragon Skin FX Pro
- Ecoflex 00-30 protocol is included in the drive
- umbilical cord and lungs were from previous design groups

Conclusions/action items:

9/15/2023-Neonatal Airway Management

Jensen WEIK - Sep 18, 2023, 1:47 PM CDT

Title: Neonatal Airway Management

Date: 9/15/23

Content by: Jensen

Content:

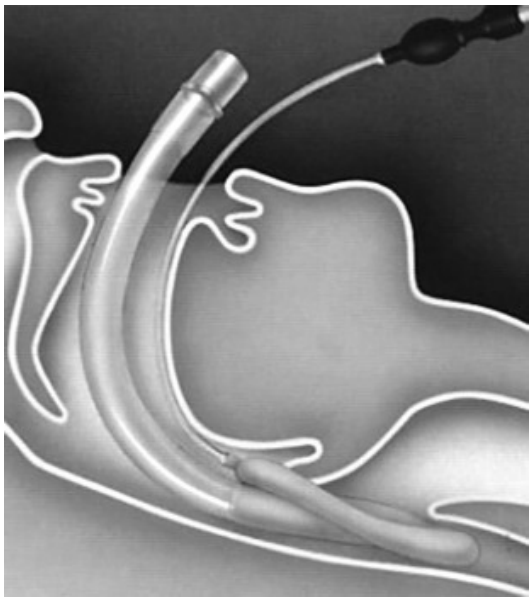
Key Anatomical Differences:

Table 1
Key anatomic aspects of the neonate versus the adult airway

1. Proportionately larger skull to body and larger cranial vault to face ratios push the head and neck into flexion (Fig. 1)
2. The tongue is proportionately larger relative the oral cavity and occupies more space posteriorly into hypopharynx
3. The epiglottis is angulated over the laryngeal inlet and onto the laryngeal inlet axis (Fig. 2)
4. The epiglottis is proportionately longer and shaped as a clockwise rotated 'C', inverted 'U' or omega (Ω) (see Fig. 2)
5. The laryngeal inlet axis is angulated anteriorly such that it is directed into the base of tongue
6. The larynx is more superior with the relative position of vocal cords at C3
7. The narrowest laryngeal portion is the cricoid cartilage
8. The aryepiglottic folds are closer to midline and may obscure the vocal cords (see Fig. 2)
9. The arytenoids together with the corniculate and cuneiform cartilages are proportionally larger compared with the size of the laryngeal inlet
10. The vocal cords are inferiorly inserted at the anterior aspect of the larynx, which results in the anterior commissure angling away from the laryngeal inlet
11. Pliable laryngeal cartilages are more prone to compression with external

Pleural pressure in neonates are at atmospheric levels whereas older adults are around -5 cm H2O.

Lung volumes are small in relation to body size along with high resistance of the airway.


this image shows the correct placement of rescue airway devices

For neonates within the weight of 1.5-3.0 kg, a 3.0 mm endotracheal tube size is normally used. For even smaller neonates, a 2.5mm tube is chosen.

ClinicalKey. https://www.clinicalkey.com/#!/content/playContent/1-s2.0-S009551081930096X?scrollTo=%23tbl1. Accessed 15 Sept. 2023.

Conclusions/action items: Use this information for modeling for intubation.

9/18/2023 Background Intubation Knowledge

Jensen WEIK - Sep 18, 2023, 5:04 PM CDT

Title: Background Intubation Knowledge

Date: 9/18/2023

Content by: Jensen

Content:

- neonates born at 22 weeks' gestation have a survival rating of 25-50%
- most studies do not include infants this young because of nCPAP failure rates of 93%
- almost every newborn at 22-23 weeks gestation requires intubation within the first 2 hours of life
- infants at 22-24 gestational age have lung fuction around 24%FVC (forced vital capacity) and 44% for Forced Expiratory Volume meaning a 5-10 times higher risk for lung function being in the <5 percentile

Sources:

Norman, Mikael, Baldvin Jonsson, Linda Wallström, and Richard Sindelar. “Respiratory Support of Infants Born at 22–24 Weeks of Gestational Age.” *Seminars in Fetal and Neonatal Medicine*, The micropreemie: Advances and challenges in treating the smallest newborn infants Part I, 27, no. 2 (April 1, 2022): 101328. https://doi.org/10.1016/j.siny.2022.101328.

Conclusions/action items: This background knowledge is important for the problem statement on the importance of intubation practice and neonatal manikin demand.

9/19/23 Neonatal Thoracic Cavity

Jensen WEIK - Sep 19, 2023, 6:17 PM CDT

Title: Neonatal Thoracic Cavity

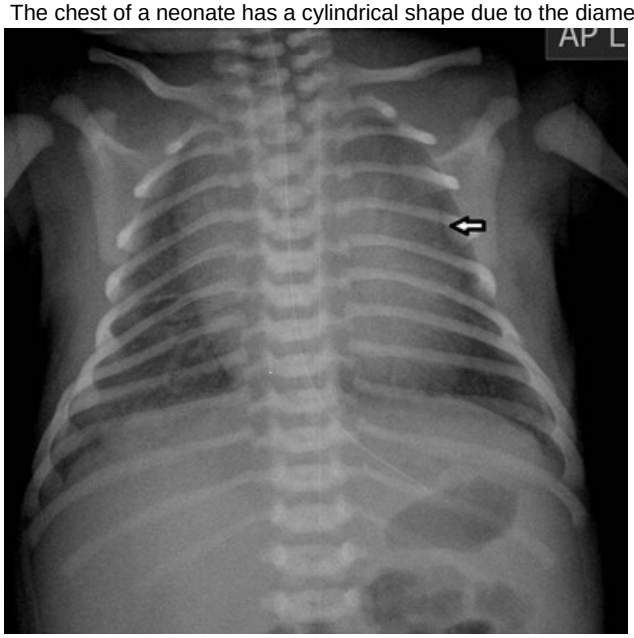
Date: 9/19/2023

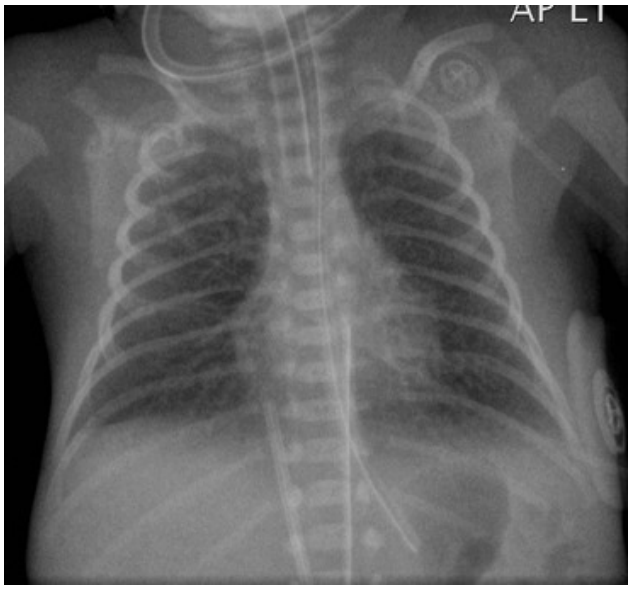
Content by: Jensen

Content:

AP = anteroposterior

- The chest of a neonate has a cylindrical shape due to the diameter of the AP being almost the same size as the transverse diameter

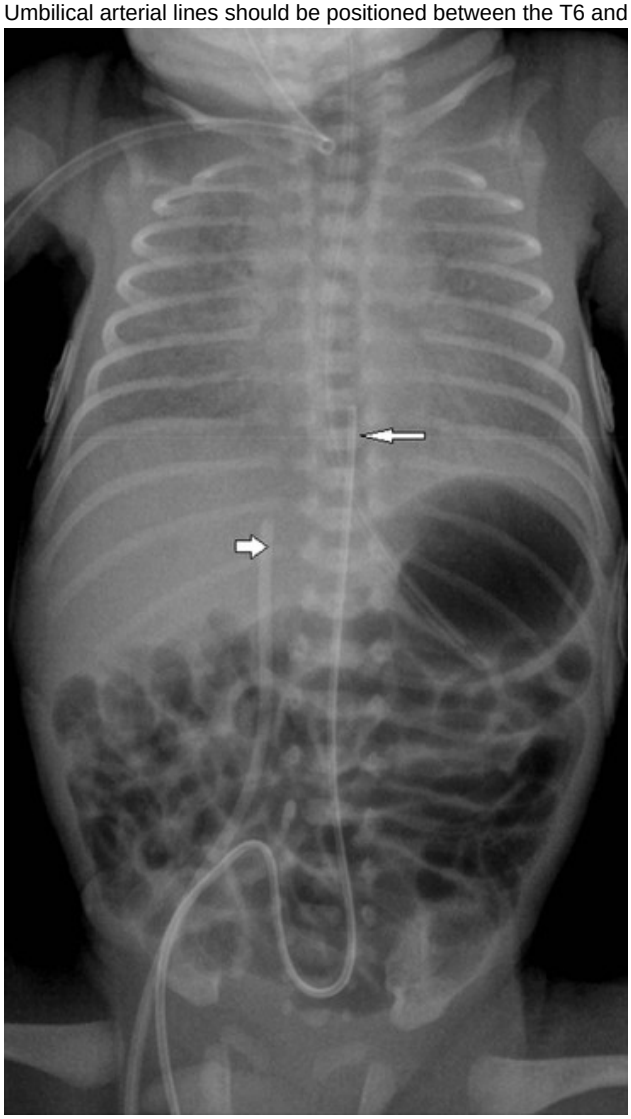




This image is taken from a neonate born at 24 weeks' gestation. The structure of the ribs are in a conical shape with thin, flexible ribs.

- The thoracic cavity should dome due to the diaphragm at the 8th-10th posterior ribs during appropriate airway pressure

- Umbilical arterial lines should be positioned between the T6 and T9 or inferior to L3 vertebrae



Source Website: The Neonatal and Paediatric Chest | Radiology Key

Conclusions/action items: These images will be helpful when designing the thoracic cavity of the manikin as they show the proper anatomy.

9/22/2023 Intravenous (IV) Lines and Tubes

Jensen WEIK - Sep 22, 2023, 12:17 PM CDT

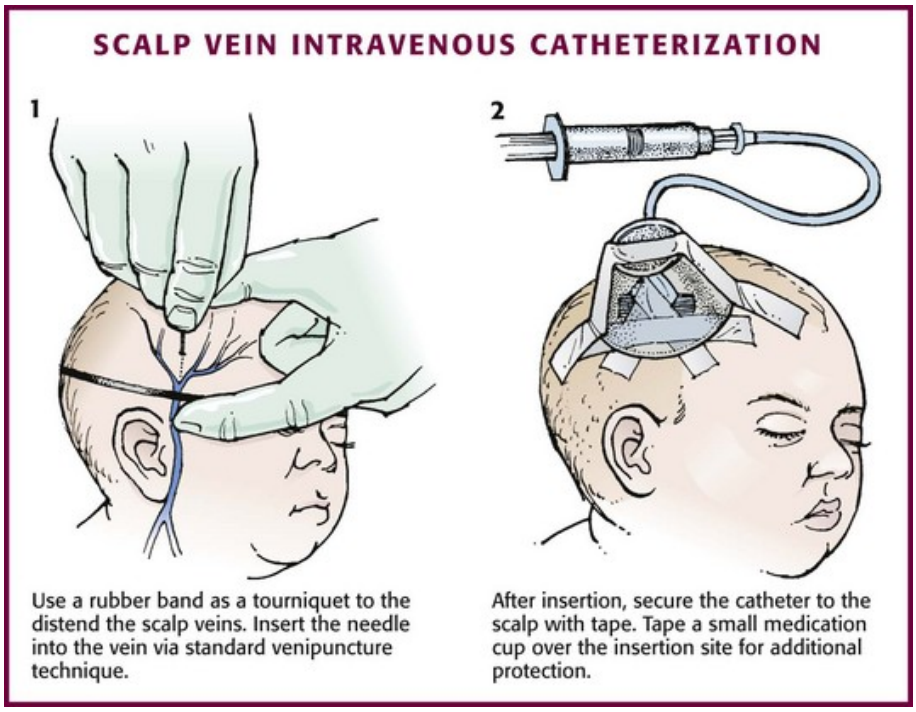
Title: Intravenous (IV) Lines and Tubes

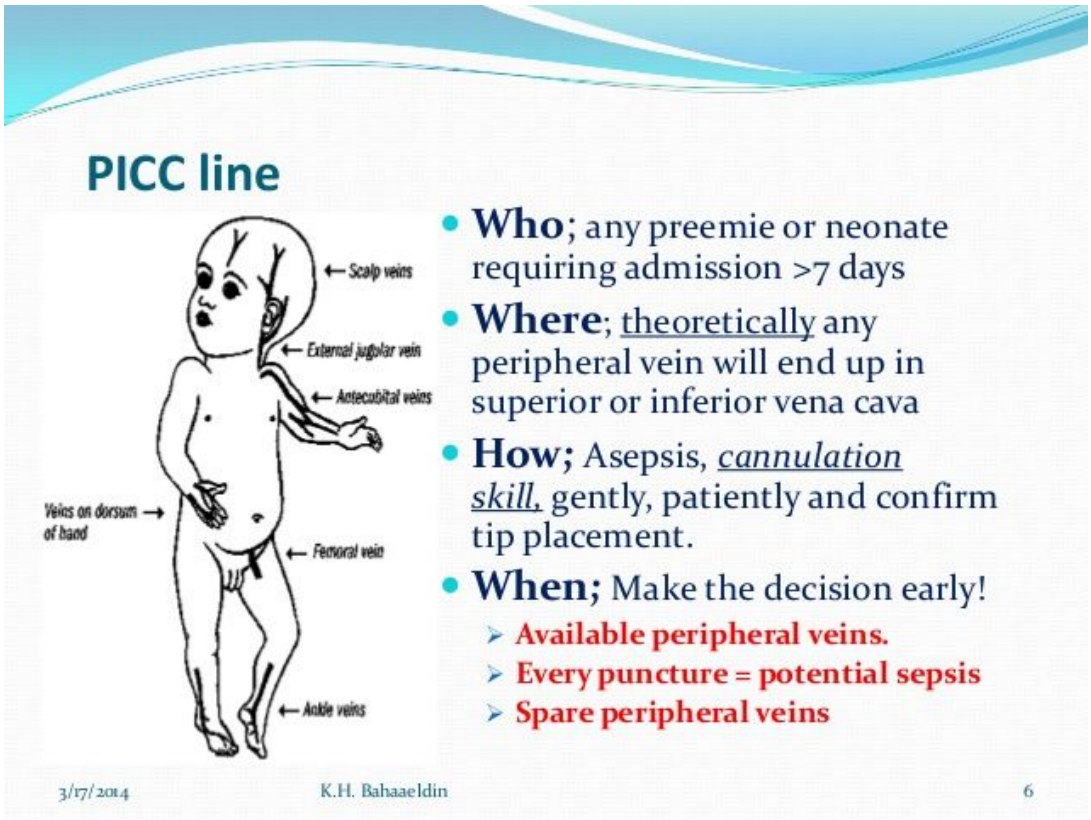
Date: 9/22/2023

Content by: Jensen

Content:

- most preterm babies require fluids through their veins due to not being able to handle feedings or medicines
- access for IV lines may be in veins in hand, foot, and scalp
- umbilical catheters (UVC or UAC) are inserted into the short stump of the umbilical cord
- a catheter called a percutaneous line may also be placed in a deep vein or artery in the neonate's arm or leg instead of hand or scalp for longer term needs





Source:

Intravenous (IV) Line and Tubes, Stanford Medicine Children's Health, www.stanfordchildrens.org/en/topic/default?id=intravenous-line-and-tubes-90-P02378. Accessed 22 Sept. 2023.

Conclusions/action items: The information about the locations for IV and umbilical access for preterm babies is important for simulating intubation practices on the manikin. These locations will be considered for the manikin's anatomy.

9/28/23 Artificial Skin

Jensen WEIK - Sep 28, 2023, 1:47 PM CDT

Title: Artificial Skin

Date: 9/28/23

Content by: Jensen

Content:

- artificial skin has 3 layers: sensing, perception, and encapsulation
   Details are in the caption following the image
- artificial skin can provide feedback and sensing technologies
- silicon wafers have been being used for artificial skin under a thickness ~150 micrometers
- Complementary metal-oxide-semiconductor (CMOS) based processing units are microchips implanted for computation and communiciation
- artificial skin must be flexible and stretchable, but still tough, to withstand twisting, bending, and stretching that human skin can do
- sensory data can be sent to exterior systems wirelessly
   Details are in the caption following the image
- This is the schematic of ultrathin chips used in "flexible hybrid electronics"
- to monitor physiological signals, the system must have a Young modulus of 0.1-2 MPa (compared to human skin at 5kPa-140MPa) and stretch 30-70% compared to human skin-- for our purposes, we would probably err on the lower side for the softer, more fragile neonatal skin

Conclusions/action items: Artificial skin may be beneficial for future groups to use when advancing this product as it cold relay feedback to the user about pressure and sensation that is vital during resuscitation. However, this may be out of scope for the current project as we do not even have a working manikin at this point.

Website: Artificial Skin Perception - Wang - 2021 - Advanced Materials - Wiley Online Library

9/29/23 Humanlike Robotic Skin

Jensen WEIK - Sep 29, 2023, 11:33 AM CDT

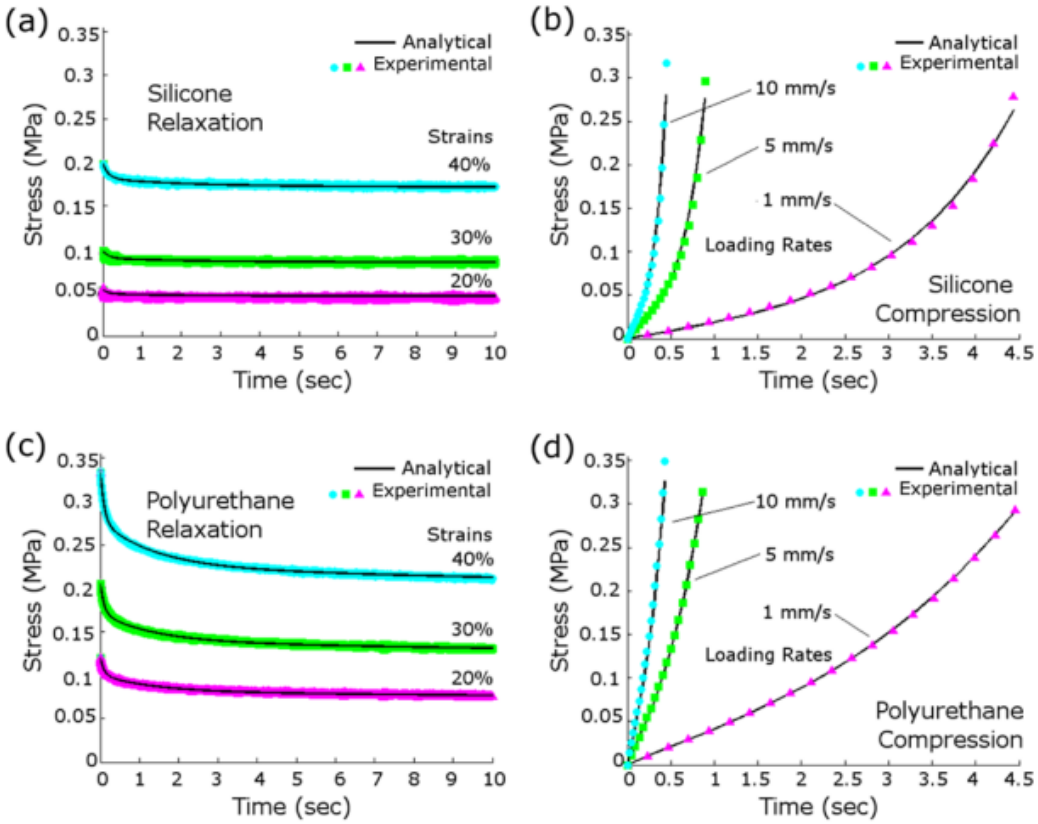
Title: Humanlike Robotic Skin

Date: 9/29/23

Content by: Jensen

Content:

- skin compliance is the ability for the skin to conform to an object which is critical for recognizing contact
- in this article, two materials were used and compared to replicate skin: silicone (GLS 40, Prochima, s.n.c., Italy) and polyurethane (Poly74-45, Polytek Devt. Corp, USA) and silicone was proven to be the least resistant to stres



- fingertip prototypes were created with both of the materials glued to a rigid base material of thermoplastic which had a Young's modulus of 775MPa
- In both materials, the skin did not conform as much as a real human finger.

Conclusions/action items: The materials of silicone or polyurethane could potentially be considered for the skin of our product. However, more testing must be done to ensure that the fragility of a neonate's skin is reflected accurately.

Source: Cabibihan, JJ., Pattofatto, S., Jomâa, M. *et al.* Towards Humanlike Social Touch for Sociable Robotics and Prosthetics: Comparisons on the Compliance, Conformance and Hysteresis of Synthetic and Human Fingertip Skins. *Int J of Soc Robotics* 1, 29–40 (2009). https://doi-org.ezproxy.library.wisc.edu/10.1007/s12369-008-0008-9

9/29/23 Materials Used to Replicate Human Skin

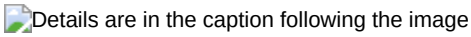
Jensen WEIK - Sep 29, 2023, 12:00 PM CDT

Title: Materials Used to Replicate Human Skin

Date: 9/29/23

Content by: Jensen

Content:


Details are in the caption following the image

- human skin has an epidermis of about 20-150 micrometers (newborn skin is most likely on the smaller scale)
- human skin depends on age, gender, body region, fitness, health, skin temperature, sweating, hydration, and more
- skin models can be made consisting of liquid suspensions, gelatinous substances, elastomers, resins, metals, and other engineered materials
- gelatinous substances are used when controlling properties of elasticity, hardness, and surface properties are related (this would be very important for our group)
- gelatinous substances used for skin are often materials of gelatine, agar and agarose, collagens, and polyvinyl gels
- water-gelatine can simulate the density and viscosity of human tissue, but it does not completely replicate skin tissue as it has low kinetic energies
- water-gelatine is best used for cavity formation (this could be useful for our thoracic cavity of the manakin but not the complete outer shell)
- agar replicates skin very well, but has a limited lifespan and does not withstand most contact (not useful for our purposes)
- polyvinyl alcohol is a gel that can accurately simulate tissue for studies and an advantage is that the stiffness can be changed by the amount of freeze/thaw cycles
- elastomers are rubber-like and have similar properties to human skin
- Silicones and polyurethane are usually the most common materials used to simulate human skin
- silicones are durable over long time periods and can be molded to fit anatomical shapes
- polyurethane better represents dry skin (this is not what we would need for our neonate manakin)
  
  Details are in the caption following the image

Conclusions/action items: Gelatinous properties probably best represent the skin since it can resemble the elasticity and texture. Silicones should be tested for our skin material. In addition, gelatine could be used for the thoracic cavity as it resembles human tissue during compression.

Source: Dąbrowska, A.K., Rotaru, G.-.-M., Derler, S., Spano, F., Camenzind, M., Annaheim, S., Stämpfli, R., Schmid, M. and Rossi, R.M. (2016), Materials used to simulate physical properties of human skin. Skin Res Technol, 22: 3-14. https://doi.org/10.1111/srt.12235

11/20/2023 Neonate's Arm Length

Jensen WEIK - Nov 20, 2023, 12:37 PM CST

Title: 22-23 Week Old Infant Arm Length

Date: 11/20/2023

Content by: Jensen

Present: Jensen and Claire

Goals: Find the length of a neonate's arm for creating the limb mold.

Content:

- At 20 weeks, a neonate's humerus is approximately 3.4-4.6 cm long
- A full term neonate has a humerus of 6-7.4 cm
- We will use the upper interval of 4.6 cm for a 22-23 week old infant and double the value for the length of the full arm

Conclusions/action items: We will make the mold of the arm 9 cm, which we have determined is proportionate to the length of the legs at 11 cm.

Source: What is Humerus Length in Pregnancy – Fetal Growth

SimNewB

Jensen WEIK - Sep 19, 2023, 4:52 PM CDT

Title: SimNewB

Date: 9/18/23

Content by: Jensen

Goals: Review competing designs to find similarities in PDS

Content:

- Chest compression simulation
- Lack of realism in intubation
- Umbilical line is important for fluid resuscitation
- Replicates a full-term newborn within the first minutes of life
- Is manufactured a variety of skin tones (something our client would eventually prefer)
- limbs appear to be detachable from the main thoracic cavity and head

Conclusions/action items: This model is best for resembling resuscitation, but not the proper size. The overall assembly of the manikin with removable limbs is a potential due to our project already having an existing thoracic cavity.

General Review

Jensen WEIK - Sep 18, 2023, 1:47 PM CDT

Title: General Review of Previous Semester's Project

Date: 9/15/23

Content by: Jensen

Goals: Review previous semester's work to understand the baseline for where we begin our project.

Content:

Ideas for Project:

- Expand mold to include legs and arms
- Include an accurate rib cage by 3D printing skeletal system
- Review idea of a zipper system
- Test materials PDMS will properly cure on
- Test reducing the gelatinous percent to 10-15% as per previous group's suggestion using an MTS Machine

References: Spring 23 Final Report

Action items: Set up client meeting.

9/19/23 Preliminary Sketches

Jensen WEIK - Sep 19, 2023, 7:10 PM CDT

Title: Preliminary Sketches

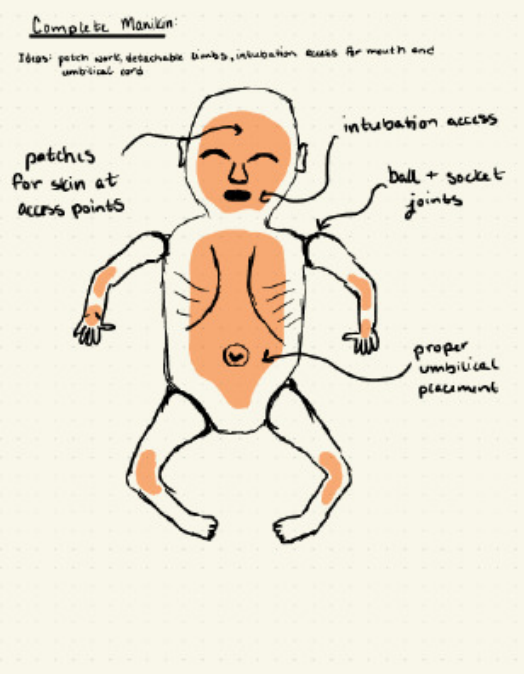
Date: 9/19/23

Content:

Check linked file. Includes product descriptions.

Conclusions/action items: Meet as a team to discuss preliminary ideas and where the project will continue. My ideas stem off from what has begun in other semesters.

Jensen WEIK - Sep 19, 2023, 7:12 PM CDT



Download

Manikin_Sketches_589_.pdf (1.56 MB)

10/5/23 PVC

Jensen WEIK - Oct 05, 2023, 1:17 PM CDT

Title: PVC

Date: 10/5/23

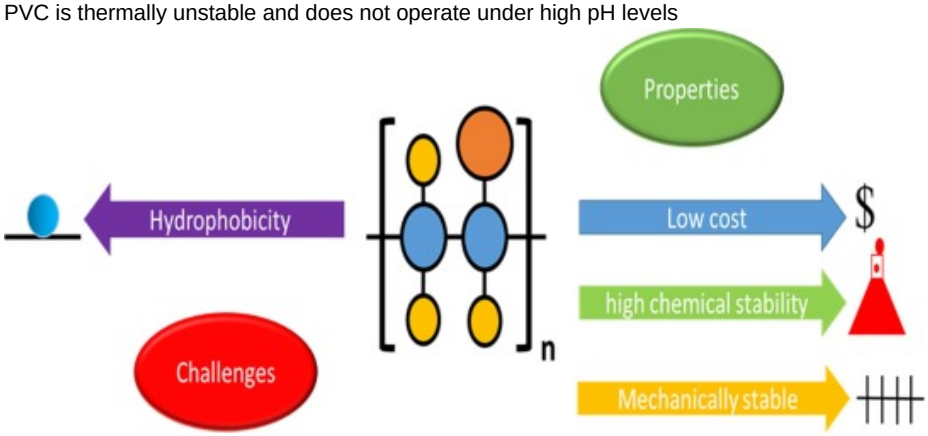
Content by: Jensen

Content:

- Polyvinyl chloride (PVC) is a synthetic plastic polymer
- appears in both rigid and flexible forms depending on the additives
- can withstand corrosive environments
- chemical stability
- ranges in thickness and color options
- longevity of over 20 years

Website: PVC Machining, Fabricating & Distribution | Emco Industrial Plastics (emcoplastics.com)

- PVC is thermally unstable and does not operate under high pH levels



- PVC-P is the flexible kind of PVC made with additives

Website: Polyvinyl chloride-based membranes: A review on fabrication techniques, applications and future perspectives - ScienceDirect

Conclusions/action items: PVC is a versatile material that could be used for our skin. I need to do future research on specific additives to make the PVC the correct material. PVC has a simple ease of use for molding in which it can be rolled or formed to a shape. This is very beneficial for formulating the manakin.

10/5/2023 Iowa Group Additives

Jensen WEIK - Oct 05, 2023, 6:20 PM CDT

Title: Iowa Group Additives

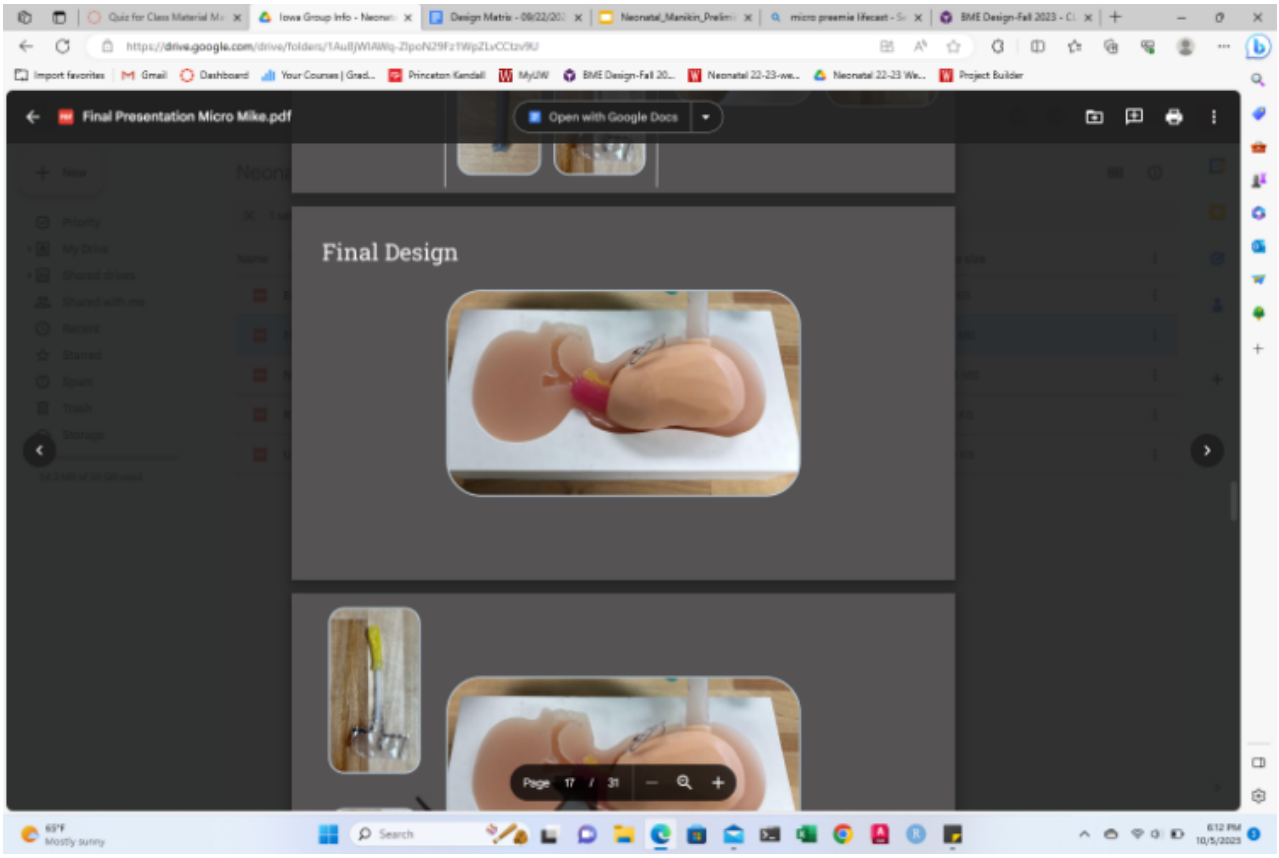
Date: 10/5/23

Content by: Jensen

Present: Team

Content:

When reviewing the Iowa Group's Team, I noticed that their model has a very heavy, dense head due to being completely filled with the body material. My idea instead is to use their black mold for the interior cavities but expand it to include creating a cavity for the head for future electronics.



Conclusions/action items: The files that the Iowa Group had for their interior mold could potentially be used if we could locate them in order to create these internal cavities.

10/11/2023 Skin Attachment Ideas

Jensen WEIK - Oct 11, 2023, 10:11 AM CDT

Title: Skin Attachment Ideas

Date: 10/11/2023

Content by: Jensen (ideas have been discussed as a team)

Content: Ideas for Skin Attachment/ Fabrication

1. Sleeve as in Laerdal's Premature Anne

- this method proposes difficulty with curing the mold into the shape of the body but with the ability to be removable
- we would have to make two molds/ inserts and the skin should be too fragile that conforming around the mold would not be feasible as tears would occur
- does provide the ability for access into the thoracic cavity (through a zipper) in order to adjust or replace the components for resuscitation

2. Curing skin on the surface of the mold and placing the body material on top

- skin is cured directly to body material (ecoflex that Iowa group used)
- method would have uneven thickness of skin because liquid would settle in lowest point

3. Painting skin material on mold or body material

- even coating of skin material
- can control thickness
- material can be coated directly on body material

Conclusions/action items: The team will most likely progress with painting the skin material in order to control the thickiness and distribution even though this will decrease the ease of fabrication.

10/16/23 Material Meeting

Jensen WEIK - Oct 16, 2023, 5:11 PM CDT

Title: Material Meeting

Date: 10/16/23

Content by: Jensen

Present: Jodi

Goals: Meet with a professional in the Makerspace to discuss additives and fabrication protocol for PVC.

Content: Unfortunately, no one at the Makerspace has experience with that material. Jodi and I looked into the Composites Lab in ECB, but that requires extensive training, and a Soft Materials Lab.

Conclusions/action items: Jodi or I will message someone from either of the labs to see if they have any experience with PVC. If we can't find anyone with any advice, we may have to proceed with PDMS as it was close in the design matrix and team members have more experience with it.

meeting notes (research)

MAYA NORNBERG - Sep 15, 2023, 12:48 PM CDT

9/15

Content by: Maya Nornberg

Current plan is to split research into 3 main roles: skin, 3D print of mold, breathing mechanics.

Meeting with Dr. Kreeger. Discussed game plan and how to potentially reach the client. PDS is due next week and we will probably just use the information from previous semesters.

After further consideration, we will focus on the skin and mold first, and then move on to the mechanics/inside features.

For next week, we will each do some research in our subsection and make around 2 design ideas and sketches for the design matrix. We will each think of one plan for the larger project and one for our respective subsections.

Primary skin research

MAYA NORNBERG - Oct 05, 2023, 6:02 PM CDT

Title: Primary Skin Research

Date: 9/15/2023

Content by: Maya Nornberg

Present: All group

Goals: Begin research on my subsection, how to curate skin that looks and acts like a 22-23 week only premature infants'.

Content:

Started looking through UW Madison libraries, but need more practice to find sources. Will focus on research this weekend, the focus on PDS after client meeting on 9/18.

Conclusions/action items:

MAYA NORNBERG - Sep 19, 2023, 2:38 PM CDT

Title: Primary Skin Research

Date: 9/19/2023

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Begin research on my subsection, how to curate skin that looks and acts like a 22-23 week only premature infants'.

Content: Web link- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4593874/

- Impaired skin function makes the skin vulnerable to chemical damage, infections, diseases, and this compromises the health of the infant. The younger the infant when born, the less the skin is developed and able to protect the infant.

- The development of the skin barrier increases with gestational age, and the epidermal maturation is complete at 34 weeks of age.

- important functions of skin: protection against UV, invasion of pathogens, irregular body temperature and sensory protection.

- since skin maturation usually begins right after birth, the process begins 2-3 weeks after premature infant birth.

- Skin maturation starts during embryogenesis through intercellular and intracellular signals between different tissue layers.

- Skin homeostasis depends on the stable cohesion between the epidermis and the dermis, which is responsible for the stability.

- From the time of delivery, newborns are exposed for the first time to different types of bacteria from a variety of sources.

- Physiology

    - Perspiration
        - In human perspiration or sweating, we can measure the lactate and urea, which are the principal sweat constituents.
        - In a premature neonate, the sweat glands are not completely formed and the secretory coils of the glandular segment and the sweating response to external stimuli are limited.

    - Hydration
        - Skin is rough and dry at birth, but extremely hydrating in the first 30 days of life in newborns.

    - pH
        - Infant skin pH levels are higher than those of adult skin, newborn skin usually ranges from 6.34-7.5.
        - "The acid mantle is considered a mechanism for skin defense against infection, influencing the composition of cutaneous bacterial flora."

    - skin immune system
        - The skin is the first defense of the immune system through "pro- and anti-inflammatory cytokines and chemokines, lipid and protein constituents, antigen-presenting cells, and mechanical barrier function."
        - The rich network of skin-associated immune cells governs the defense against pathogenic microorganisms, responds to environmental changes, and performs several homeostatic functions.
        - The human skin is colonized by a variety of microorganisms, most of which are innocuous or offer a benefit to their host.

Conclusions/action items: This paper does provide useful information about newborn infant skin significance, complications, and mechanism, but it does not focus on 22-23 week old or neonatal infants.

MAYA NORNBERG - Oct 05, 2023, 6:04 PM CDT

Title: Skin Materials Research- Mechanical modeling and characterization of human skin: A review

Date: 9/27/2023

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Continue research on my subsection, how to curate skin that looks and acts like a 22-23 week only premature infants'.

Content: **https://www.sciencedirect.com/science/article/abs/pii/S0021929021006217**

- Efforts on modeling skin using linear, nonlinear, viscoelastic, and anisotropic materials.

- The mechanical properties of human skin such as Young's and shear moduli are important for many applications, including medical science, engineering, artificial skin devices, wearable sensors, biomimetics and cosmetic.

Structure: Three different layers, including epidermis, dermis, and hypodermis.

Methods for Characterization: indentation, torsion, suction, tension, and dynamic tests as well as optical methods. For numerical modeling and simulation, skin thickness is an important parameter.

Mechanical behavior: Human skin is an anisotropic, nonlinear, and viscoelastic material. These regions show the linear and nonlinear behavior of skin under different deformations. For small deformation, the human skin acts as a linear material, and the fibers are in alignment.

Conclusions/action items: Honestly this is really useful information for thinking about how we can measure some of our desired properties for our skin and mold. Also, obviously we aren't going to build a skin that has 3 layers, but it is important to think about because even if we want our skin to be sticky and easy to tear, it should still hypothetically be three layers thick/deep and have different parts that provide different properties to the layers.

MAYA NORNBERG - Oct 05, 2023, 6:25 PM CDT

Title: PVC Safety

Date: 10/5/2023

Content by: Maya Nornberg

Present: All group

Goals: Jodi, Jensen, Maya discussing skin materials and some concerns and thoughts about using Polyvinyl Chloride for our skin material.

Content: **https://pvc.org/about-pvc/pvcs-physical-properties/**

Can add plasticizers to PVC which is a reason to use it over PDMS or hand-painted silicone (and it's more realistic). But, we are worried PVC is going to be too strong and it won't tear, even if it is really thin. For example, PVC can be used for IV bags which are really thin and hard to puncture.

Some research about PVC properties:

Durability:

- Under normal conditions of use, the most influential factor in affecting the durability of a material is its ability to resist oxidation by atmospheric oxygen. PVC is highly resistant to oxidative reactions, therefore maintaining its performance for a long time.

Oil/chemical resistance:

- PVC is resistant to acid, alkali and almost all inorganic chemicals.

Mechanical stability:

- PVC is a chemically stable material that shows little change in molecular structure or mechanical strength.

Mouldability:

- PVC also exhibits excellent on-site workability, as well as secondary processability in bending fabrication, welding, high-frequency bonding and vacuum forming. Paste resin processing such as slush moulding, screen printing and coating are convenient processing techniques that are feasible only with PVC.

Conclusions/action items: PVC has a lot of benefits and good attributes that make it a promising material to work with. We will do our samples in little petri dishes and try different amounts of PVC to see how tearable it is. Now that ECB is open, we will be able to use that wet lab to fabricate it. If we do not succeed, we will try PDMS, and if that doesn't work, we will resort to hand painted silicone.

basic initial research

Title: Primary Research- article title: An Immature Science: Intensive Care for Infants Born at ≤23 Weeks of Gestation

Date: 9/18/2023

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Conduct primary research on attributes and important topics in a 22-23 week old premature infant.

Content: Credible resource (NIH. gov)

- Today, the most premature infants cared for by neonatologists are born at 22-23 weeks of gestation, with many weighing less than a pound.

- Ethical issues can come up regarding whether to even provide intensive care at that age.

- "Although births at 22–23 weeks made up only 0.1% of the 3,791,712 live births in the US, they accounted for nearly 1 in 7 (2,985/21,498) liveborn infants who died in the first year of life."

- "The incidence of admission hypothermia is inversely proportional to gestational age, due, in part, to high evaporative losses from a larger surface area and less keratinized skin."

- Respiratory management of 22–23 week infants is complicated by small size of the mouth, nostrils, pharynx, larynx, and trachea in addition to physiologic immaturity.

  - 2.0-mm internal diameter endotracheal tubes are often necessary for tracheal intubation of these infants
  - Lung development is heterogeneous, resulting in areas of the lung apparently mature enough to support gas exchange in some infants born at 22 weeks of gestation.
  - Infants born at 22–23 weeks often require weeks or months of invasive or non-invasive respiratory support as the lungs develop.

- there is considerable experience to support applying a cautious approach to their skin care, particularly during the first weeks of life, avoiding as much as possible the application of tape and potential for absorption.

- At 22–23 weeks of gestation, the fetus consists predominantly of water and lean body mass with minimal fat mass

-Infants born at 22–23 weeks are also at increased risk of adverse neurodevelopmental outcomes.

- Several hospitals around the world now report high rates of survival (>50%) as early as 22 weeks of gestation, but data on long-term outcomes are limited.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8154715/#:~:text=Protection%20of%20the%20Immature%20Brain&text=Infants%20born%20at%2022%E2%80%9323%20weeks%20are%20al
(I will cite this ASAP, trying to figure out how.)

Conclusions/action items:

This study gives a brief overview of various topics relating to a 22-23 neonatal infant and the biggest challenges in caring for one. There is a lot of useful information about respiration, a little bi neonatal premature care.

Competing Designs Research

MAYA NORNBERG - Oct 05, 2023, 6:11 PM CDT

Title: 9/28/23

Date: Micro Preemie Manikin Research- Competing Design

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Research competing existing models and designs and discover new potential materials and information about our design.

Content: https://www.lifecastbodysim.com/micro-preemie-manikin

Brand: Lifecase

Name: Micro-Preemie Baby Manikin

Weight: 500 grams

Skin: Hand painted silicone

Includes: Nasal and Oral access, OP airways, intubation, accurate ventilation. Chest drain, needle decompression, umbilical cord access, nasogastric tube placement.

- micro preemies face long stays in the neonatal intensive care units (NICU) and although many extremely premature babies can mature with no long-term effects, most face severe health problems at birth.

Pictures:

Conclusions/action items:

The skin looks really realistic ad the size looks promising but we're wondering if the skin feels realistic and if the size of the limbs and body and head is realistic. Also, we have no information about the price and feasibility for reproducing this product and using it for medical use. While this may be a relevant prototype, there just isn't a lot of information about it in the internet leading us to believe that it is either in early development stages or not ready to be publicized.

MAYA NORNBERG - Oct 05, 2023, 6:14 PM CDT

Title: 9/28/23

Date: Continued Micro Preemie Manikin Research- Competing Design

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Research competing existing models and designs and discover new potential materials and information about our design.

Content: **https://www.worldpoint.com/micro-preemie-sim-lt-sk**

Brand**:** Life/form®

Name: Micro-Preemie Simulator

- 25 week neonate

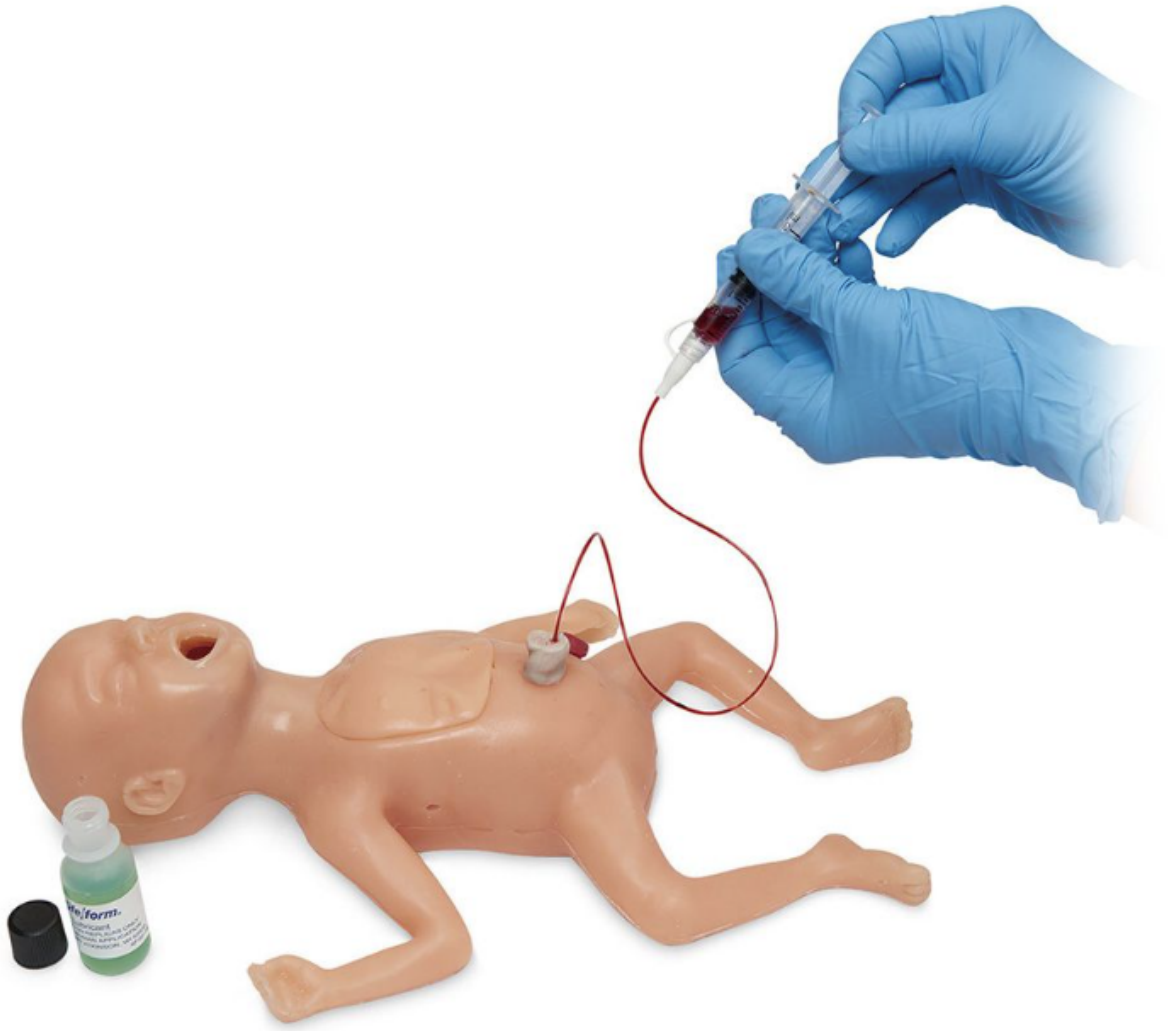
- Simple to use for simulation, requires no specialized equipment, and is compact and highly mobile

Includes: Airway, breathing, ventilation, chest tube, diaper (!) changing, GI, Neural tube defect, simulated breathing, "very soft and lifelike skin" (not sure what that means), suction, etc

Many pieces: Diaper, hat (?), umbilicus, chest blocks, 3 cc syringe, butterfly needle, lubricant, blood powder, bulb and tube assembly.

- The baby can be ventilated and will accept a functional ET tube, NG tube, umbilical catheter, and IV line, as well as a non-functional chest tube and stomas.

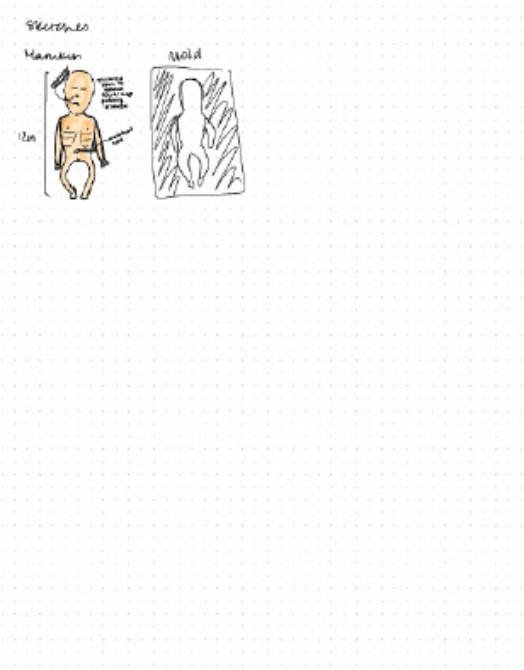
Conclusion/thoughts: This one looks significantly less realistic, leading me to believe that it feels and acts less realistically too. The prototype looks like its made of pure plastic, and it is not necessary to have the medical tools as an accessory before we have the skin accurate. Finally, we would have to investigate the size and proportions to know more about the accuracy.




Life/form
Lubricant

9/21/23 preliminary sketches

MAYA NORNBERG - Sep 28, 2023, 10:30 PM CDT



Download

Sketches.pdf (774 kB)

Fabrication/ Design Ideas

MAYA NORNBERG - Dec 01, 2023, 12:36 PM CST

Title: Fabrication and design ideas as we work through the project

Date: 12/1/23

Content by: Maya Nornberg

Present: Maya Nornberg

Goals: Document some individual design ideas and solutions to problems

Content:

For the chest and head cavities, it may be relevant to use the previous hard chest insert from the iowa project and saw it in half and remove the umbilical cord in order to use that as the chest ad head cavities when filling our mold with ecoflex.

Important to maintain the same amount of pigment for the ecoflex for filling the molds of the limbs and the chest and head.

For supplementary skin patches in case of rip it may be useful to create extra half baked PDMS patches that the doctors could apply on in case its necessary.

Conclusions/action items: Fabrication is currently undergoing and we are running into some problems that require creative thinking!

Week of 9/8

MAYA NORNBERG - Sep 14, 2023, 12:31 PM CDT

Week of 9/8

Personal Accomplishments:

1. Read and researched the previous projects progress; May 2023, Dec 2022 final projects. Fri 9/8 (1 hour), Mon 9/11 (30 mins.)
2. Checked in with group regarding expectations and responsibilities. Fri 9/8 (1 hour)
3. Reviewed project description. Wed 9/13, 20 mins.

Personal Goals:

1. Conduct additional, external research.
2. Aim to meet with client, prepare client questions.
3. Update LabArchives more regularly as I work on the project.

10/25/23 Order list

Title: Communication with group and angela gangstad about ordering materials

Date: 10/25/2023

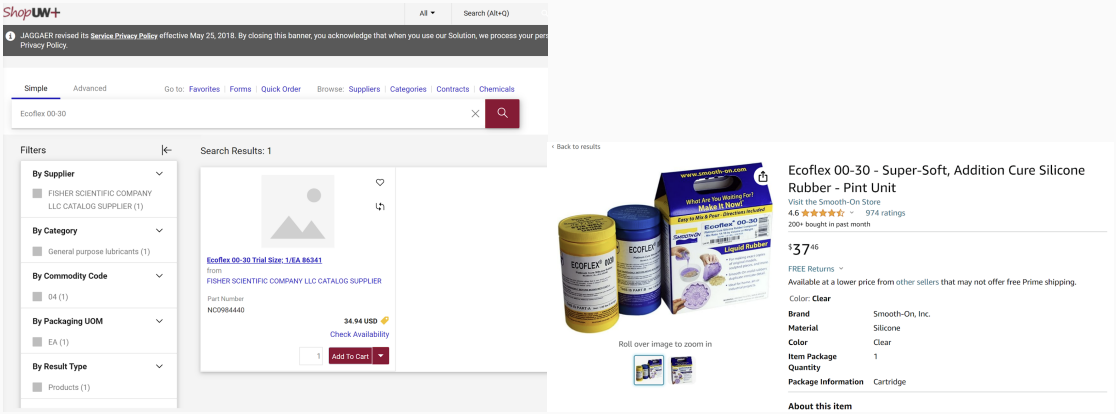
Content by: Maya Nornberg

Present: Maya, Claire, Emma

Goals: Email angela for ordering materials, discuss maerials with group

Content:

1. **Ecoflex 00-30**
- This item will be used to fill the manikin mold, and make up the bulk of the manikin. One mold requires 180 grams of part A and 180 grams of part B (a molds.
- Order from Amazon: https://www.amazon.com/Ecoflex-00-30-Super-Platinum-Silicone/dp/B00CA5VY3U/ref=sr_1_1_sspa?crid=3QX7CD7KYVMRW&30&qid=1698173187&sprefix=ecoflex%2B00-30%2Caps%2C243&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1
- ShopUW only has the trial size available, and we need around 500 grams.

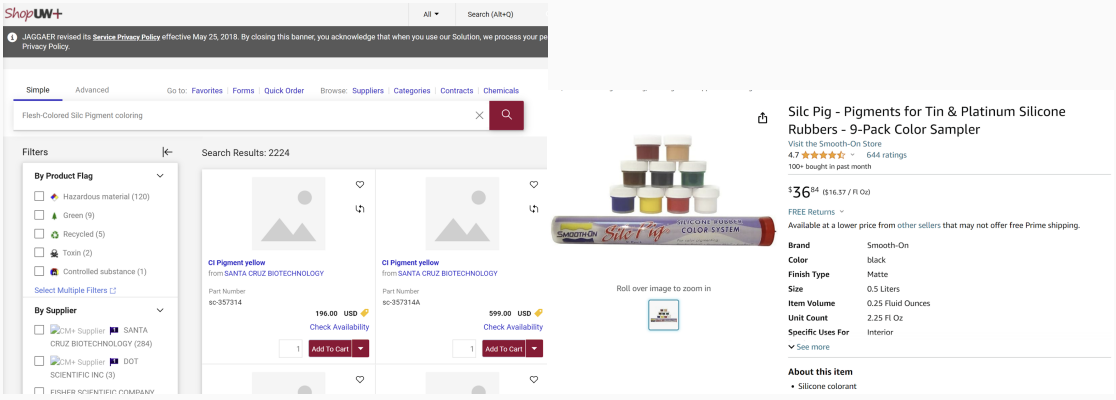


2. **Flesh-Colored Silicone Pigment Coloring**

2. ○ This item will be used to color the Ecoflex of the mold to make the manikin more life-like.

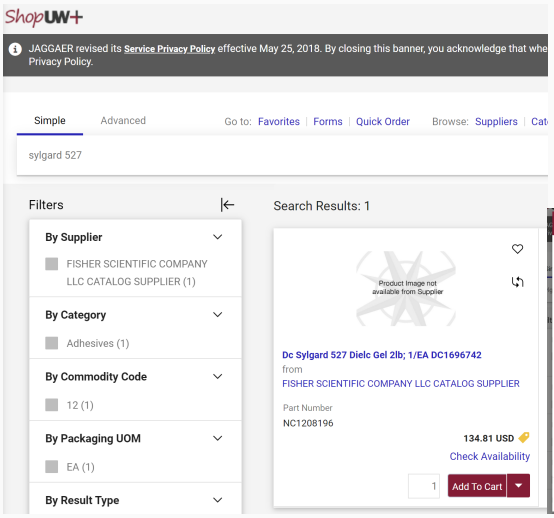
2. ○ Order from Amazon: https://www.amazon.com/Silc-Pig-Silicone-Pigment-9-Pack-Sampler/dp/B005ZH0SFU/ref=asc_df_B005ZH0SFU/?tag=hyp20&linkCode=df0&hvadid=198100706044&hvpos=&hvnetw=g&hvrand=7755423191011702042&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcm319559634389&psc=1

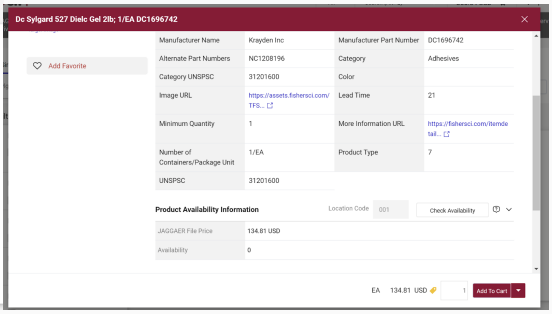
2. ○ ShopUW does not have silicone pigmentation kits.

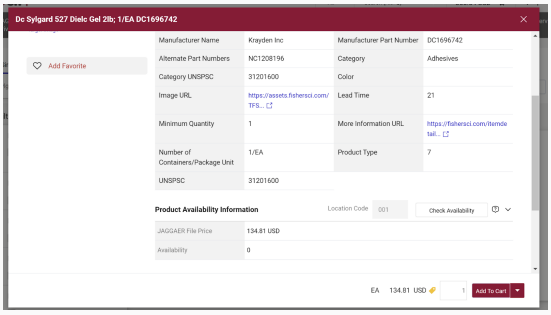


Sylgard 527

- This item will be used to fabricate the life-like skin for the manikin
- Order from Amazon: https://www.amazon.com/Dow-Corning-Silicone-Dielectric-Encapsulant/dp/B0711LBBFG/ref=sr_1_1?crid=20D2PKPAWDZF2&keywords=Sylgard+527&qid=1698173882&s=hi&sprefix=sylgard+527%2Ctools%2C73&sr=1-1
- ShopUW does have this product however, upon checking for availability through ShopUW, there are no units available.



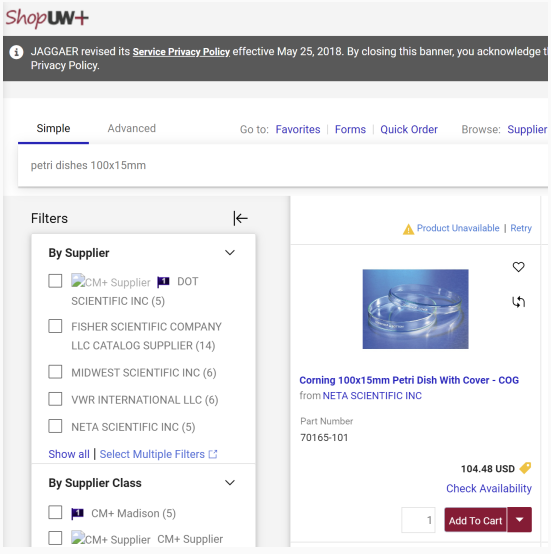


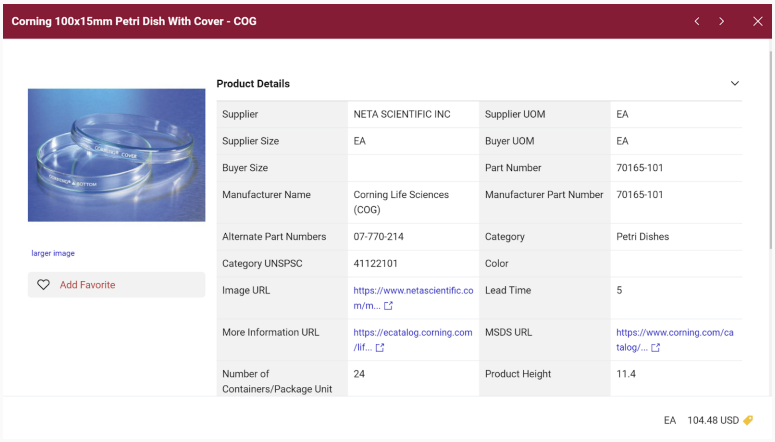


4.

Petri Dishes

- These will be used for the skin material fabrication and to hold samples of the skin to get feedback from healthcare professionals on the accuracy of tl
- Order from ShopUW:



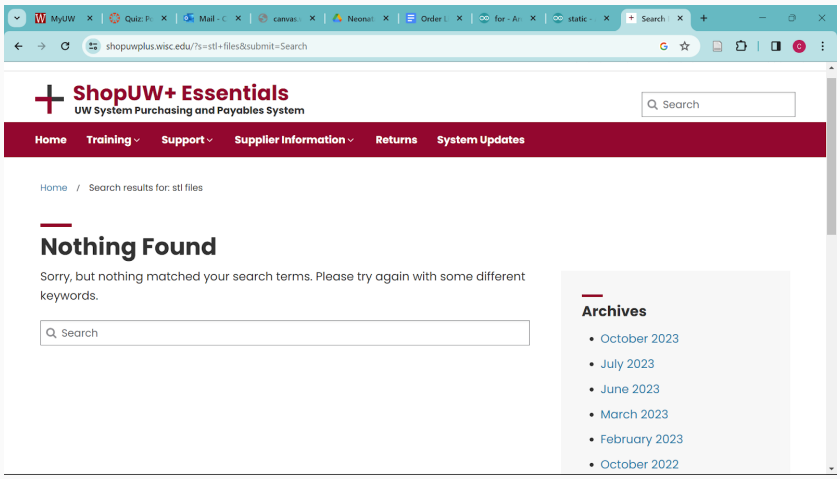


5.

Limb STL Files

- These will be used to make and 3D print molds of the addition of limbs.
- ShopUW does not have STL files for limbs.
- Purchase from this site:

https://www.cgtrader.com/3d-models/character/child/baby-t-pose-with-5-subdivision-levels-quad-mesh



Conclusions/action items: Angela was able to order these items and they are shipping now.

Communication with Angela Gangstad week of 10/28

MAYA NORNBERG - Nov 01, 2023, 12:24 PM CDT

Title: Communication with Angela Gangstad, updates

Date: 11/1

Content by: Maya Nornberg

Present: Maya, Angela Gangstad

Goals: Receive updates on the items we ordered as they have not yet been delivered, and on the STL limb files

Content: I had been emailing Angela since 10/30 since we have not yet received any of our ordered materials or the limb files we ordered and we wanted to start working with our materials in fabrication. Angela accidentally wrote down the wrong unit number in our orders on amazon, so some materials were unable to get delivered. She is now communicating with amazon and USPS to see if she can change the unit number and get those items redelivered. I also asked about the limb files that should be electronically delivered upon ordering. She said she received an email about the files about a day after she ordered them and didn't pay much attention to it thinking it was receipt, and the link in the email apparently expired. That being said, it seems the link might still be letting us access the files. The link is attached below:

cgtrader.com

login: agangstad@wisc.edu

pass: ElginProject1!

Conclusions/action items:

We are still trying to reach those materials and will have to put fabrication on hold for a little longer until that issue get fixed. It may be a good idea to have most regular communication with Angela as it seems she might have a lot on her plate and sending reminders/updates could help.

9/20/23 Premature Infant Statistics

Molly Wilhelmson - Sep 27, 2023, 2:49 PM CDT

Title: Premature Infant Statistics

Date: 9/20/2023

Content by: Molly

Content:

-According to the Centers for Disease Control and Prevention each year more than half a million babies are born prematurely in the US.(page 1) Up 20% from 1990.

-According to the CDC the US is ranked 28th among developed countries in infant mortality (page 5).

-Prematurity is a leading cause of infant mortality in the U.S. (page 8)

United States. Congress. House. Committee on Energy and Commerce. Subcommittee of Health. *Prematurity and infant mortality : what happens when babies are born too early? : hearing before the Subcommittee on Health of the Committee on Energy and Commerce, House of Representatives, One Hundred Eleventh Congress, second session, May 12, 2010*, Washington D.C. 2013

Conclusions/action items: This information provides reason for the project, can be used in PDS and abstract.

9/20/2023 Neonatal Skin

Molly Wilhelmson - Sep 27, 2023, 2:52 PM CDT

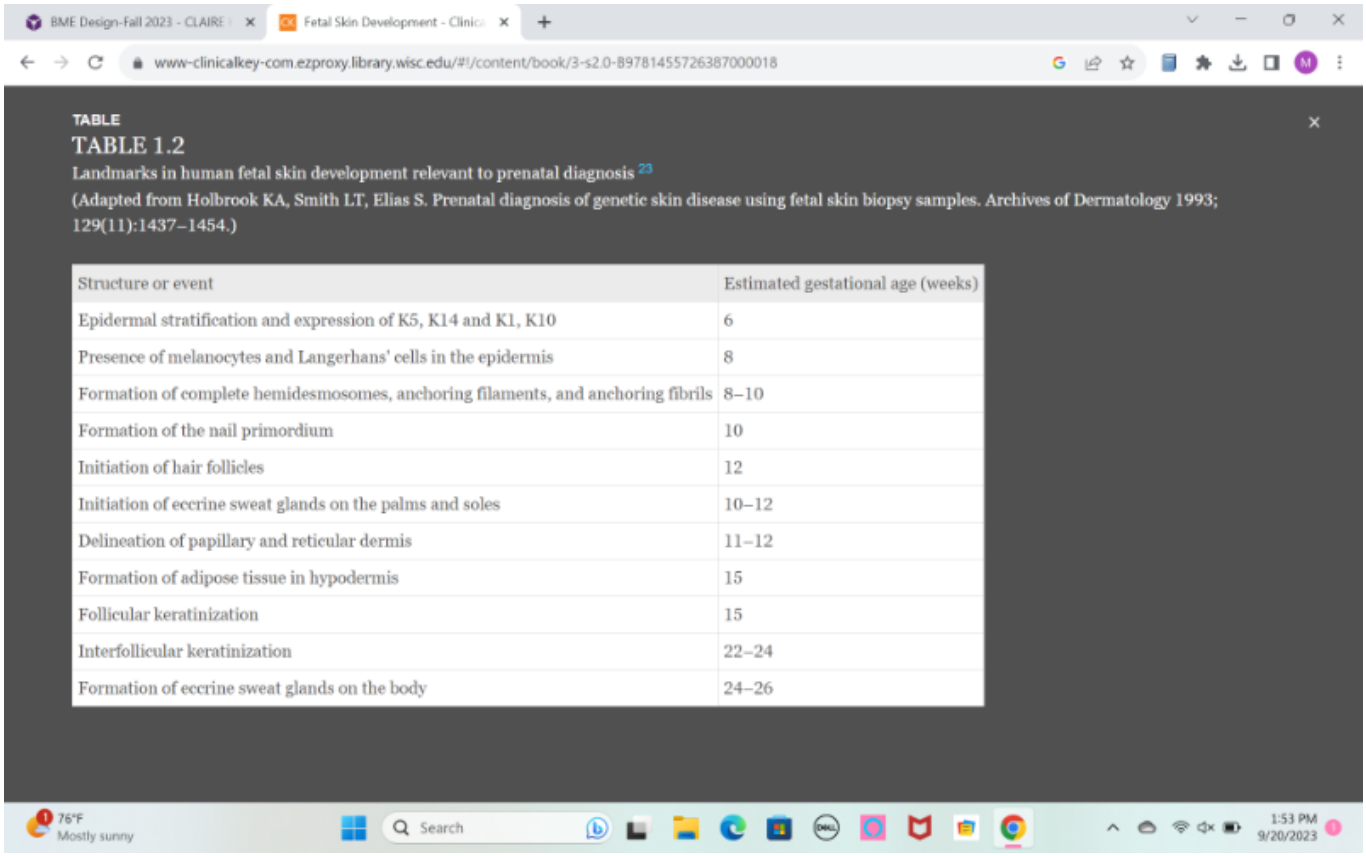
Title: Neonatal Skin

Date: 9/20/2023

Content by: Molly

Content:

-In humans the border of when the fetus could survive in the extrauterine environment is at 23-25 weeks of gestation, varying. This is the time of formation of the epidermal barrier, crucial to postnatal survival (Fetal Skin Development- Introduction).



(Fetal Skin Development-Timing of Ebryonic and Fetal Development)

Steven B. Hoath and Theodora Mauro, *Neonatal and Infant Dermatology Third Edition*, London: Elsevier Saunders 2015

Conclusion: This chart provides an idea of skin characteristics at 22-23 weeks of gestation and can be considered when choosing the material of the skin for the manikin.

9/20/2023 Neonatal Resuscitation

Molly Wilhelmson - Sep 20, 2023, 2:49 PM CDT

Title: Neonatal Resuscitation

Date: 9/20/23

Content by: Molly

Content:

Resuscitation techniques for newborns

-Obtain an open airway, neutral or slightly lifter head position, baby's eyes looking directly upward.

-Gentle suction of the mouth and nose may be necessary if the baby has difficulty breathing or is not breathing-start positive-pressure ventilations (includes the use of a mask administering 40-60 breaths per minute, chest rise is an indicator of adequate oxygen into lungs).

-If PPV does not suffice, a tracheal tube or laryngeal mask will be used.

Chest Compressions

-should be intubated if compressions are needed, compressions begin after ventilation is provided

-encircle the chest with both hands and compress middle of the sternum with both thumbs. Compressions should be 1/3 of the antero-posterior diameter. 90 compressions to 30 ventilations per minute.

-UVC inserted 3-4 cm for in-term newborns.

-In premature infants <32 weeks of gestation, goal is to maintain temperature of 36.5-37.5 degrees C which is 97.7-99.5 F.

-If baby is breathing but with difficulty, use pulse on right hand or wrist to assess the need for supplemental oxygen.

(Neonatal Resuscitation p 145-147)

Mary Alice Reinoehl, Kayla A. Seedial, and Gary M. Weiner, *Manual of Neonatal Respiratory Care, C*ham Switzerland 2022

Conclusions/action items:

This information will aid in the design of the mold, giving good descriptions of what Practitioners will need to practice while resuscitation.

9/27/2023 Ribcage and Thoracic Cavity Development

Molly Wilhelmson - Sep 27, 2023, 3:54 PM CDT

Title: Ribcage and Thoracic Cavity Development

Date: 9/27/23

Content by: Molly

Content:

The two ribcage regions- upper and lower- develop at different rates, but breathing movement begins at 10 weeks of gestation. Breathing movements are describes as "stirrings in the amniotic fluid and not air ventilation."

Lungs develop after the ribcage.

At the end of the embryonic state (10 weeks of gestation) ribs are formed, but there are no signs of ossification.

Okuno, Kasumi, et al. "Rib cage morphogenesis in the human embryo: A detailed three-dimensional analysis." *The Anatomical Record* 302.12 (2019): 2211-2223.

Lung Development

Canicular stage- mesenchyme thinning is the first step in formation of gas exchange regions.

Lung growth before birth is aided by fetal lung fluid (FLF)- produced in the lungs and leaves through the trachea. Fetal breathing movements maintain lung expansion and promote lung growth.

Neonates ability to receive oxygen delivery depends on partial pressure of oxygen in inspired air, ventilation and perfusion matching, hemoglobin concentration, cardiac output, and blood volume. This system can become stressed when adjusting to outside of the womb.

Lungs resist inflation using recoil, resistance and inertance.

Ventilators in clinical use include high-frequency ventilators and conventional ventilators. Standard modes of ventilation are intermittent mandatory ventilation(IMV), synchronized intermittent mandatory ventilation (SIMV), assist-control ventilation (AC), and pressure support ventilation (PSV). Extracorporeal life support (ECLS) is provided if ventilation methods cannot be used.

Infants born before 28 weeks of gestation are between the canicular and saccular phases when the air-blood barrier is thinning to the point where gas exchange is possible.

Ryan P. Davis, George B. Mychaliska, Neonatal pulmonary physiology, Seminars in Pediatric Surgery, Volume 22, Issue 4, 2013, Pages 179 184, ISSN 1055-8586, https://doi.org/10.1053/j.sempedsurg.2013.10.005. (https://www.sciencedirect.com/science/article/pii/S1055858613000577)

Conclusions/action items:

The correct stage in development of the lungs and ribcage is important to represent in our manikin, since we want to make the manikin as realistic as possible. Ribs are formed before lungs but are not as solid as adult bones, they are formed before the lungs which are in the canicular stage at 22-23 weeks gestation. The lungs still have characteristics of adult lungs like recoil although not fully developed which is important to note when deciding how to model the thoracic cavity on out manikin.

10/6/2023 IV Access Points

Molly Wilhelmson - Oct 06, 2023, 11:23 AM CDT

Title: IV Access Points

Date: 10/6/2023

Content by: Molly

Content:

Peripheral IV insertion is prioritized in young children compared to interosseous catheters and central venous catheters. Peripheral IV insertion is commonly femoral during resuscitation because of the easy access away from the chest cavity.

Schweer, Lynn MSN, RN, CNP. Pediatric Trauma Resuscitation: Initial Fluid Management. Journal of Infusion Nursing 31(2):p 104-111, March 2008. | DOI: 10.1097/01.NAN.0000313657.50163.b2

Intraosseous needles are placed far from the location of compressions. These needles were placed more quickly and easily in a study comparing intraosseous needles with umbilical venous catheters. The ION were placed on average 46 seconds faster than the UVC's. The study was done with a manikin featuring an internal tibia for needle insertion, 1 cm below the knee joint.

Anand K. Rajani, Ritu Chitkara, John Oehlert, Louis P. Halamek; Comparison of Umbilical Venous and Intraosseous Access During Simulated Neonatal Resuscitation. *Pediatrics* October 2011; 128 (4): e954–e958. 10.1542/peds.2011-0657

Conclusions/action items:

These sources Indicate that a common IV access point is on the leg, femoral and tibial access points. This reinforces the need for our manikin to include limbs for practicing IV insertion.

9/18/23 Previous Semester's Work

Molly Wilhelmson - Sep 18, 2023, 3:01 PM CDT

Title: Previous Semester's Work

Date: 9/18/2023

Content by: Molly

Present:

Goals: Review what has been accomplished by previous teams that have worked on the Neonatal Manikin project.

Content:

Spring 2023

Client Requirements- synthetic breathing tube (2-2.5 mm diameter) in the mouth of the manikin, synthetic umbilical cord, able to practice CPR (mimic lung movement and chest should be able to recoil after compressions), less than 30.5 cm long, 400-500 g, skin elasticity of around .42 MPa-.85 MPa.

Final design and improvements for the mold- mold made form tough PLA to resist heat, made from a scaled down scan of Premature Anne, sliced down the coronal plane and 3D printed, did not include limbs needed for IV locations. Addition of a ribcage would have been useful to make compressions more realistic.

Conclusions/action items: Research anatomy of infant born at 22-23 weeks of gestation and make improvements to previous team's mold including the addition of limbs.

10/2/2023 Micro Preemie and Premature Anne Dimensions

Molly Wilhelmson - Oct 02, 2023, 4:51 PM CDT

Title: Micro-Preemie and Premature Anne Dimensions

Date: 10/2/2023

Content by: Molly

Content:

Micro Preemie:

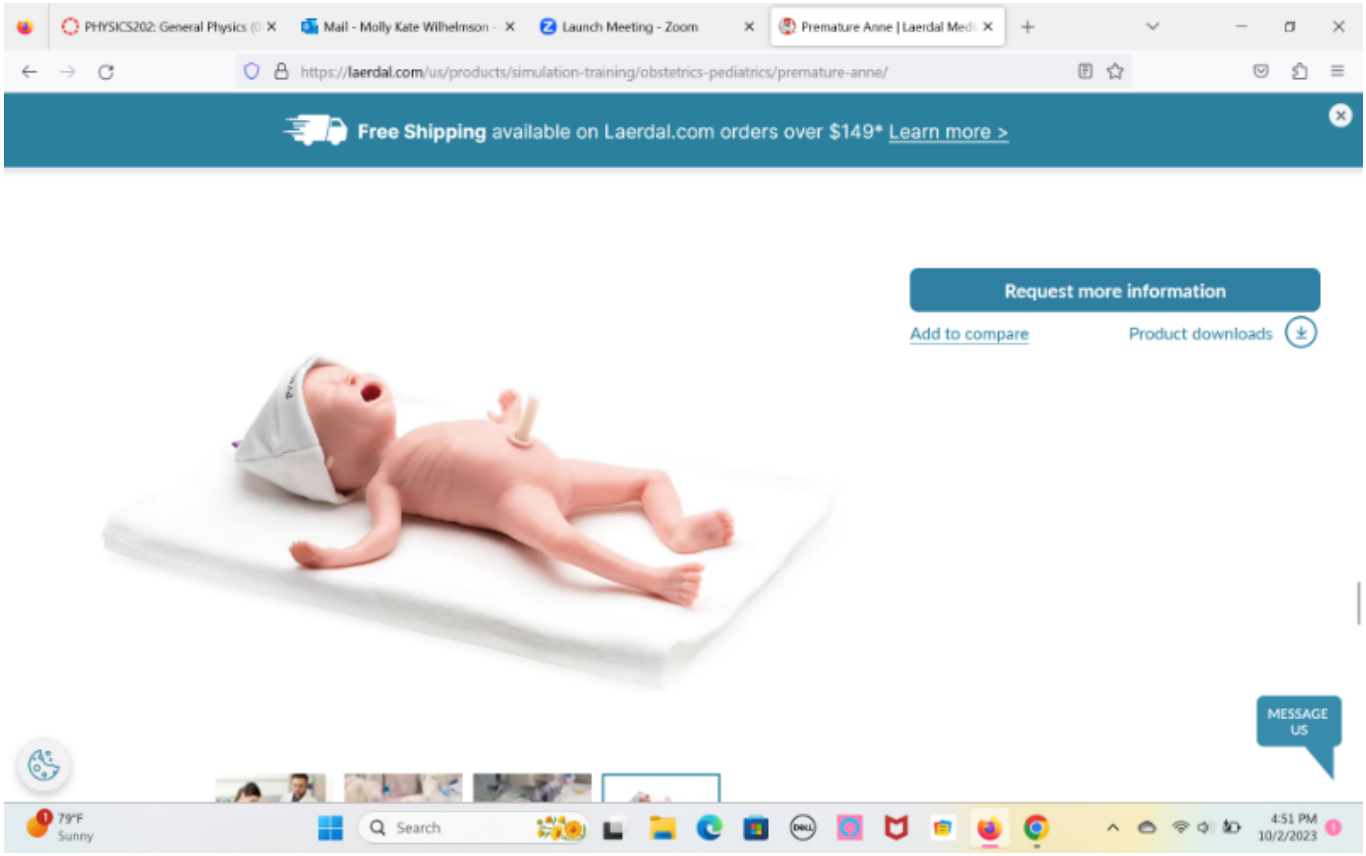
The Lifecast Website lists their micro-preemie baby as being 24 cm long and 500 grams at 22-23 weeks of gestation.

Based on the images on the Lifecast website, the arms and legs appear to be around 10-11cm long, and are very skinny.

Premature Anne:

Premature Anne is 30 cm long, 10 cm wide, and 8cm in depth according to Laerdal's website.

From the pictures on Laedral's website Premature Anne's arms are about 10 cm while the legs are around 13-14 cm long.



Conclusions/action items:

In creating the mold for the limbs of our manikin, we will need approximate dimensions of a neonate born at 22-23 weeks of gestation. These preexisting manikins provide good guidance on how long our model's limbs should be. Our manikin should have closer to 10-11 cm long limbs since the micro-preemie model is made at 22-23 weeks of gestation.

10/5/2023 Preliminary Presentation Preparation

Molly Wilhelmson - Oct 05, 2023, 8:07 PM CDT

Title: Preliminary Presentation Preparation

Date: 10/5/2023

Content by: Molly

Present: Claire

Goals: Divide presentation evenly between group members

Content:

After our group's meeting where we practiced our preliminary presentation, we decided that Claire and I should split up some of her speaking points. We agreed that I should cover the competing designs slide in addition to presenting our first design idea of adding limbs to the manikin. We spoke about detailing both Premature Anne and the Micro-preemie models in our presentation, as well as the size, age, cost, and features of both designs. We made sure to focus on the fact that neither design fulfills our clients criteria as Premature Anne is too large, and the Micro-preemie does not have a cost yet or IV access points that we know of.

Conclusions/action items:

Splitting up the slides will allow for every group member to speak for equal amounts of time, making our presentation flow better.

Design Sketches

Molly Wilhelmson - Sep 20, 2023, 4:06 PM CDT

Download

Molly_s_Design_Sketches.pdf (432 kB) The mold will build off of previous semesters' mold by using the previous body mold and 3-D printing new molds for each arm and leg. The addition of arms and legs would be an improvement from previous semesters' work by allowing healthcare professionals to practice insertion of IV's as well as more realistic resuscitation. The whole manikin will have skin encasing soft ribs and an air bag like the ones used in Little Anne.

STL Files for Limb Fabrication10/17/2023

Molly Wilhelmson - Oct 17, 2023, 2:08 PM CDT

Title: Limb STL files

Date: 10/17/23

Content by: Molly

Goals: Find an STL file to use for 3D printing the limb molds

Content:

This file on cgtrader is of an infant and could be scaled to the size needed for limbs. Would not need the entire body, could cut the limbs and resize to be more accurate

$26.92, more realistic model

https://www.cgtrader.com/3d-print-models/art/sculptures/newborn-baby-realistic-sculpture-stl-file-3d-printer-model

$35, less realistic looking model

https://www.cgtrader.com/3d-print-models/art/sculptures/baby-3d-print-74644ac4-ebb4-42e9-b951-32b76bead356

Conclusions/action items:

Most files that I could find are not realistic looking. I could find realistic looking models that were in a sitting or fetal position, but would not be easily modified/manipulated to match our manikin's body. I will continue looking for more realistic files to use.

11/2/23- Fabrication Plan Ideas

Molly Wilhelmson - Nov 02, 2023, 10:17 AM CDT

Title: Fabrication Plan Ideas

Date: 11/2/23

Content by: Molly

Content:

-3D print the limb molds with the help of the makerspace-sized down to about 11 cm legs and 10 cm arms.

--Mix the ecoflex according to the Iowa Group's ecoflex Protocols pdf.

-Fill the arm and leg molds completely with the ecoflex, since intubation is not our focus this semester. This will save time in the fabrication process.

-Fill the body mold with ecoflex, making hollow cavities in the chest and head for future internal components. We could use clay as a space holder while the ecoflex dries. Mold the clay into the shape we want for the chest cavity and hold in place while the ecoflex dries, so the clay does not sink to the bottom of the mold and create a hole. Same would be done for the head cavity, but with a slightly smaller ball of clay. We could suspend the clay with a string and attach to some surface above the mold so we don't need to hold the balls of clay the entire time since drying will take 24 hours. Earlier this week our team talked about using balloons instead of clay which could be an alternate method of creating the chest and head cavities.

Conclusions/action items:

We need to access the limb STL file, modify to correct dimensions, and 3D print the limb molds. Once we have the ecoflex delivered, we can fill the molds and begin fabrication of the skin materials.

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

BME Design-Spring 2023-Notebook

JODI LAWSON - Sep 08, 2023, 1:40 PM CDT

BME Design-Spring 2023 - LOUKIA AGOUDEMOS
Complete Notebook

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Charlie Fisher
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CLAIRE KRAMAR - Sep 08, 2023, 1:40 PM CDT

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Dec 14, 2022 @06:26 PM CST

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2023/11/10 - Esophagus 3D Files

CLAIRE KRAMAR - Nov 10, 2023, 11:22 AM CST

Title: Esophagus 3D Files

Date: 11/10/2023

Content by: Claire Kramar

Present: N/A

Goals: document files of 3D modeled esophagus cavities given to us by the Iowa First Breath Design Team

Content:

(files attached below)

Conclusions/action items: While we likely won't use these files this semester, these could easily be 3D printed and used in future semesters to create an accurate chest cavity.

CLAIRE KRAMAR - Nov 10, 2023, 11:22 AM CST

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esophagus_moldTOP.stl (20.3 MB)

CLAIRE KRAMAR - Nov 10, 2023, 11:23 AM CST

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esophagus_moldBOT.stl (18.2 MB)

2023/11/10 - Micro Mike Final Presentation

CLAIRE KRAMAR - Nov 10, 2023, 11:29 AM CST

Title: Micro Mike Final Presentation

Date: 11/10/2023

Content by: Claire Kramar

Present: N/A

Goals: document the final presentation for Iowa Design Team Micro Mike presentation

Content:

(pdf attached below)

Conclusions/action items: We are going to use a very similar protocol to make the under layer of the prototype, made out of EcoFlex. It is helpful to look at the pictures of the fabrication to get a better understanding of what we will be doing. We will also apply the protocol to the limbs as well.

CLAIRE KRAMAR - Nov 10, 2023, 11:29 AM CST

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Final_Presentation_Micro_Mike.pdf (10.5 MB)

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