

Neonatal 22-23-Week Premature Infant Simulation Manikin

Executive Summary: Design Excellence

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Neonates born at 22-23 weeks are rare, and thus medical professionals often have minimal experience with these infants. This creates a demand for medical simulation manikins that accurately and reliably represent neonates born at this stage of gestation. There are currently no neonatal manikins for infants born between 22-23 weeks, the earliest model represents a neonate born at 25 weeks. Due to the significant size difference between these ages, an accurate manikin could reduce the likelihood of trauma caused by improper intubation and IV insertion during critical medical procedures. To improve upon this, the team will consider the anatomy of a neonate born at 22-23 weeks as well as training needs. These needs have been outlined and identified by the client and the team.

There are several design specifications that the team must meet with anatomic and functional accuracy. Accurate replication allows doctors and students to get effective practice when using the model. The manikin must be able to be intubated, meaning a breathing tube must be able to be placed into the manikin's trachea. The model's trachea is a tube from mouth to lungs, with a T-connector to replicate the branching between right and left lungs. Additionally, a chest cavity must be created to allow further procedural training for medical professionals in chest compressions, thoracentesis, and pericardiocentesis. The team chose to use ballistics gel for the body structure of the infant, and will use 3D printed polylactic acid (PLA) to create an anatomically accurate mold. The ballistics gel will allow for the support the rib cage would give, and a balloon will be inserted into the chest cavity and attached to the breathing tube to replicate lungs. Another benefit of ballistics gel is that it retains moisture and can thus replicate a neonate's skin. If too much tearing or compression is applied, the gel will break like neonatal skin and further provide feedback to the user.

The prototype will undergo various testing procedures. Medical professionals will be surveyed in order to collect data about the accuracy and ease of the intubation procedure. The ballistics gel and PDMS skin will undergo MTS testing in order to ensure it has properties similar to real neonatal skin. The team will also experiment with several fabrication procedures, varying curing times and gelatin powder to water ratios to develop the most realistic skin-like texture.

The Neonatal 22-23-Week Premature Infant Simulation manikin helps fulfill the need for training devices representing one of medicine's most critical and underserved populations. It fills a dire healthcare need at a fraction of the current cost of manikins on the market while ideally improving the outcomes of

intubation procedures. Thus, this design has the potential to be a significant advancement in the field of neonatology and help medical professionals train on more affordable manikins.