Transport Warmer for Infants

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Medical Devices and Children

Medical Devices and Children

Saw how medical devices are used on children

Visited OPDs, NICUs, PICUs, pediatrics , radiology departments- where children would have interacted with medical Equipment

Focusing on the NICU

NICUs provide critical care to infants especially premature babies

Interest was triggered reading reports on deaths in incubators and the general state of neonatal care in India

Statistics

Some 82 percent of newborn deaths in India are the direct result of three main causes:

1) Infections- 24 percent of all newborn deaths.
2) Asphyxia - 23 percent of newborn deaths
3) preterm births - **35 percent** of newborn deaths.

Lack of attention to **thermoregulation** continues to be a cause of unnecessary deaths in the neonatal population.

Ref: UNICEF state of worlds Children report 2009
http://www.unicef.org/india/final_data_sheet-sowc_2009_15-01-09.doc

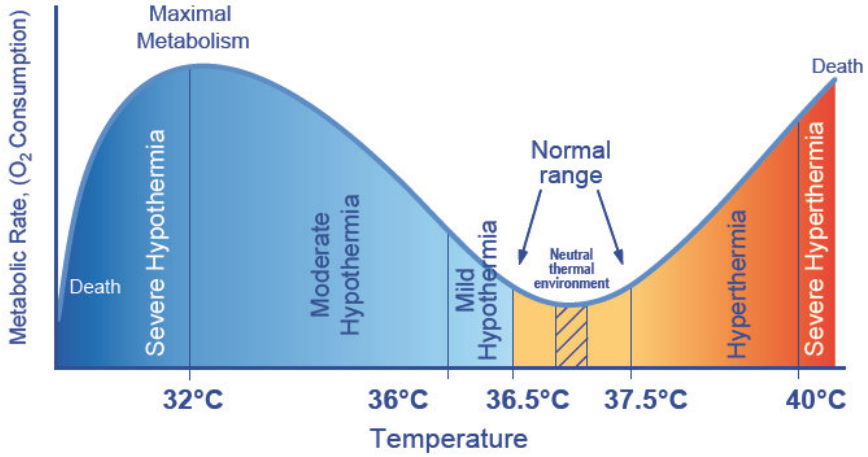
Thermoregulation

Every new born needs his temperature to be regulated in the range of 36.5 deg C.

Incubators are used to keep premature babies/ sick babies and new born babies warm in the range 36.5 deg C depending on birth weight

Premature babies and sick babies need an incubator the most

Any temperature above or below would lead to mortality, retardation or other ill effects. Room temperature of 28 deg C is like 0 deg C for adults



Incubators

Open Style

Closed Style

Places and People Visited

- Visited three hospitals in Bombay to learn about the radiant warmers
  - Hiranandani Hospital
  - Sion Hospital
  - KEM Hospital
- Observed infants at the NICUs at Sion Hospital and KEM hospital
- Followed and observed the Head of neonatology Dr. Jayshree Modkar at Sion Hospital and Dr. Nanavati at KEM Hospital
- Interviewed Sr. Jolie of Well term ward at Sion Hospital and Sr. Ashmita ponshe at KEM hospital
- Visited Padmalaya Maternity clinic at Powai and spoke with Dr Padma Ramakrishnan
- Visited Bakul Parekhs childrens hospital at Ghatkopar and spoke with Dr. Patil

Inferences

Through the interviews found that

- Transport incubators were not commonly available at smaller hospitals even with maternity wards
- **Transport incubators were sent from those that have NICUs** and the infrastructure and money to these smaller hospitals
- Transport incubators are very few- KEM has only 2, one of which is broken
- Sion hospital has yet to buy a transport incubator, though it has an NICU
- **They are bulky and always need ambulances to use**

Since there are a lack of these machines around

- Babies are **wrapped in hot water bottles and sent with the father or relatives**
- Babies are simply wrapped in lungies and sent to these hospital
- Most of these travels takes place in private transports
- There is **no medico support**

Product brief

To design a **transport warming solution** that can keep a premature infant safe and warm in the range of 36.5 deg to 37.5 deg during the journey from a local hospital or maternity clinic to a tertiary hospital. The solution must be affordable to the smaller hospital in the urban scenario.

The user of the product would be **an accompanying adult** who maybe the infants father or relative. A medic also may assist in travelling with the product.

It should allow **for easy access** to the baby in case of emergencies

It should be easily transportable from the local hospital to the vehicle and from the vehicle to the tertiary hospital; **The vehicle would be a car or an ambulance**

It should provide **for necessary and decipherable monitors/ indicators of the babies health**

It should be **easy to secure the baby** into the device

It should be **easily repairable** by the hospital

Synchronic Analysis

Commercial transport incubator

Pros

Can provide all care facilities if bought with all the options

Cons

Bulky
Expensive Rs 20k upwards
Reliance on stored electricity/ or ambulance

Conductive mattresses and Electric Blankets

Does not rely on heating the air but heats only the mattress that carries the baby

Pros

Better transportable, makes the transport incubator lighter

Uniform heating over the mattress

Cons

Still relies on a battery supply, electricity

Final product will be heavy due to battery

expensive

Traditional Methods

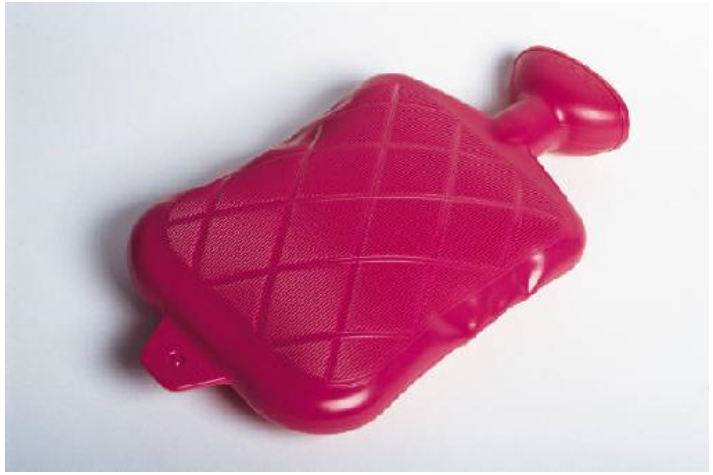
Traditional methods such as hot water bottles and thermocol boxes have been used to transport babies. However they do not provide thermoregulation.

Pros

Readily available, easy to use

Cons

Heat does not last long
Temperature output is never constant
Does not provide any regulation



Phase change materials

A Phase Change Material is matter which undergoes a phase change at a specific temperature and gives off, or takes in, large amounts of energy in the process. They can be used for cooling or heating.

NASA scientists have been using phase materials for cooling astronauts in space and is non-toxic. Currently they are widely used in

- Hot Pads and Solar Heating
- Telecom Enclosure
- Space heating/cooling
- Freezing below 0 deg C

A sodium acetate heating pad. Gives off 58 deg C when activated

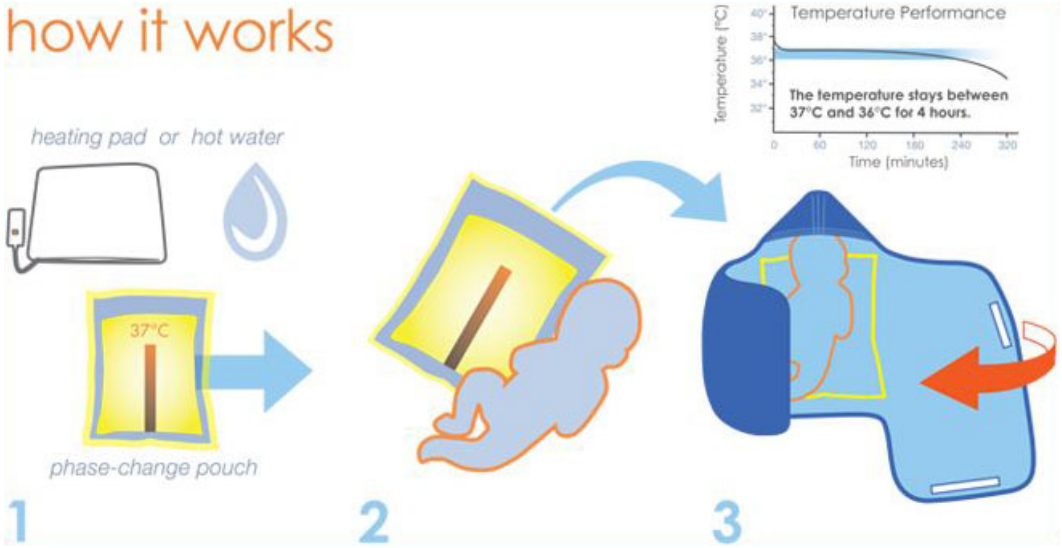
Embrace Infant Warmer

Pros

Price of warming is brought down to $25
Works without electricity
Perfect for rural setup

Cons

Not made for transport



Baby Pod II by Cooper Surgical

At the heart of baby Pod II is a single use PCM material

Pros

Does not use electricity for warming
Immediate activation of the warming system

Cons

Big in size
Single use PCM material
Expensive

Choosing the right PCM

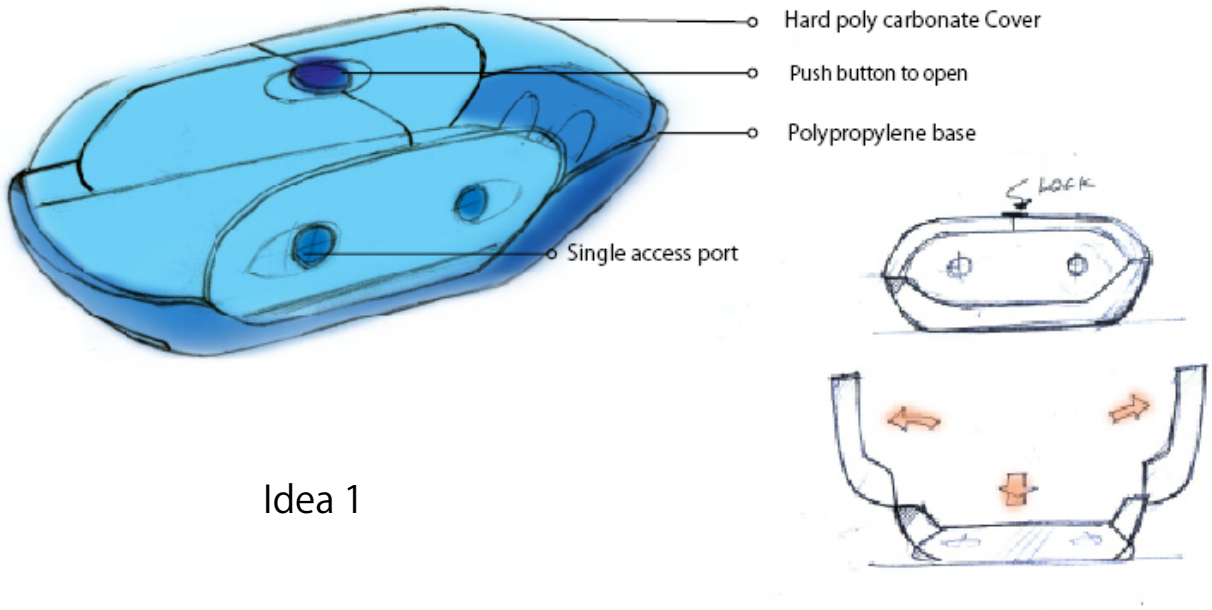
The one closest to **36.5 deg C**

1 - 2 Kg of the material is sufficient to last for 5 hours for the heat generated and volume of an infant. There are organic and inorganic salts. Organic PCMs like paraffin wax lasts longer but susceptible to combustion.

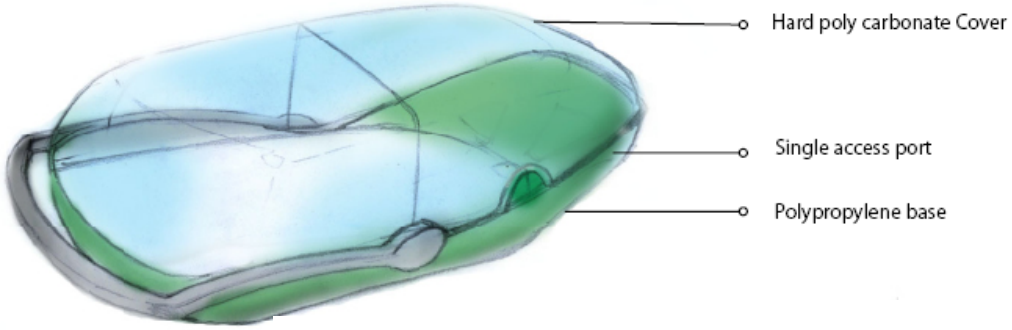
PCM can be encapsulated in aluminum, SS ,polyethylene jackets or even impregnated into textiles.

It costs Rs 250 per kilo ; organic salts are more expensive.

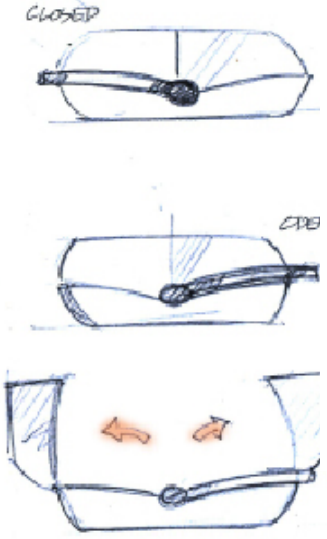
Ideation for exterior

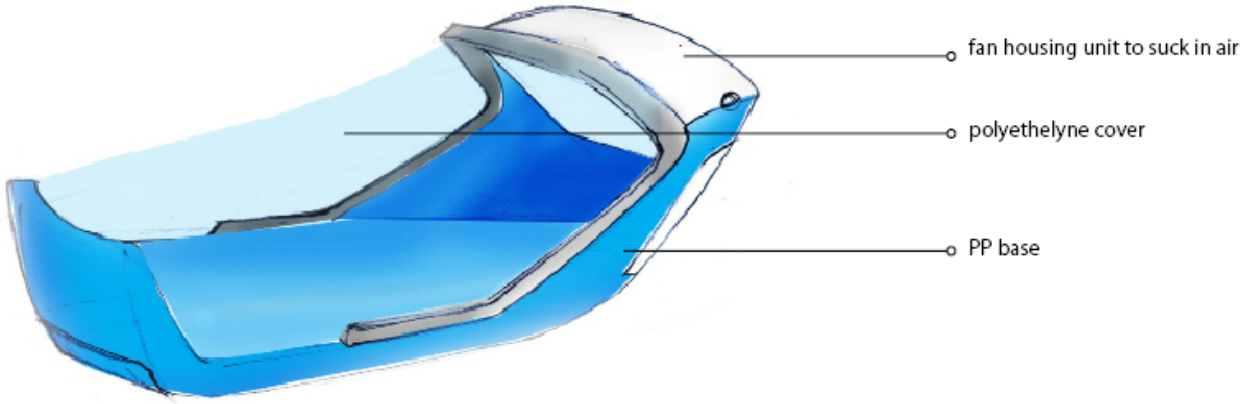


Idea 1

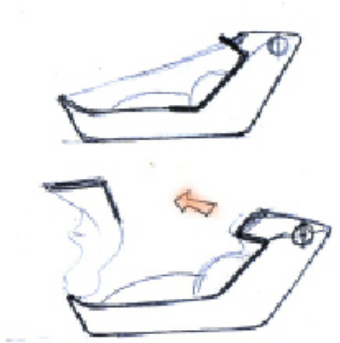

Hard poly carbonate Cover
Single access port
Polypropylene base

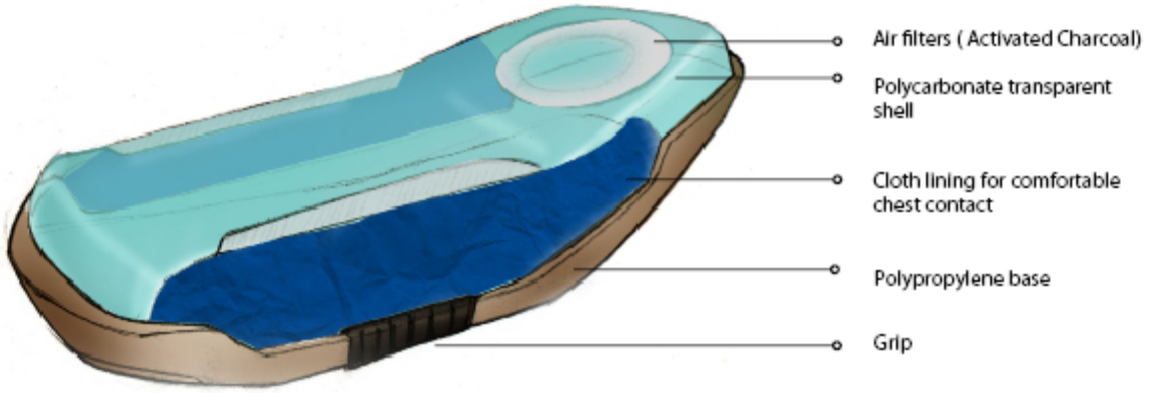
Idea 2



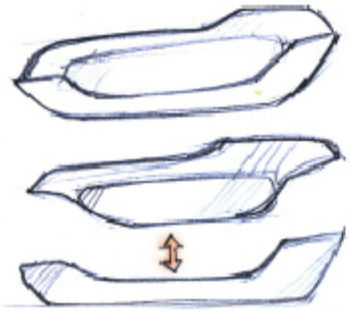


Idea 3

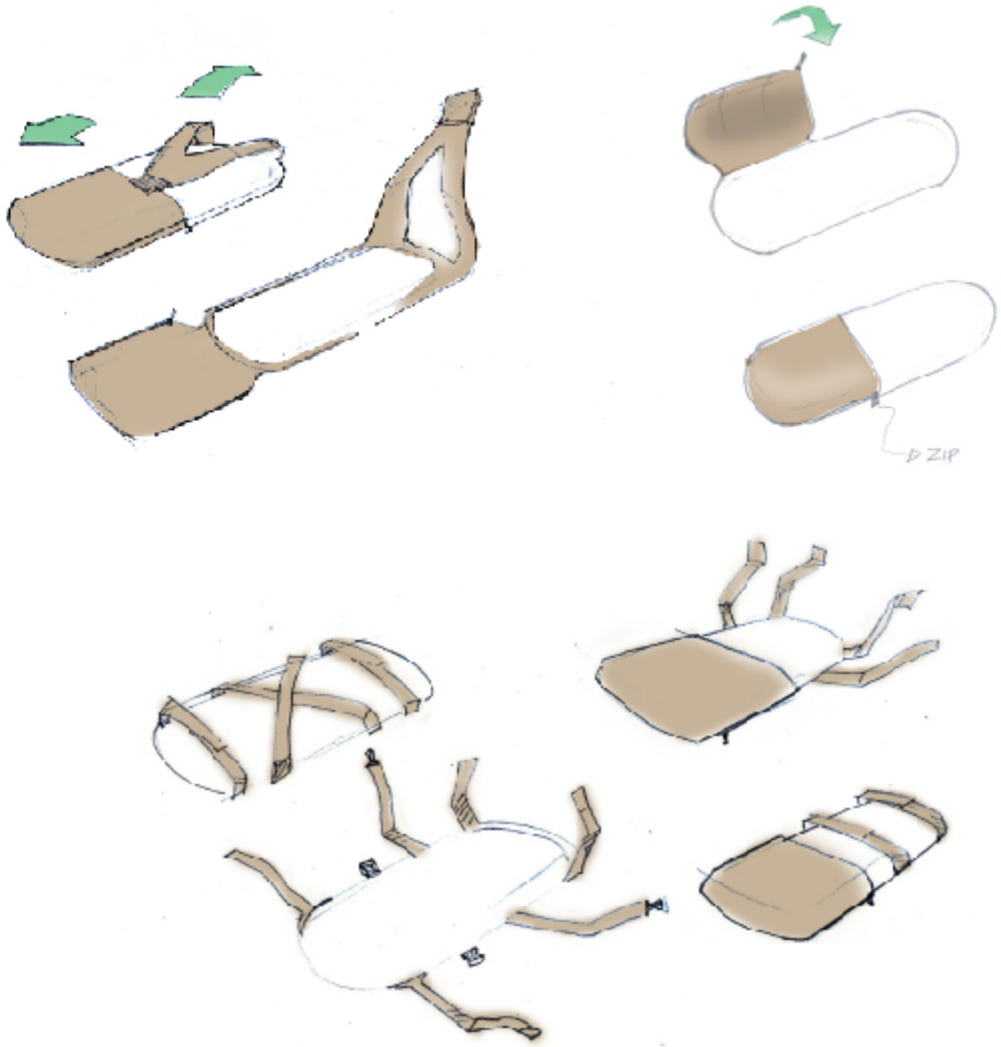



Air filters (Activated Charcoal)
Polycarbonate transparent shell
Cloth lining for comfortable chest contact
Polypropylene base
Grip

Idea 4



Ideation for Interior



Testing

Holding tests

Lifting and walking





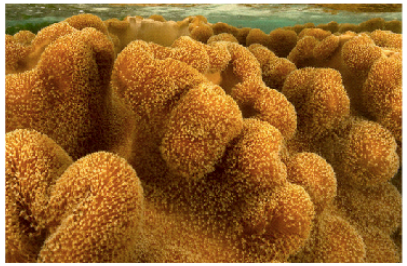



Concept Refinement

Expressions were used to style the product and cater to the visual appeal of the end users. The final product would incorporate these expressions to lead to a product that is acceptable and appealing to the target user.

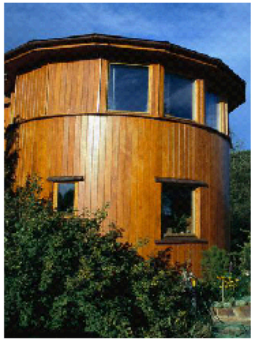
The expressions chosen were

Soft
Warm
Strong
Secure
Medical

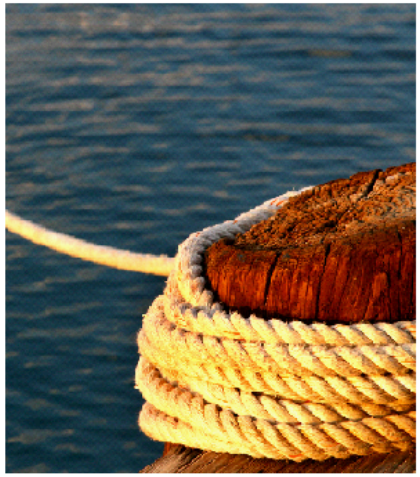


Soft

Strong



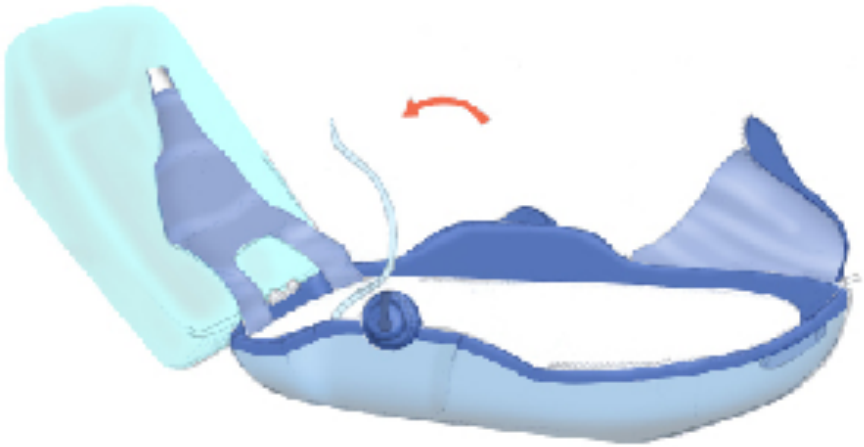
Warm

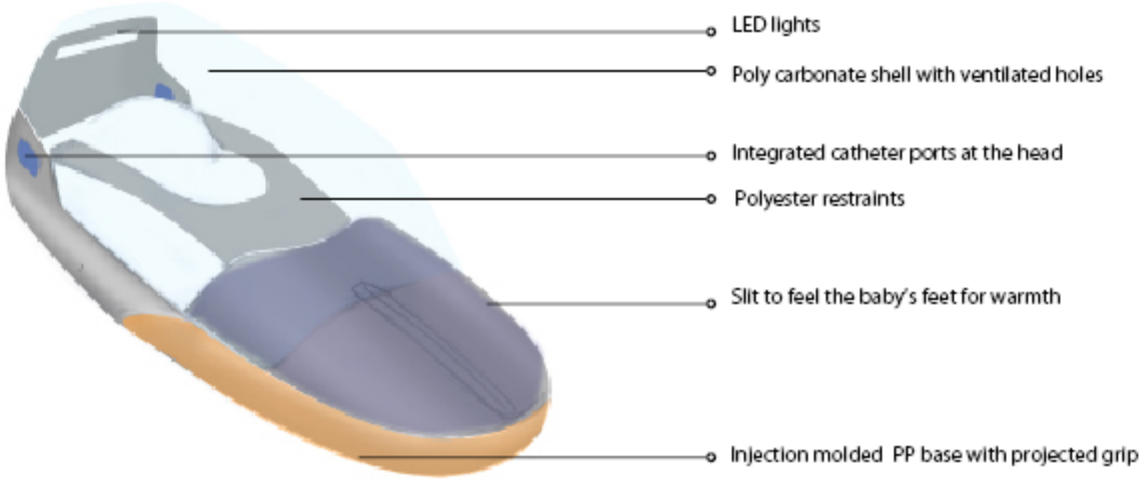


Secure

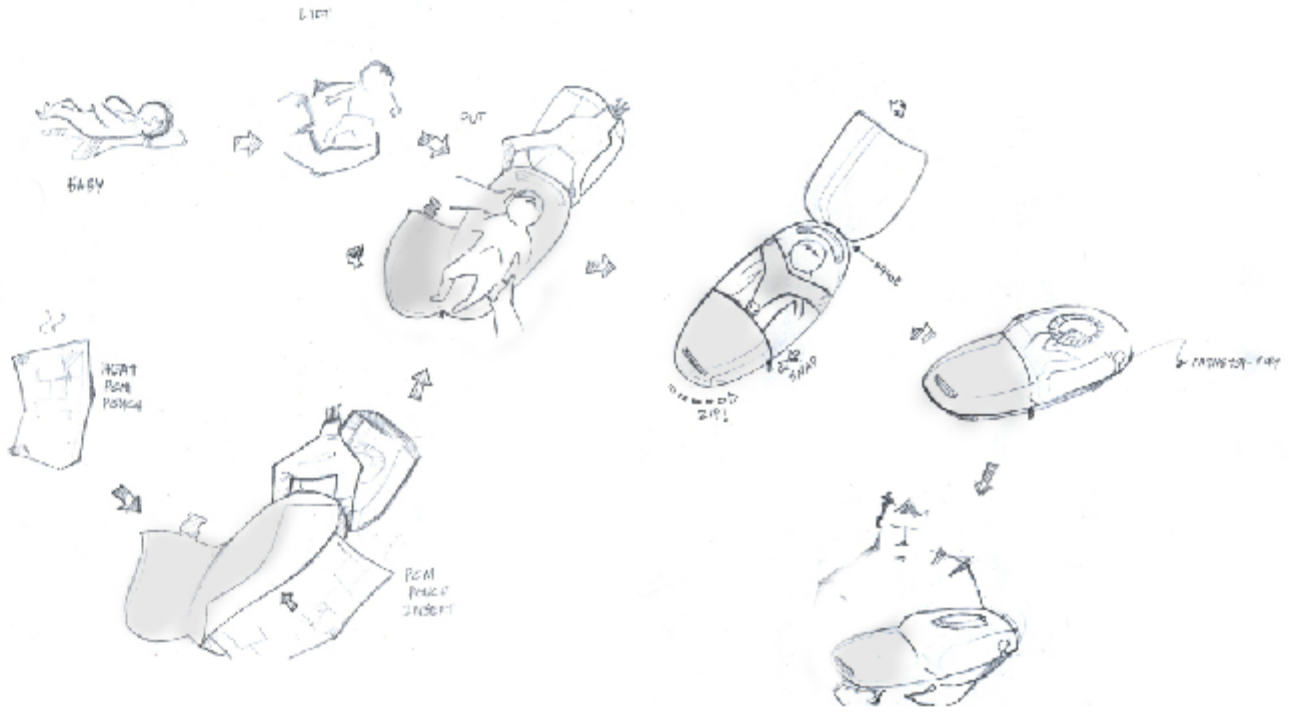
Medical

Refined concept




LED lights
Poly carbonate shell with ventilated holes
Integrated catheter ports at the head
Polyester restraints
Slit to feel the baby's feet for warmth
Injection molded PP base with projected grip

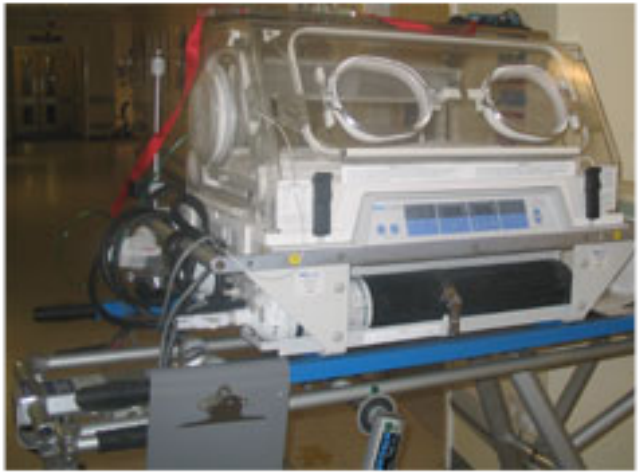
Concept in Use



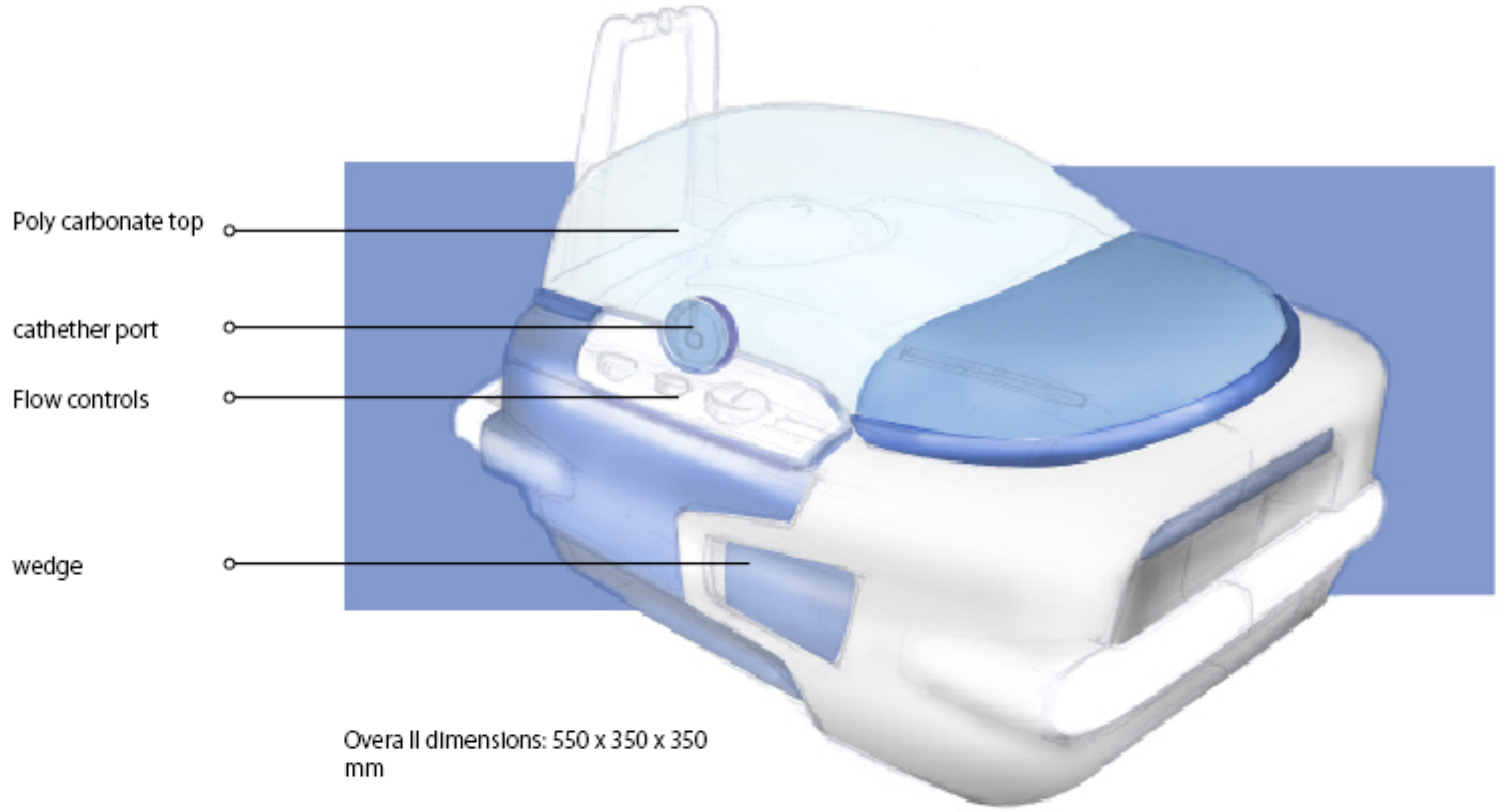
Concept two

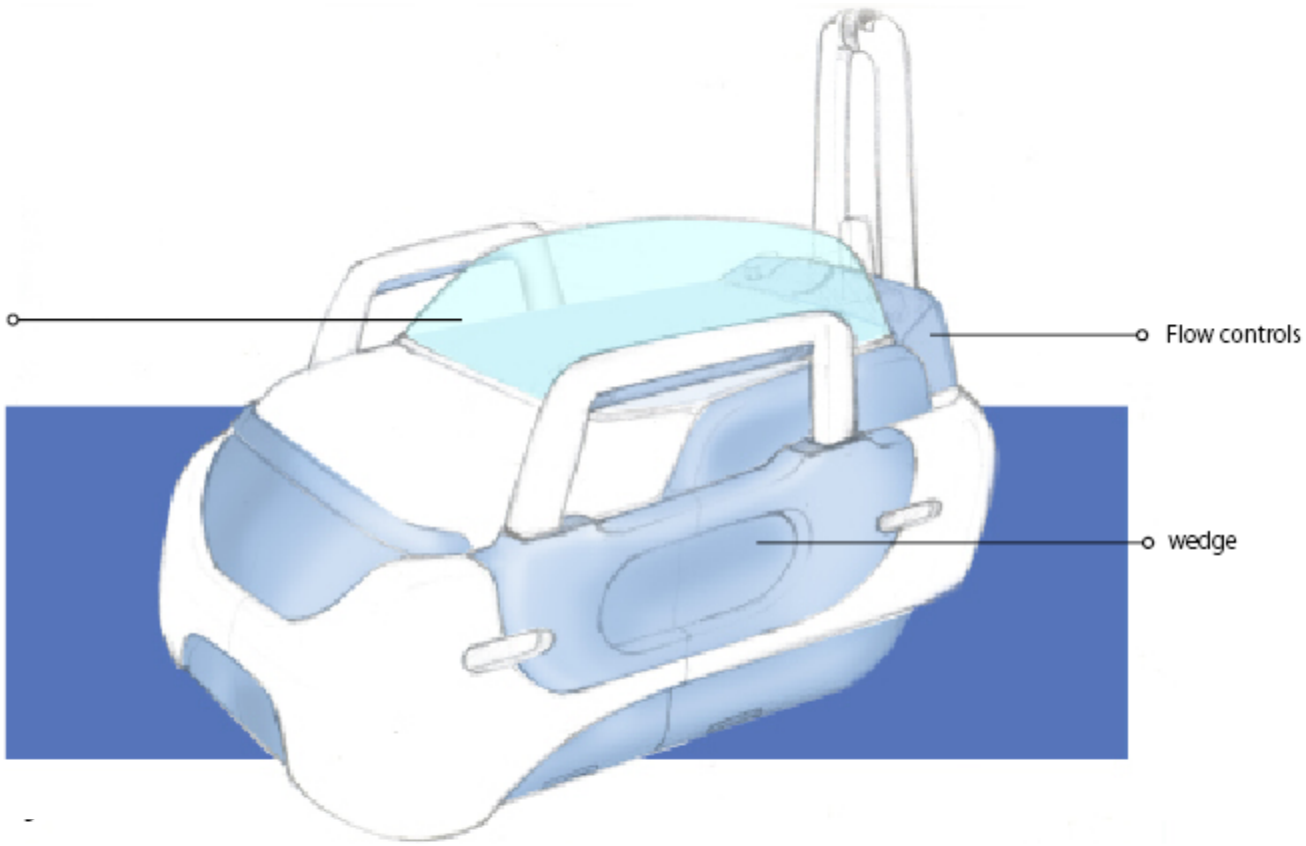
Inclusion of a medical air cylinder

Medical air is necessary for a sick preterm who need oxygen along with a warming solution

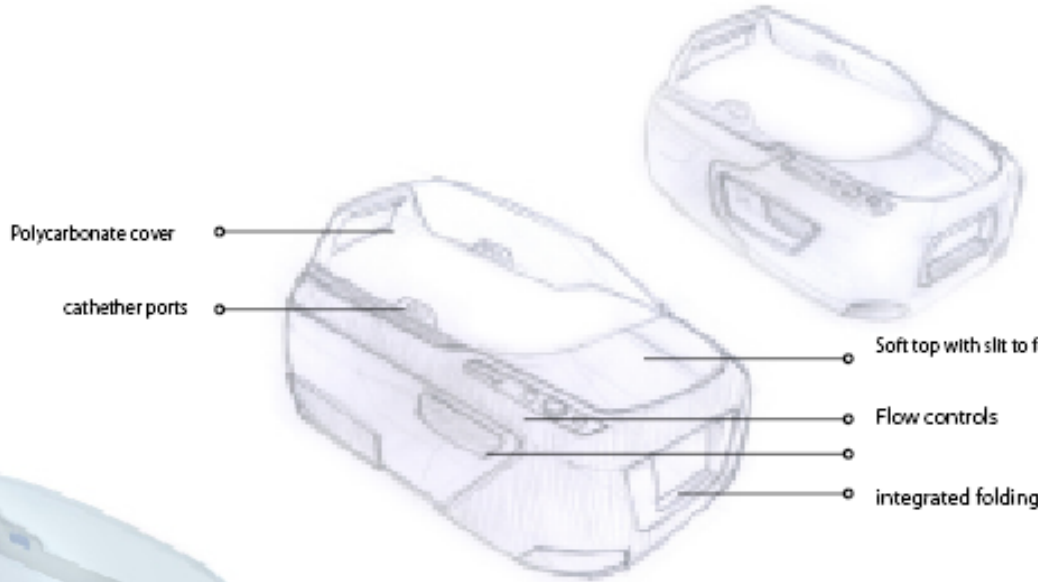


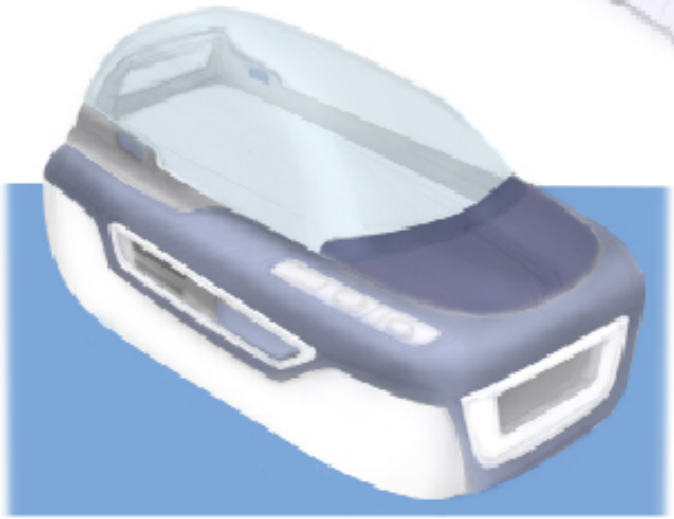
Ideation


Poly carbonate top
cathether port
Flow controls
wedge
Overa ll dImensions: 550 x 350 x 350 mm



Overall dimensions: 600 x 325 x 350 (excluding IV post) mm





Overall dimensions: 550 x 350 x 350 (excluding IV post) mm

Testing

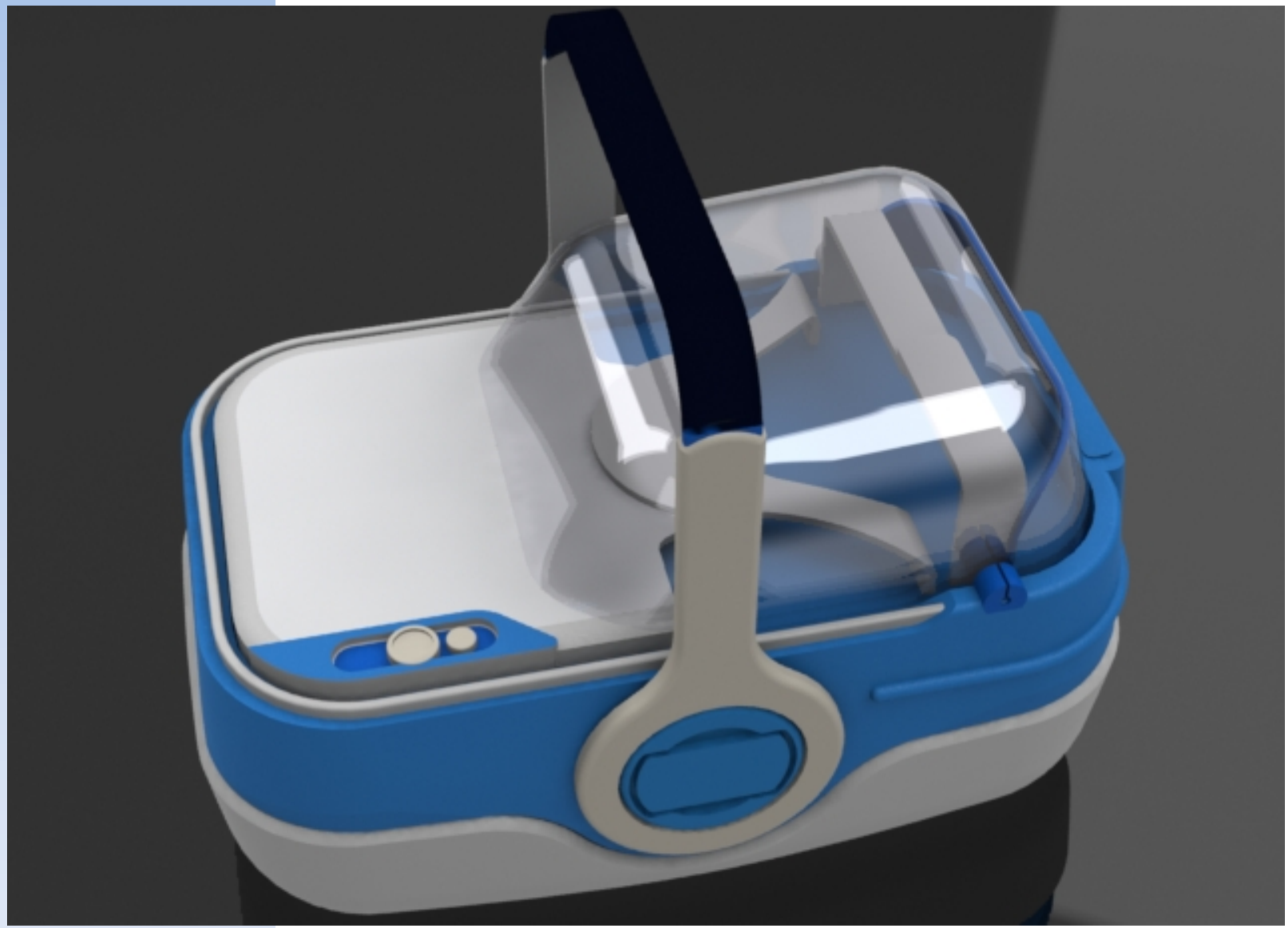
Testing for an ambulance

Using a different handle configuration

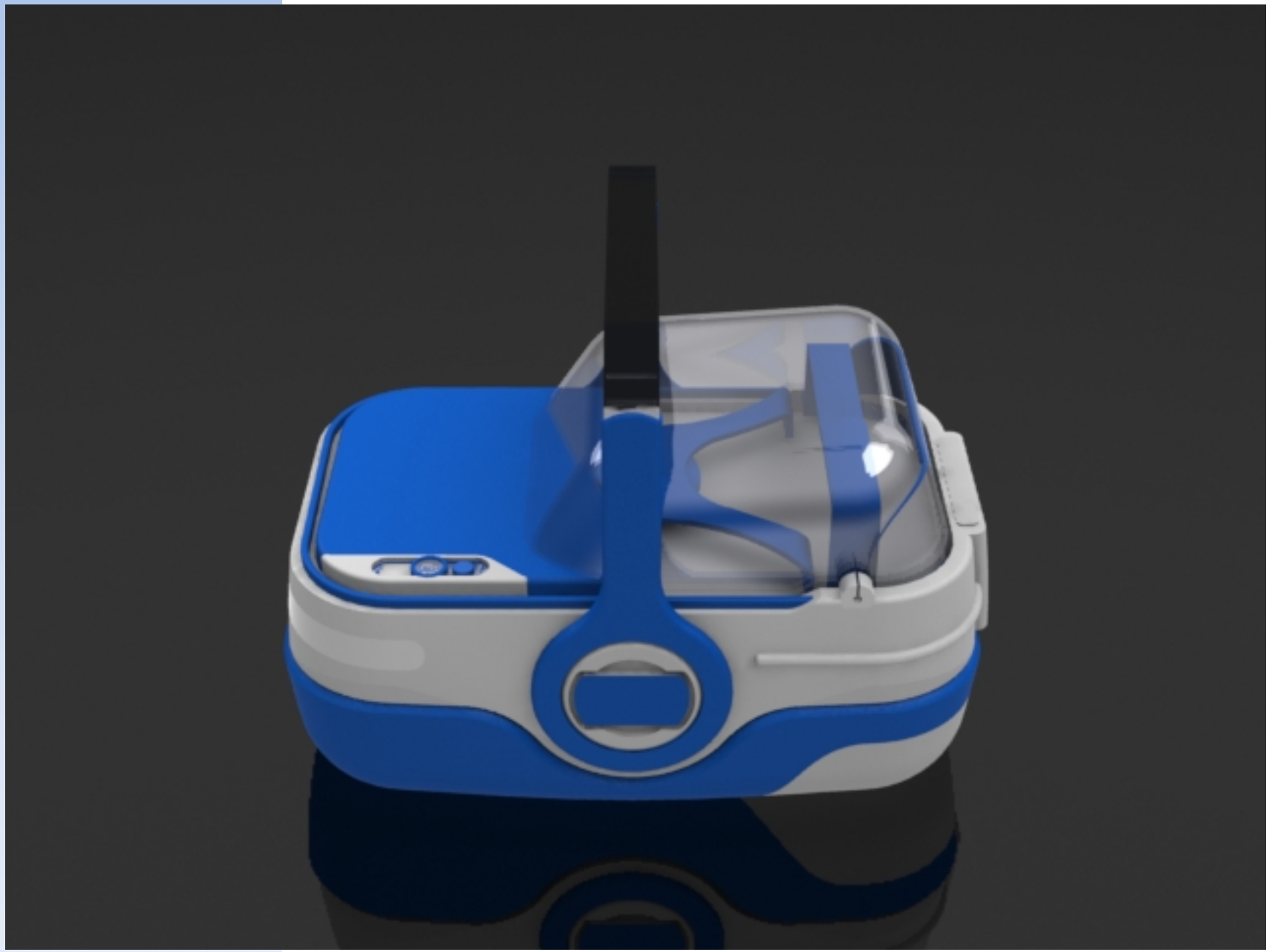
Testing for a Car

Using the loop handle

Using the side handles



Dim: 500 x 350x 300 mm
Weight: 10 kgs



Concept Evaluation

More viable than concept two

Concept two requires a lot more intervention in engineering and has more components of manufacture

Better maneuverability

it can be used in a car (and possible use in a rickshaw) without oxygen and can be oxygen compatible when used in an ambulance

Lower cost

The product would be cheaper owing to lesser components and smaller size.

Final Concept

Dim: 500 x 280 x 200 mm
Weight: 2~3 kgs






Business Model

The owner of the product would be the smaller hospital who would rent out the device to the family requiring the product. However, the product will be in use only from point a to point B. This would mean that the product might not be returned.

Having a rental system would still keep the responsibility to the user to return the product back to the smaller hospital. This is an added burden to the already stressed parents

So a delivery system in conjunction with a local courier service could be started wherein the local courier service would return the used transport warmers from the tertiary hospital back to the smaller hospital. The user would pay this delivery fee upon enrollment at the tertiary hospital. This would generate work and income for the local courier service or services.

In short, this product will be bought by a local clinic/ hospital and charge the user for the delivery back to the hospital after use.

Thank You