Sustainable & Faster Cannulation

10 Page Summary

By- Surmya Goel

Problem

5Ws’

Who?- Nurse and patient

What?- Cannulation tray for faster treatment

Why?- First step for treatment is IV cannulation

Where?- Ambulance (bottom right) , hospitals (top left) and army camps (bottom left)

When?- Critical life saving moments

Research & Human Factors

Need:

- Faster cannulation as it is the first step in most emergencies.
- Faster treatment = less deaths, higher economy, better lifestyle

Research results- Talk with Pinky(University Of Glasgow)

Pinky Virhia

Lecturer • Nursing & Healthcare School

Call

Requirements in tray:

Cannula

Alcohol Swab

Dressing

Syringe

IV extension

Tourniquet

Product Design Specification (PDS) :

- Sterilization (ISO)
- Printed on packaging (ISO):

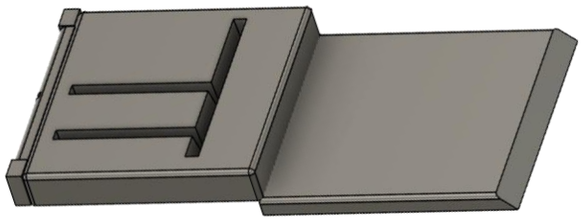
✓ Instructions of use
✓ Date of manufacturing
✓ Expiry date
✓ Batch number
✓ Contents

User Design Specification (UDS):

- Stack ability
- Moldability
- Less weight
- Easy access
- Strength

Concept Development Timeline

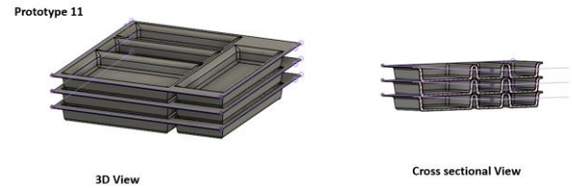
Learning: IV set not required

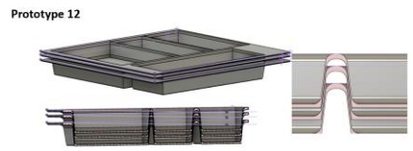


Initial Mold for understanding
Learning: Fillets, draft needed

Learning: 3mm thickness suits best for paper pulp, 2mm for cardboard pulp

Prototype 11&12- product with stacking



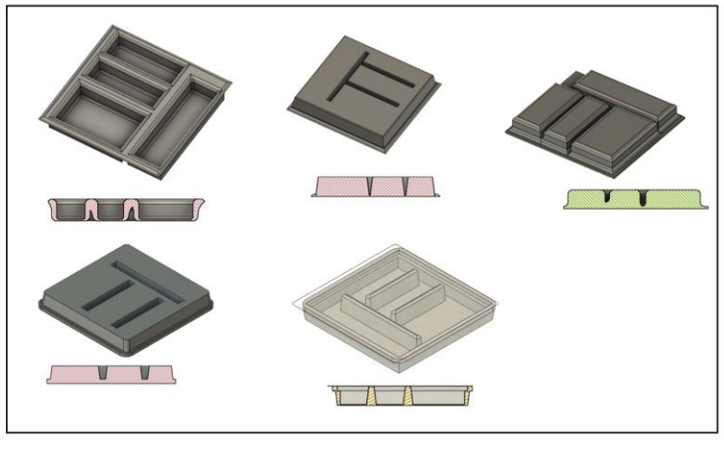


Learning: 12 degree draft is ideal, needs equal thickness

Paper mache prototype

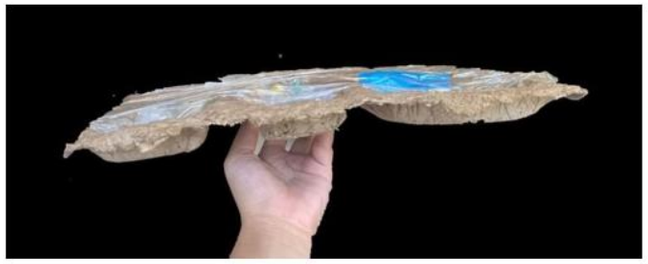
Learning: 0.5cm spacing for easy access

CADs for learning- 4degree draft is not enough for stacking



User Journey

Could not do it in hospital as covid cases in India have risen to 10,000 per day



- Get tray, saline and required bottles to collect blood sample.
- Wash hands, sanitize and wear gloves

- Peel open tray

- Tie tourniquet

- Peel all packaging

- Dispose tray in recycle bin

- Flush the cannula with saline
- Apply the rest of the dressing

- Secure the wings with dressing
- Collect sample

- Insert cannula

- Clean area with swab

Engineering & Final Prototype

Note: Tried to get feedback from pulp packaging manufacturers but no one responded. So. I went ahead with my experience and finalized the design.

1. 3D printed mold

2. Made a perimeter to pour plaster (POP)

3. Making plaster

4. Pouring in the mold

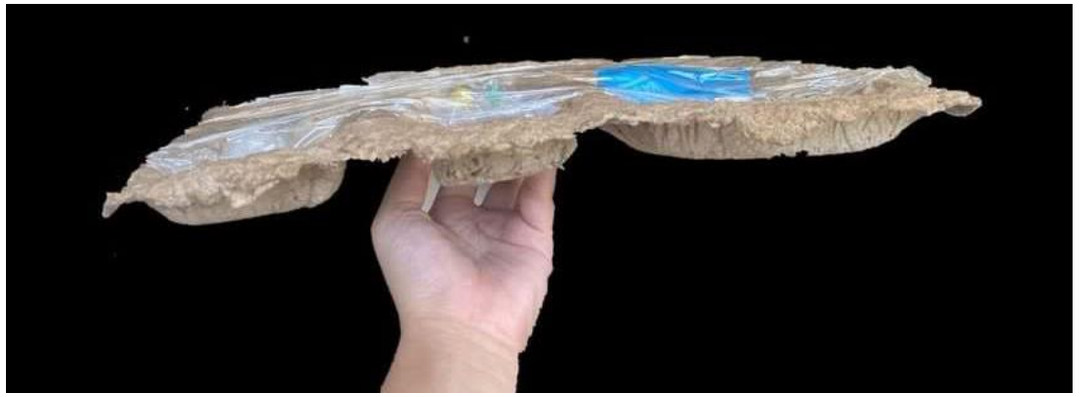
5. Drying

6. Result

7. Sanded the mold- this will be used to give thickness to compartments

8. Poured the slurry (cardboard + water) and gave thickness by pressing the mold

9. Drying



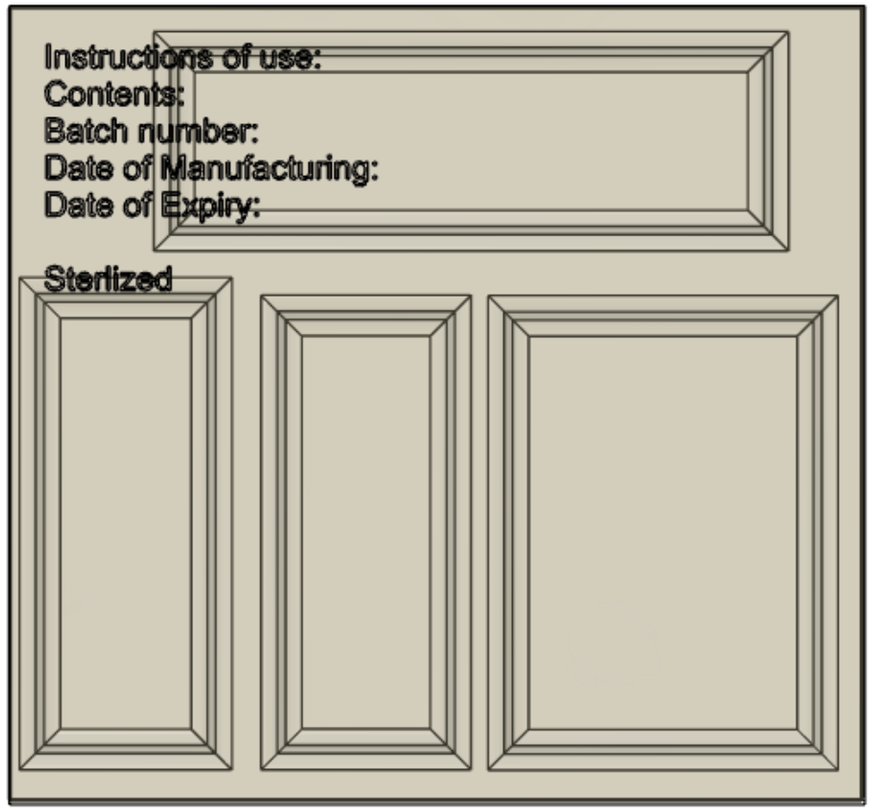
Features of Final Design

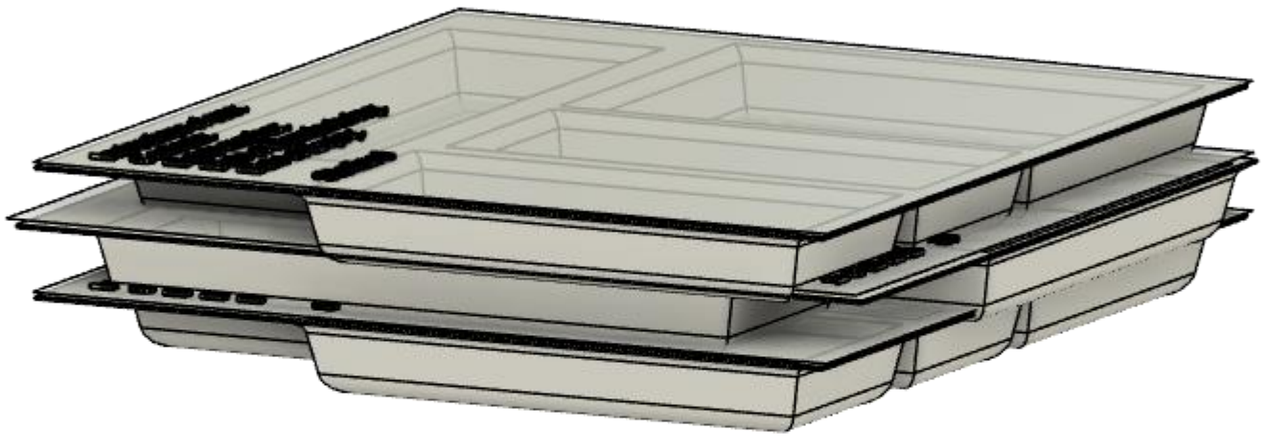
Even thickness- 2mm for strength

Draft -12 degrees for stacking

Fillets wherever possible

0.5 cm spacing for easy access between wall and equipment





Engineering Calculations

The equipments were taken from a clinician in the university

according to that the dimensions are:

- Swab = 7 x 3.2 cm
- Tourniquet = 7 x 3.2 cm
- Extension = 25 x 12 cm
- Syringe = 16 x 4 cm
- IV cannulas x 2 = 17 x 4.5 cm
- Dressing = 10 x 15 cm

+0.5 for spacing from sectioning

Through the thickness evaluation the weight of that prototype was 10 gram and the dimensions were 12.7 x 8 x 0.3 cm. From which the density was calculated using equation 1.

$\rho = \frac{mass}{volume}$ [Equation 1]

$\rho = \frac{10}{30.48}$

$\rho = 0.328\ g/cm^3$

From CAD Volume= $699.5cm^3$

$\rho = 0.328\ g/cm^3$

mass = ρ x volume

mass = 229.4 grams

The equipments in the tray weigh 35 grams.

15 trays in a box sample did not break even with twice the weight.

Density= 0.0328 g/cm3
Weight= 65 g
1 box weight= 0.525 kg

Testing & Results

Moldability: Achieved, tray came out from mold easily as one piece.

Stack ability: Using one more of the same tray. They nested.

Strength: Can carry 7kgs before being ruptured

Weight test: with equipments 261.5 grams, without equiments 224 grams.

Results:

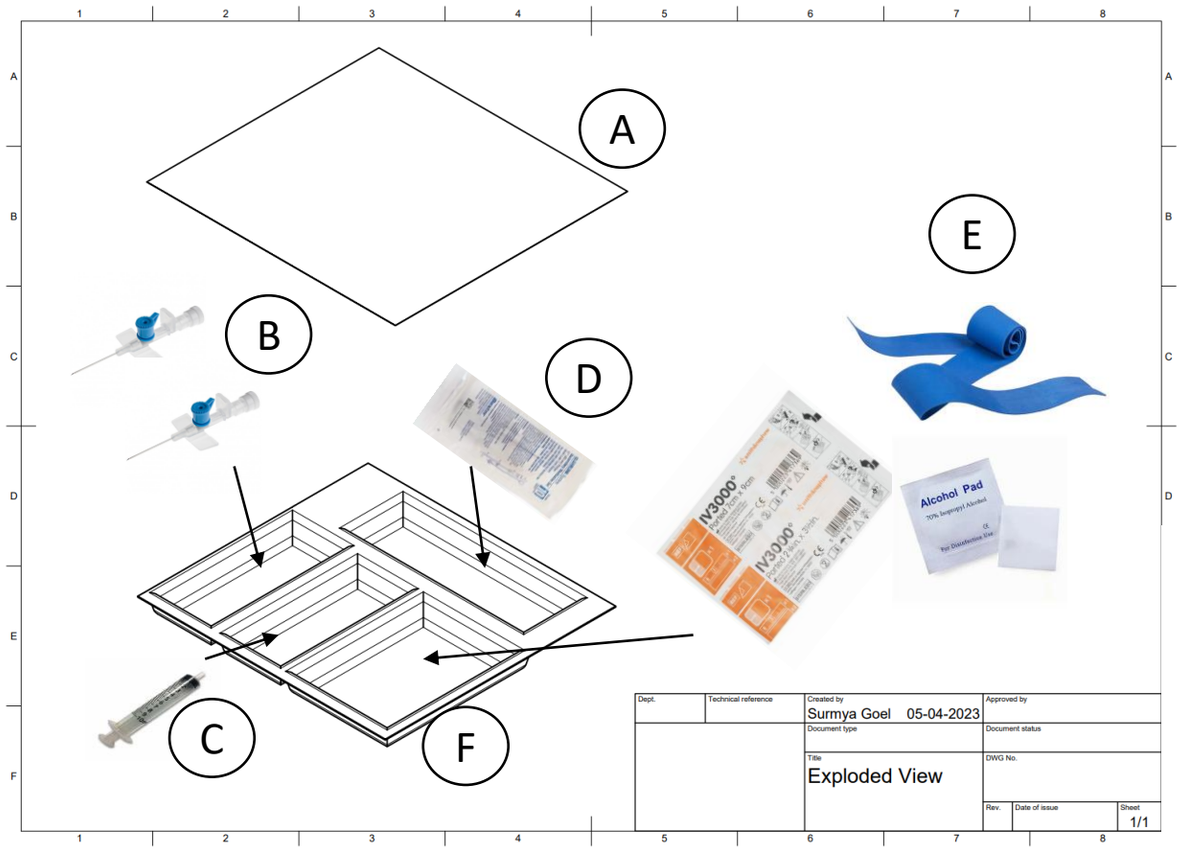
Moldability- Yes

Stack ability- Yes

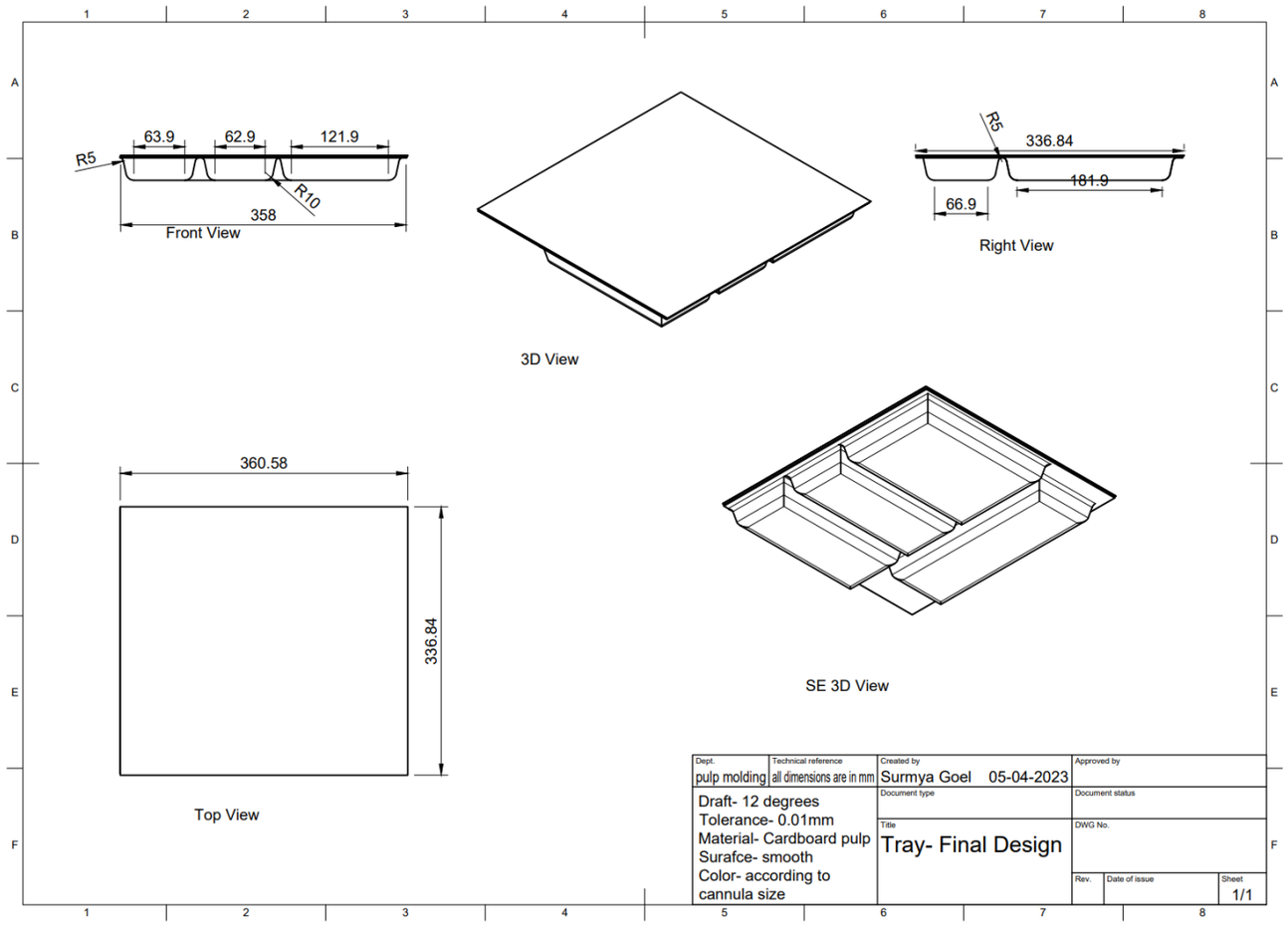
Weight- 261.5 grams low weight = low CO2 emissions while transporting

Strength- Needed 3.9kgs strength has 7 kgs strength

Exploded Drawing & Engineering Drawing



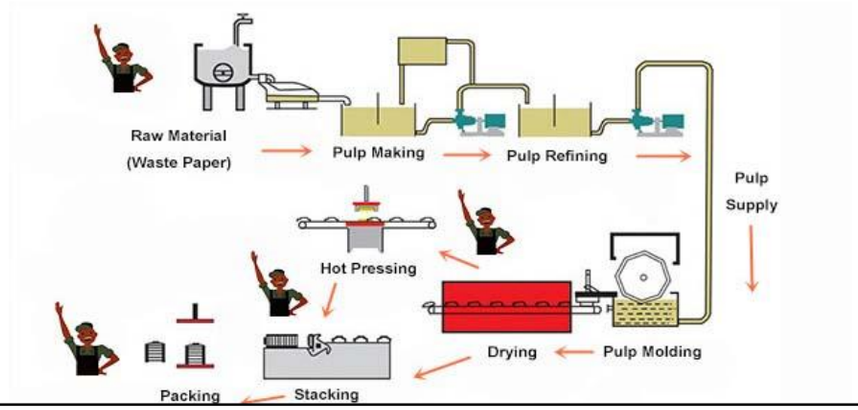
	Component
A	Printed Seal
B	Cannulas
C	Syringe
D	IV extension
E	Dressing, tourniquet, swab
F	Tray



Manufacturing & Cost

Pulp molding - Assembly of equipment - Seal –Print- Sterilize - Ship

1. Manufacturing



("Egg Tray Production Process | Egg Tray Manufacturing Process," n.d.)

2. **Manual assembly** on conveyor belt- one by one
3. **Plastic Seal-** By a company "Graphic Packaging International" (Atlanta, Georgia, United States)
4. **Printing-** Date of manufacture, expiry date, batch number, instruction of use, contents and sterlized
5. **Steam sterilization**

	Cost (Rs) /100000 pieces	Cost (Rs) /piece
Raw material	₹500,000	₹5
Mold	₹2,000,000	₹0.02
Machine	₹2,500,000 (5000pcs/hour)	₹2.5
Electricity	₹20,000	₹0.2
Plastic seal	₹15,000+160,000	₹0.175
Printing	₹32,000	₹0.032
Labor wages	₹4,980	₹0.05
Freight	₹4,877,888	₹ 4.8
Recycling	₹20,000	₹0.2
Total=	₹100,519,888	₹12.977= £ 0.129

Total equipment cost= ₹16
1:3 rule, Cost : Price
£0.28977 : £1