

# D-LAB HEALTH | DESIGN CHALLENGE WORKSHEET

Problem or need: Patients with severe burns require skin grafts. Surgeons use a tool called a dermatome that can cut away very thin layers of skin for self-transplantation. The existing tools break often and are very difficult to replace. They are very expensive. The parts are made out of surgical steel which complicates on-site repair.

Background information (Why do you use this equipment, what is the treatment that is sought, what does the entire process entail): The instruments is essential to be able to take specific layer of skin and transplant it to another part of the body of a burn patient. In addition, they are also used to excise diseased skin which needs to be removed.

Technical description/specifications: Pneumatic power. Runs on nitrogen gas. Local doctors have been able to use a Caulfield compressor running at 12hp with 80 PSI. Lower PSI induces resonance and vibration. Perhaps this is why the parts break off?? A broken one is being taken back to MIT for dissection. Dr. Sheridan suspects the cams are the weakest link. They are made out of a compound materials. Part surgical steel, and some other ABS plastic. It does DOES NOT show sign of wear and tear on the outside.

How is the local user community approaching the problem? What type of improvised, or local solutions are being used? A nurse aide in Honduras dunked the entire apparatus in liquid nitrogen for 30 second every 30 minutes. This seems to stabilize the parts and they claim to make them last longer. The problem is that they also run out of liquid nitrogen. A German titanium coated version is in use and has not broken, but that is \$18,000!!

Who is the primary contact for this challenge? Dr. Sheridan and Dr. Lopez

Who are the key stakeholders (do you have their contact info? if not, get it...)

| Name        | Role                                   |
|-------------|--|
| Luis Medina | Local biomedical tech                  |
| Sarai Funez | Honduran nurse aide - Nitrogen dunking |

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What relevant resources are available? Consider materials (not just local materials, if they are imported, then just note it. Don't get hung up in price. Cost is best defined as how difficult it is to obtain. Difficulty MAY include price, but may also be affected by other issues. Also consider resources to obtain relevant training, and frequency of supply. Use the parameter table.

*There are machine shops on the outskirts, but mostly focus on automotive parts. NO precision fabrication. There is an abundance of precision parts for the printing industry (mostly high speed photocopiers). We may be able to borrow some high speed cams to compare the wear and tear. Compressors are widely available.*

What resources may be needed? *Compressors. Pneumatic connectors. Safety valves. Precision machine fab shops. Cheap injection molding.*

*Expert help with: plastic cutting, compression of materials, biosafety of plastics in surgery. Can someone at Gillete help us? Local manufacturing of either the blade or the cam might be an option. Operator training and an autoclave that won't compromise material strength is also important.*

What are the potential benefits of solving this challenge? *Locally available sources for parts make this device more sustainable. Also, if the device is reliably available, more patients can be saved.*

What are the potential obstacles? *We are concerned with long-term quality control. The point is to have a disposable cam that is cheap. If it is reused it could break. Currently, very little research has been in plastics that cut AND can be autoclaved. More information on sterilization options is necessary. If the device has a different feel given that we may have to lower the PSI, then surgical retraining might be necessary.*

What are the risks of undertaking this project? *This is high risk surgery that requires precision. Contamination of a reused disposable product could lead to infection. ← Can we get an antibacterial coating???* *Can you "sterilize" it...or does that defeat the purpose?*

How can you get the local user community involved in the process? *Learn about locally available sterilization options. They have some advances with material pre-processing (the nitrogen) that could be essential to understanding how to lengthen tool life. They are the doctors, and they can continue to show us their surgical techniques to co-design a better instrument.*

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What photographs and videos should you take? (take them!!) \_\_\_\_\_

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What additional information should you collect? (collect it!!) \_\_\_\_\_

\_\_\_\_\_

## Checklist

- Did you see the patient?
- Did you see the user go through the process?
- Did you interview people high and low along the solution chain?
- Where you able to deflect “preventative” measures that do not address the problem at hand? (e.g., *clean water to avoid cholera instead of a better IV for the patient once he has cholera*)
- Where you able to deflect big science solutions that are far away from solving the problem at hand? (e.g., those in the upper right hand of the Global Health Innovation Compass; those that rely on fancy technology that is years and millions of dollars away being delivered)
- Did they share some anecdotal “war stories” on how they deal with the issue?
- Did you go through the parameters of design to obtain a vantage point from each parameter?
- Did you look at the design strategies so brainstorm some potential solutions?
- Where you able to share some initial ideas with your user?
- Did you sketch out the problem?

## D-Lab Health Medical Device Design Attributes

| Essential  | Enhancing   | Long-Term  |
|--|---|--|
| <ul style="list-style-type: none"><li>• SAFE</li><li>• Accurate</li><li>• Robust</li><li>• Longevity</li><li>• Cheap</li><li>• Reliable</li><li>• Reusable/Disposabl</li><li>• Redundant</li></ul> | <ul style="list-style-type: none"><li>• Mobile</li><li>• Connected</li><li>• Smart</li><li>• Plug n’ Play</li></ul> | <ul style="list-style-type: none"><li>• Local Manufacturing</li><li>• Local Innovation</li></ul> |

## D-Lab Health Medical Device Design Strategies

- Hybridization = Two types of technologies mashup up
- Vintage Technologies + Smart Design/Tech = New Solutions
- Finding an invention in an improvised solution and sprinkling some engineering
- Bottom up observation: What are the people telling you? What are the users saying?
- Be trendsetting, not trendy
- Context shifting
- Distributed Systems: Decentralizing solutions by using many nodes that talk to each other
- Crowdsourcing: Using many individuals working as a passionate army to arrive at a solution

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