

## Elixir Problem Statement

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This year, we are proposing an open biomedical design competition, in order to stimulate creative and innovative students to come up with solutions to current problems that impact the quality of health care in urban and rural areas. We have provided some sample problems below. However, a participant can submit any other idea that will have an impact on the current state of healthcare in India.

### **Low cost, Portable, Subcutaneous Infusion Pump**

A subcutaneous infusion is an infusion of fluid under the skin. Also known as hypodermoclysis or interstitial infusion, this technique can be used in the treatment and management of many health conditions, especially when care is being provided at home. In a subcutaneous infusion, a needle is inserted under the skin, rather than into a vein (blood vessel), and connected to an infusion pump which allows fluid to slowly enter the injection site. This may be as simple as hanging a bag of fluids and allowing gravity to do the work, or a mechanized pump may be used to precisely control the dosage and to allow the patient to adjust it, if necessary. This includes pumps which can be attached to the body of patients who need long term subcutaneous infusions. Some patients cannot take medications orally or rectally and have poor venous access, making subcutaneous infusion the best method for drug delivery. This method is also inexpensive to administer and it can be performed by people without formal medical training.

*To develop a low cost, portable, infusion pump, suitable and affordable at personal level by middle income group among Indian patients.*

### **Breath Monitor**

In newly born babies the temperature of breath and respiratory rate plays an important role in determination of diseases in newborns. The average rate of breathing in newborns is 44 breaths per minute. There are various diseases that can be due to alteration in respiratory rate. Abnormal breathing rates in babies are often an indication of some problem. Breathing rate thus becomes an important tool for early diagnosis of diseases.

*The challenge is to design an instrument that can measure respiration rate (time interval between two breaths) and temperature of air exhaled out.*

### **Suturing of Skin**

Suturing of skin is the stitching together of skin tissues. Sutures are a necessary component to the healing process after any serious injury or a surgery. Many a times, due to lack of time and manpower, suturing is not done properly. Improper suturing leads to adverse effects, including infections, a re-opening of the wound, blood loss, and heavy scarring.

*The challenge is to design an automatic machine which can do suturing of skin (for superficial cut). The machine should be able to do cleaning of cut area, do good approximation so that edges of skin tissues*

*come in contact while suturing. The material used to stitch can be a sponge with cover of thin leather or cycle tyre tube and stitching can be done with the use of surgical suture thread.*

### **Blood Pressure Measuring Apparatus Failure Detection**

Measurement of blood pressure is a very important part of diagnosis. There are three types of blood pressure measuring apparatus available in the market-Mercury Column Based, Dial type and electronic. The expectation however is that they would be used once or twice per day at home. These devices last many years when used according to expectations. However, in government hospitals, they are used 24 hours a day. Due to excessive usage the product usually fails earlier than expected.

*The task at hand is to device an instrument which should be able to check whether a blood pressure apparatus has failed or not. The device should be able to detect whether an apparatus is giving proper readings and should also be able to re-calibrate the apparatus.*

### **Playful Feedback Mechanism for Muscle Tone Control**

Cerebral Palsy is a condition in which people face problems co-ordinating muscle movement since they lose muscle tone control. Normally, our muscle motion is highly coordinated and precise whereas in a person with cerebral palsy condition, muscle motion is highly un-coordinated and jerky. By introduction of feedback system it might be possible to help the children in controlling their muscle movement. Feedback systems involve doing actions and getting a reaction (response) for that particular action. The feedback can be either audio or visual or combination of both, and can be designed in the form of a small game for keeping the child occupied for at least half an hour. The feedback can also be in the form of competition between two children. The system would also be useful for normal children to develop their motor skills from early childhood.

*Develop a portable system (game/toy) which can be used either by toe tips or by fingers to get a feedback from the actions of muscles in hand or legs. The feedback can be a qualitative or quantitative way to help the child control his muscle movement. The idea is to have a system (game/toy) which can generate different responses for different muscle movements.*

### **Prosthetic Limbs**

The human body is a remarkable piece of biological machinery, but having physical incapacity as a result of the loss of a limb is tragic. With the advancement of science and technology, artificial replacement through prosthetic limbs has improved lives of many disabled people. The scope for discovery and innovation in the field of prosthetics is limitless. Till now, prosthetic limbs available are very costly and not technologically advanced. They lack the capability of integrating with the human body and work as a real limb.

*The challenge here is to make prosthetic limbs which can be integrated with body part and can effect movement by sensing facial expression, muscle movement, eye motion etc. (for ex. If you are making a*

*prosthetic hand then the muscles of the upper part of the hand can be used as stimulus for movement of the prosthetic limb).*

### **Innovate and Create**

The fields suggested above are just few examples to initiate the thought process and should only be taken as a starting point in the innovation process. The participants are free to choose any field in which they feel the need to innovate and come up with solutions. Also provided below is a pool of ideas encompassing various aspects of the healthcare systems today.

**The list given below is not exhaustive and should be used as reference –**

1. Mechanisms to detect, rehabilitate or prevent falls while walking in patients suffering from Parkinson's condition.
2. Non-invasive blood monitoring systems for measuring glucose concentration, urea, hemoglobin level.
3. Light weight, portable baby incubator affordable by primary health centers in rural areas and which can work while transferring baby in 3 hours from a primary healthcare centre in village to nearby hospitals. The device should be following all specifications required for premature babies like temperature, oxygen supply, humidity and sterility etc.
4. Devise a small automated thermometer with storage capacity, which can store data of fluctuation in temperature over a period of time. The device should not interfere with the patient's sleep or work.
5. Devices and systems for advancement of healthcare in rural areas.
6. Mechanisms/devices for safe disposal of medical waste in an environment friendly way.
7. Pulse analyzing device to measure pulse rate, blood flow in pulse and analyze the type of pulse (thread, smooth, wiry or normal).
8. Portable, low-cost microscope with image processing system and send the image to nearest hospital through data transmission.
9. Low-cost diagnostic kits for diseases like Malaria, MDR tuberculosis, AIDS etc. and presence of pathogens in air or water.
10. Walking aids or computer aided navigation devices for the blind which help them in easy movement by detecting obstacles in their path and communicating their position and that of the surroundings.
11. Wireless devices like ECG.
12. Stethoscopes which can analyze sound pattern store it and transfer that information to mobiles etc.

**Note: If you can come up with any other such problems, solutions for them are also invited.**