Design of a Medicine Cold Storage for Electricity Intangible areas

Project III

By
Nikita Fatarpekar
176130014

Guide – Prof. Avinash Shende

Industrial Design Centre
Indian Institute of Technology
2019

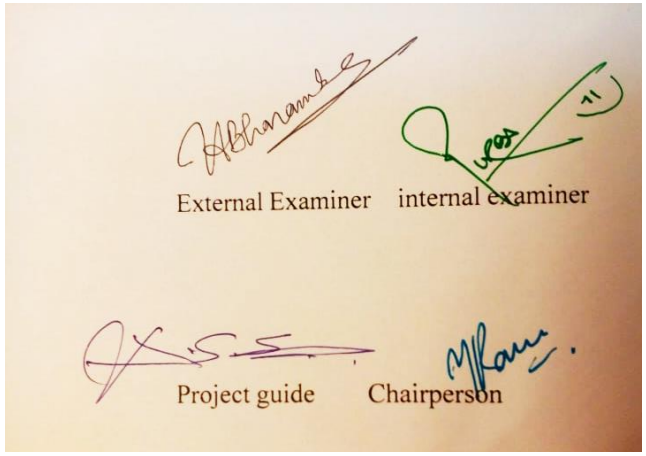
Approval

Industrial Design Project – III

Design of a Medicine Cold Storage for Electricity Intangible areas

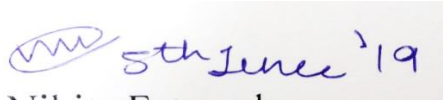
Name : Nikita Fatarpekar
Roll no: 176130014
Department : M.Des in Industrial Design
Batch : 2017- 2019

Is approved as a partial fulfillment of a requirement of a post graduate degree in Industrial design at IDC , IIT Bombay



Declaration

I declare that this written document represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I have also declared that I have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsed any idea / data /fact / source in my submission. I understand that any violation of the above will be cause of disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



Nikita Fatarpekar
176130014
M. Des (ID)
Industrial Design Centre
Indian Institute of Technology, Bombay

Acknowledgement

I take this opportunity to thank the entire faculty at IDC School of Design for the inputs that helped me successfully complete this project successfully. I express my gratitude to my guide Prof. Avinash Shende for his consistent support and guidance in this project.
The feedbacks I received at every stage of the project were immensely helpful and it allowed to look at a wider perspective of the project. Last but not the least I am grateful to my classmates for contributing their valuable insights to this project.

Abstract

As we are all aware of the Medication and its importance for healthy and quality living. Medication by injecting medicines that are effective in the cold state is an aspect of medication. There is a whole set of refrigerated medicines developed for a betterment of human life. This project focusses on the need of a portable cold storage product for the rural population involved in treatment and medication.
The project was to design a medicine cold storage in electricity intangible areas for health workers for treatment and medication in a rural area.

Content

A cold chain is a temperature-controlled supply chain which is required to preserve and maintain perishable products like food items, chemicals and pharmaceutical products.

It involves constant refrigeration of the product from the time of its production, through its transportation, handling and storage, right up to delivery.
Pharmaceutical cold chain management is an important aspect of the supply chain in the healthcare industry.

The cold storage services help the pharmaceutical and healthcare industries maintain a continual stock of drugs from suppliers and distributors across varied locations.

Historically the pharmaceutical industry was not a big consumer of cold storage. This was because majority of its drugs did not have to be stored or transported in a temperature controlled environment.

It is only in the recent past that there has been an eruption of cold chain activities due to the growing acceptance of a new class of drugs called biologics.

Even though biologics have recently been introduced in the world of medicine, they have already taken the market by storm. Biologics excel not only in terms of their treatment capability, but also in terms of the demands they are placing on the pharmaceutical supply chain as most biologics require both temperature and time-controlled distribution.

We also need to consider the fact that manufactured drugs have evolved to contain more high-value ingredients. They have a shorter shelf life and stricter temperature requirements for storage. Thus, the need for temperature control and monitoring through the entire supply chain has increased.

Even drugs that are safe at room temperature may need protocols to avoid the risks associated with transportation at ambient temperatures or Controlled Room Temperatures (CRT) which include the use of insulated containers, refrigerants, thermal blanketing and temperature-monitoring electronics

1. Early marriage and conceives children at early age.
2. Low weight babies
3. Existing Nutrition issues
4. Weakness and diseases
5. Vadya Medication
6. To save other 11 kids of the 12 as there is a Single earning member
7. Each village is 30 km away
8. No proper Transport
9. 1 lakh Population
10. Each settlement has 600 people
11. Mountain region

Figure 1. Early marriage and conceives children at early age.

Figure 2: Each village is 30 km away

Figure 3. Present Scenario of medicine storage

Figure 4. Vadya Medication

Need of Medicine cold storage :

1. Constant temperature
2. Protection from ambience pollution
3. Refrigeration to medicines

Cold storage terminology :**Understanding the common manufacturer's terms for medicine storage**

Store at 2°-8°C (36°-46°F)
Some medical products can be very sensitive to heat but they should not be frozen either. "Inactivated" vaccines are most commonly stored at these temperatures. Exposing them to temperatures outside these parameters could lead to a decrease in their effectiveness.

Store frozen
Products such as "live" vaccines require storage temperatures ranging from -20°C to -10 °C as they will deteriorate quickly when they are removed from the freezer. "Live" vaccines are commonly used for diseases such as measles, mumps, rotavirus, etc.

Keep cool
Medicines and other medical products or supplies that are labelled "Keep Cool" should be stored between 8°-15°C (45°-59°F).

Store at ambient temperature
This term is not commonly used because of many variations in the surrounding temperatures. "Store at Ambient Temperature" also means to store medicines in normal conditions, with a room temperature ranging from 59°F to 77°F, depending on climate conditions.

Room temperature
Most medicines simply need to be stored at room temperature, which is between 15°-25°C (59°-77°F) but others are sensitive to extreme temperatures.

In general, medicines should always be kept in a cool, dry place, away from sunlight and moisture. Different instruction terms should also be considered (and followed) at all times to maximize their effectiveness

Definition

The term **cold chain** or **cool chain** denotes the series of actions and equipment applied to maintain a product within a specified low-temperature range from harvest/production to consumption. A **cold chain** is a temperature-controlled supply chain. An unbroken cold chain is an uninterrupted series of refrigerated production, storage and distribution activities, along with associated equipment and logistics, which maintain a desired low-temperature range. It is used to preserve and to extend and ensure the shelf life of products, such as fresh agricultural produce, seafood, frozen food, photographic film, chemicals, and pharmaceutical drugs. Such products, during transport and when in transient storage, are sometimes called **cool cargo**. Unlike other goods or merchandise, cold chain goods are perishable and always en-route towards end use or destination, even when held temporarily in cold stores and hence commonly referred to as cargo during its entire logistics cycle.
Cold chain logistics includes all of the means used to ensure a constant temperature for a product that is not heat stable, from the time it is manufactured until the time it is used. Moreover, cold chain is considered as a science, a technology and a process. It is a science as it requires the understanding of the chemical and biological processes associated with product perishability. It is a technology as it relies on physical means to ensure desirable temperature conditions along the supply chain. It is a process as a series of tasks must be performed to manufacture, store, transport and monitor temperature sensitive products.

Applications

Cold chains are common in the food and pharmaceutical industries and also in some chemical shipments. One common temperature range for a cold chain in pharmaceutical industries is 2 to 8 °C (36 to 46 °F), but the specific temperature (and time at temperature) tolerances depend on the actual product being shipped. Unique to fresh produce cargoes, the cold chain requires to additionally maintain product specific environment parameters which include air quality levels (carbon dioxide, oxygen, humidity and others), which makes this the most complicated cold chain to operate.
This is important in the supply of vaccines to distant clinics in hot climates served by poorly developed transport networks.

Mobile refrigeration was invented by Frederick McKinley Jones, who co-founded Thermo King with entrepreneur Joseph A. "Joe" Numero. In 1938 Numero sold his Cinema Supplies Inc. movie sound equipment business to RCA to form the new entity, U.S. Thermo Control Company (later the Thermo King Corporation), in partnership with Jones, his engineer. Jones designed a portable air-cooling unit for trucks carrying perishable food, for which they obtained a patent on July 12, 1940, subsequent to a challenge to invent a refrigerated truck over a 1937 golf game by associates of Numero's, Werner Transportation Co. president Harry Werner, and United States Air Conditioning Co. president Al Fineberg

https://en.wikipedia.org/wiki/Cold_chain

Double section Miller Chiller

- 1-3 Tons
- Rs. 0.75-1.8 Lakhs
- Electricity
- Mainly Milk
- Urban Rural

Double section miller is mainly used for cooling and chilling milk before transportation. It has a capacity of one – three tons of milk in each unit. The setup and the unit is in rural context from the milk is transported to cities in urban settlement. The unit runs on electricity. The unit requires a lot of space and can be run only by professionals.

Household refrigerator

- 180-810 Litres
- Rs. 9485-259999
- Electricity
- Food
- Urban/Rural

This is a normal kind of a refrigerator that is being used in any household. This refrigerator ranges from nine thousand to one lakh rupees. Most of the refrigerators work on electricity. It range of the capacity is from 180 liters to 810 liters. It is mainly used for food refrigeration. It is used in household use. This refrigerator can be used in places with electricity irrespective of urban and rural context . The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space.

Mini Refrigerator

- 45-52 Litres
- Rs. 6990-9950
- Electricity
- Food
- Urban/Rural

This is a normal kind of a refrigerator that is being used in any studio apartment. This refrigerator ranges from seven thousand to ten thousand. Most of the refrigerators work on electricity. It range of the capacity is from 45 liters to 52 liters. It is mainly used for food refrigeration. It is used mainly while travelling. This refrigerator can be used in places with electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space. It is used in car.

Chotu Kool

- 35 Litres
- Rs. 6990
- Thermoelectric
- Food
- Rural

This is a refrigerator that is being used in particularly a rural context. This refrigerator costs about a seven thousand. Most of the refrigerators work on Thermoelectric principle of cooling. It has a capacity of 35 liters. It is mainly used for food refrigeration. It is used mainly while towns and villages. This refrigerator can be used in places with shortage of electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space. It is used in a mud house too.

Windchill

- Few Litres
- Rs. 17000
- Thermoelectric through wind
- Food
- Urban

This is a refrigerator that is being used in particularly a rural context. This refrigerator costs about a seventeen thousand. This refrigerator work on Thermoelectric principle of cooling. It has a capacity of few liters. It is mainly used for food refrigeration. It is used mainly while towns and villages. This refrigerator can be used in places with shortage of electricity irrespective of urban and rural context with a prime amount of wind energy. The refrigerator needs a trained individual and can be used by only a certain group of people. It can be set up only in a wind zone area in external areas.

Peltier based

- 12.5 Litres
- Rs. 5800
- Thermoelectric
- Food
- Rural

This is a refrigerator that is being used in particularly a rural context. This refrigerator costs about a six thousand. This refrigerators work on Thermoelectric principle of cooling. It has a capacity of 12.5 liters. It is mainly used for food refrigeration. It is used mainly while towns and villages. This refrigerator can be used in places with shortage of electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space. It is used in a mud house too.

Car driven

- 7.5 Litres
- Rs. 2900
- Car power/Electricity
- Beverages
- Portable

This is a normal kind of a refrigerator that is being used in any travel. This refrigerator costs around three thousand rupees. Most of the refrigerators work on electricity either directly on by car driven electricity. It can hold 8 liters of water. It is mainly used for food and beverage refrigeration. It is used mainly while travelling. This refrigerator can be used in places with electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space. It is used in car.

Mitti cool

- 50 Litres
- Rs. 8000
- Natural cooling
- Food
- Rural

This is a clay refrigerator that is being used in any electricity intangible areas. This kind of refrigerator does not need refrigerator. It has a capacity up to 50 liters. It is mainly used for food refrigeration. It is used mainly in a household. This refrigerator can be used in places without electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space.

Reference: https://mitticool.com/product/mitticool-clay-refrigerator50-liter/

Pot -in - pot Refrigeration

- 50 Litres
- Rs. 500-700
- Natural cooling
- Food
- Rural

This is a basic kind of a refrigerator that is being used in any electricity intangible areas. This kind of refrigerator does not need electricity. It has a capacity up to 50 liters. It is mainly used for food refrigeration. It is used mainly in a household. This refrigerator can be used in places without electricity irrespective of urban and rural context. The refrigerator can be used by a untrained individual and any age group people. It does not occupy much space.

Aristo Insulated Chiller Ice Box

- 50 Litres
  - Rs. 500-700
  - Natural cooling
  - medicines
  - Rural

This is a basic kind of a refrigerator box that is being used in any electricity intangible areas. This kind of refrigerator box does not need electricity. It has a capacity up to 50 liters. It is mainly used for medicine refrigeration. It is used mainly in a medicine carriage in rural places. This refrigerator box can be used in places without electricity irrespective of urban and rural context. The refrigerator box can be used by a untrained individual and any age group people. It does not occupy much space.

Milton Medical Box

- 2500 ml
  - Rs. 500-700
  - Natural cooling
  - medicines
  - Rural

This is a basic kind of a medicine carriage box that is being used in any electricity intangible areas. This kind of refrigerator box does not need electricity. It has a capacity up to 2.5 liters. It is mainly used for medicine refrigeration. It is used mainly in a medicine carriage in rural places. This refrigerator box can be used in places without electricity irrespective of urban and rural context. The refrigerator box can be used by a untrained individual and any age group people. It does not occupy much space.

	Name of technique	Resourse	Place	Cost	Uses	Volume
1.	double section miller chiller	electricity	rural - urban	0.75-1.8 lakhs	mainly sudden cooling of milk	10 tons
2.	solar refrigeration for rural applications s. o. Enibe	solar energy	rural		food and drug	100 litres
3.	Godrej chotukool	thermoelectric	portable	Rs. 6990	food , beverages	35 litres
4.	windchill	water wind	rural	Rs. 17000	food preservation	
5.	peltier based	thermoelectric	portable	Rs. 5800	food preservation	12.5 liters
6.	clay pot refrigerator	natural cooling	rural	Rs. 8000	cooked food	50 litres
7.	solar integrated vapor absorption and adsorption refrigeration	solar energy	rural			

Statement : Medicine cold storage for electricity intangible areas.

Objectives :

- Is to design a cold stage device for **electricity intangible** places
- Which meets the demands of **normal medical refrigeration** of different medicines needed
- Easy to **carry and operate** in remote parts of village
- User friendly

Brief :

The problem is to design a cold storage device for **medical workers** mainly.
It has to be accessible by them in remote parts of village with no electricity , which improves medicine **carriage and storage**.
Reducing the efforts while **moving across** places and houses.
As medicine intake forms major parts of any treatment , yet **200 million people in India** still lack access to electricity.
The object has to be friendly and feeble by all that encompasses new technology and medicinal needs.
The device is meant for various **health facilities** in electricity intangible places , to be used by medical workers only.
Governed by standards that is independent to be based in any **environment and geographical conditions**
The product is a **new** of its kind to be idealized to be manufactured and developed over years that helps the purpose of **development of society**.

Product Positioning :Targeting the audience *of :*

1. ***Travelling*** : from a trip to work as it is needed among the asha workers.
2. It shall involve ***packaging*** as a feature - as it has to be portable
3. Designed for a ***lower economical group*** - since the problem arises for that source.
4. Highlighting the importance of light in weight- ***portable***.
5. Carrying forward the key message of ***security and safe***.
6. ***Low pric***e in comparison to the competitive products.

Product Features :Targeting the product *for :*

1. ***Can be held by physically challenged*** for the universal use - Such that it can be used by the minimum surface of the hand and minimum movement.
2. ***Easy to fix/fill*** for the different fixtures already exists.
3. ***Levels of uses*** , in various forces and **speeds** for different purposes and uses.
4. ***Purification*** is the outlet level for the maintenance of the hygiene.
5. ***Security*** , in a form for precaution from transmittable diseases.
6. ***Convenient*** for the asha worker's in terms of usage.

Initial Ideations

a) Refrigerators that open on the top are more efficient than vertical ones, because hot air rises while cold air falls.

b) The coldest part of vertical refrigerators is at the bottom.

c) Store products that are sensitive to freezing or very low temperatures can be kept on the upper shelves.

d) Water packets between the space, as water in the refrigerator will help maintain the temperature for a longer period of time if the power is cut off.

e) 1/5th part shall be portable with phase change material with the kinds of freezing

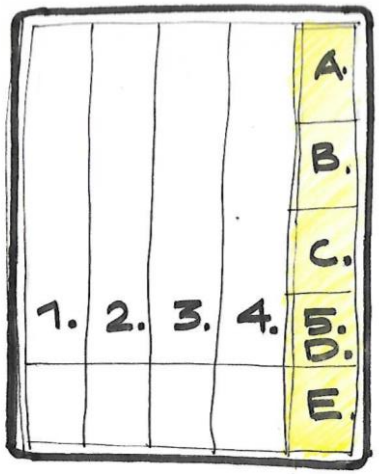


Figure e)

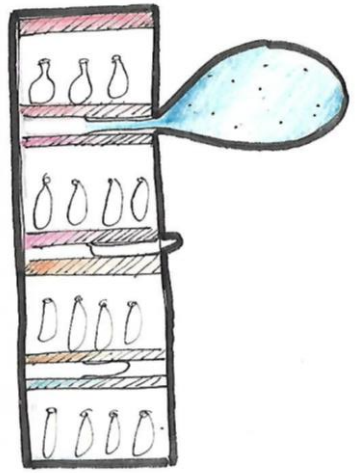


Figure d)

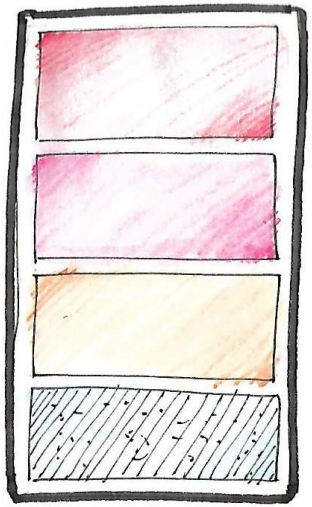


Figure b)

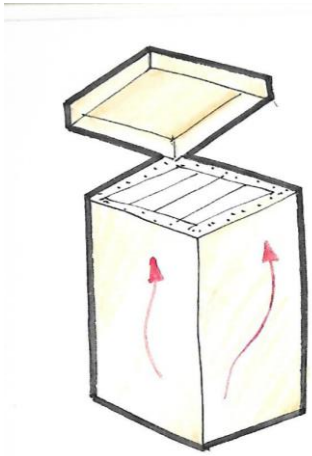
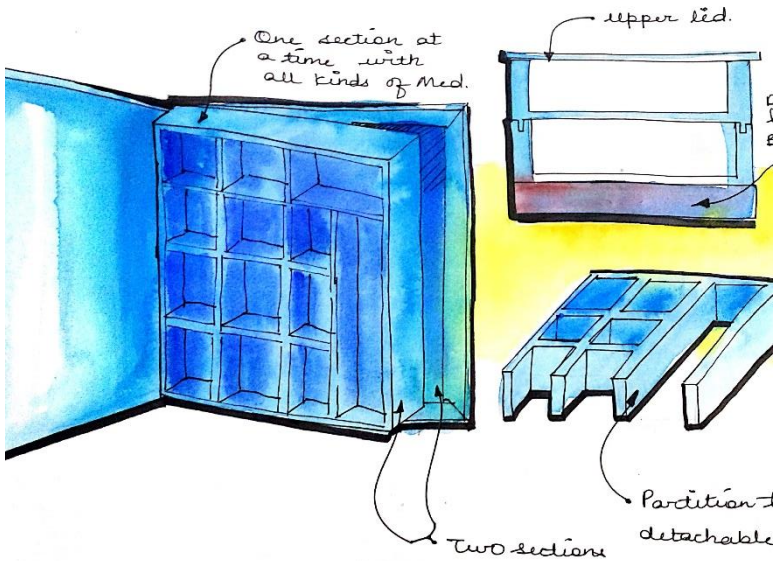


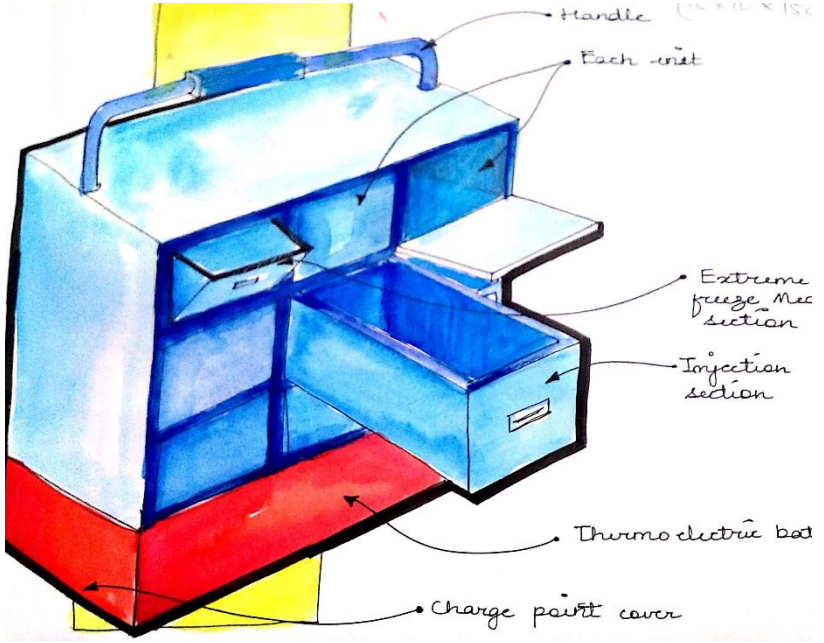
Figure a)

Initial Ideations – Idea 1 :



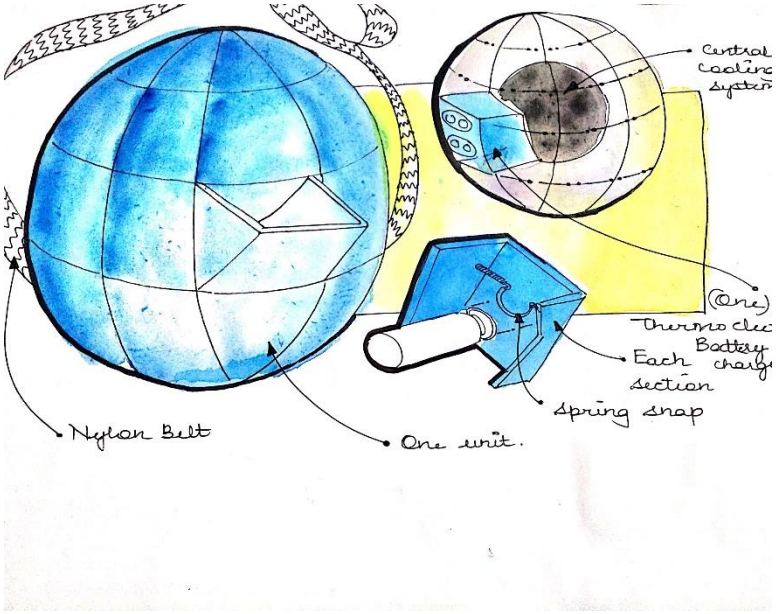
Ideation 1: In this the medicines shall be filled in two different levels or trays and each of them will have a adjustable plates so that the number of bottles could be varied according and the different needs can also be encompassed in it. It can rightly fit into the bag. The cooling shall be from the bottom surface.

Initial Ideations – Idea 2 :



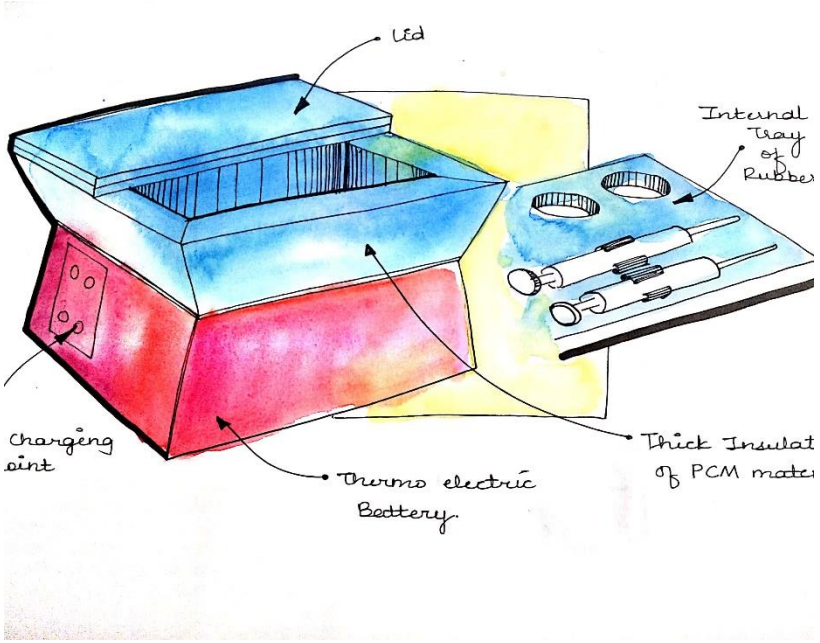
Ideation 2: In this the medicines shall be filled in different levels or height in vertical manner. each of them will have a drawer so that the number of bottles could be fitted according to the needs. Also injection of longer dimensions can also be encompassed in it. It has to be held in hand and travelled and hence can be tedious. The cooling shall be from the bottom surface.

Initial Ideations – Idea 3 :



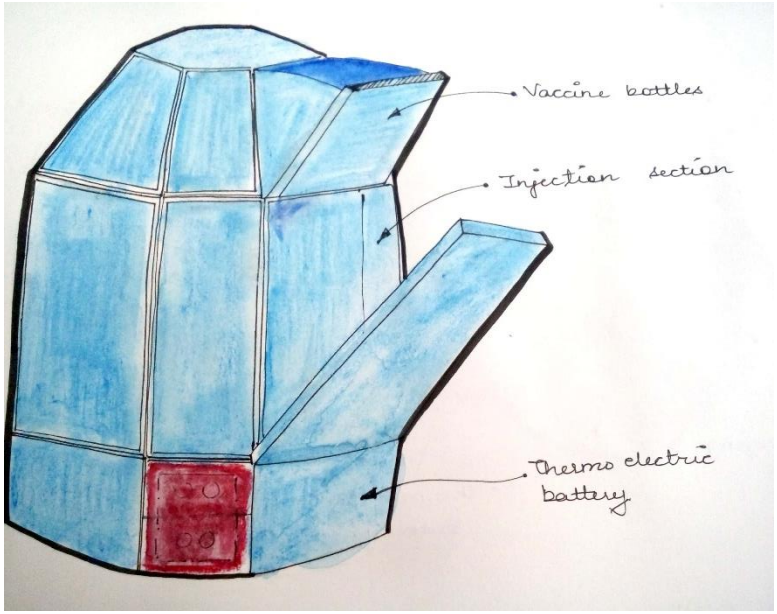
Ideation 3: In this the medicine shall be carried in each of the sectoral unit and the whole unit will be a sphere such that the core part of the unit provides cooling. Since each of the part is connected to the core cooling part is shall provide direct cooling. In this each sector unit would be pulled out and fed by medicines in it

Initial Ideations – Idea 4 :



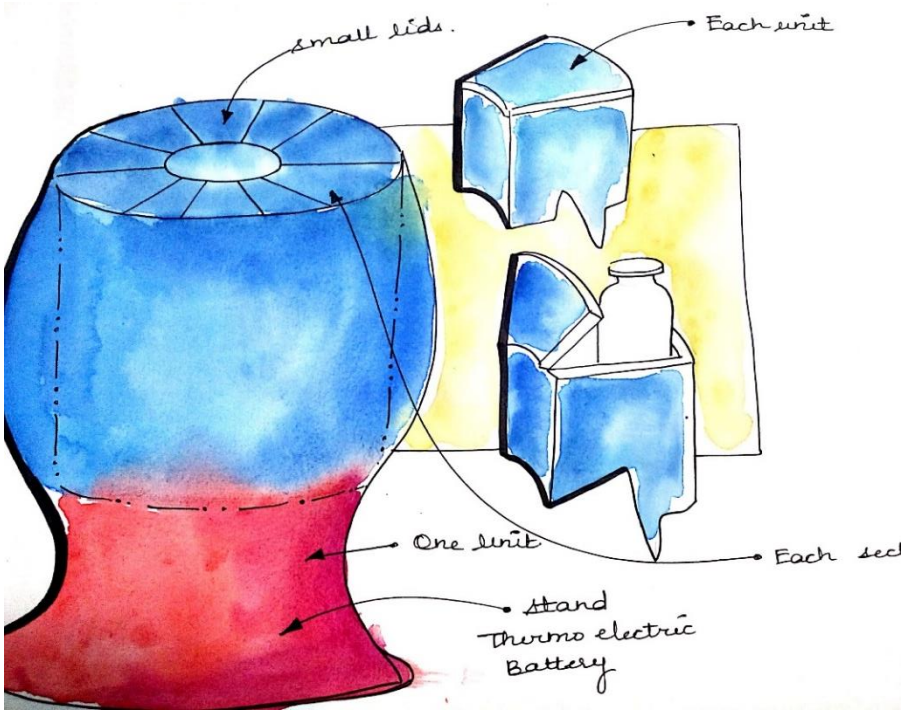
Ideation 4: In this the medicine shall be carried in the central unit box which shall have customizable tray to fit in the medicines. The base shall give the power to cool the unit. Since only half of the unit can be opened at a time, medicines shall remain more cooler efficiently.

Initial Ideations – Idea 5 :



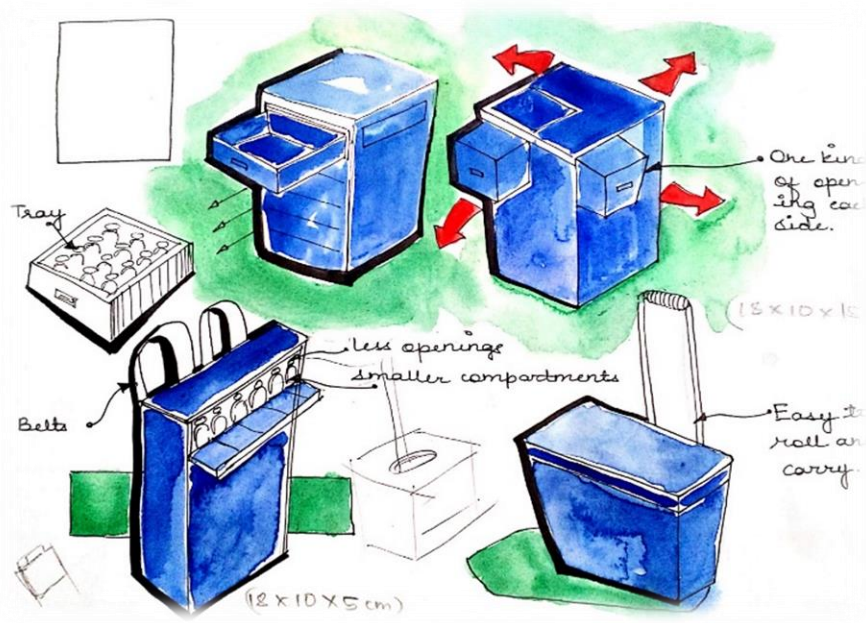
Ideation 5: In this unit the medicines will be carried in a vertical chambers with several openings of different sizes. The top most chamber would open angularly with lesser unit consumption while the bottom chambers could fit in injections and more bottles of medicines. The charging plug chamber at the bottom for the comfort of changing and servicing batteries.

Initial Ideations – Idea 6 :



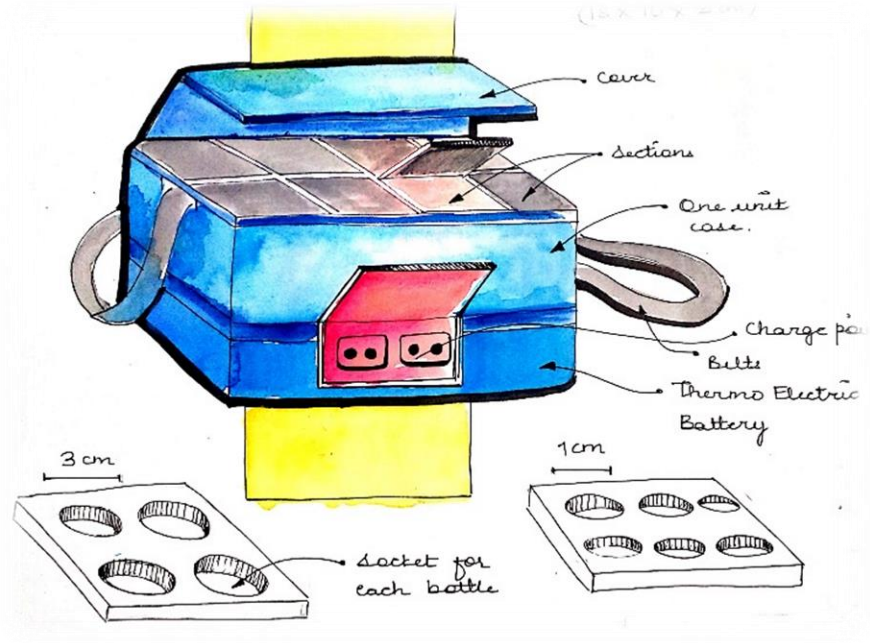
Ideation 5: This is a smaller carrying unit to carry medicines with lesser chambers and smaller opening the benefit of this carrying unit is easy to carry and colder regions of cooling. Each chamber opens by simple vertical push and then closes with normal push. Each chamber has only one bottle storage capacity and provides more cooling to each chamber.

Initial Ideations – Idea 7 :



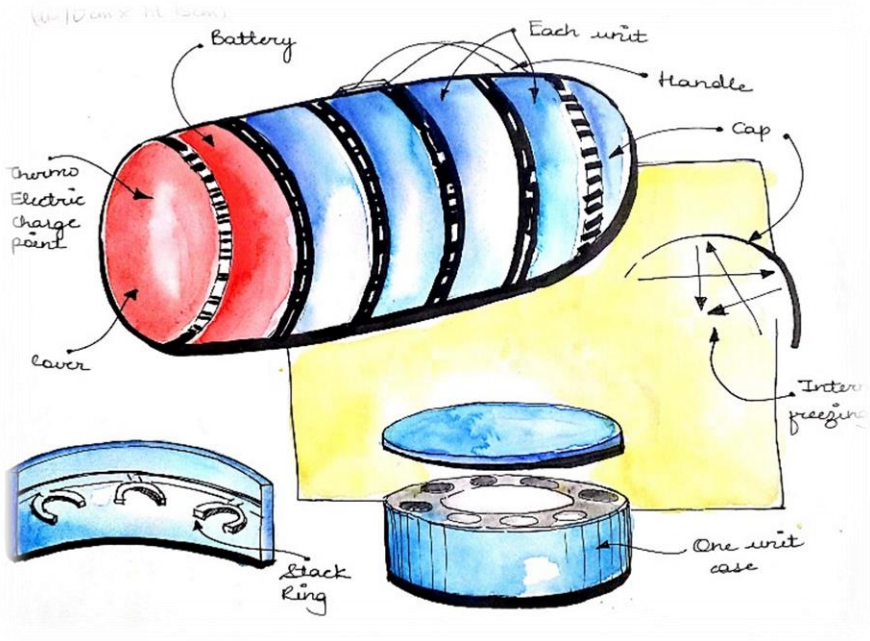
Ideation 7: In this unit the medicines will be carried in a vertical fashion with different chambers from top to bottom. The unit would have different drawers from one or more sides. It can be carried by wheels at the bottom and or by carrying it on shoulders by using the back belts. In this the medicines can be stacked in huge number and also be carried easily.

Initial Ideations – Idea 8 :



Ideation 8: In this unit there shall one major opening cover after which there shall be a different chambers with a separate lid. As the there is a need of a certain medicine the worker can open each unit and use the medicines so that there is a constant refrigeration for each unit. Also each unit will have a different tray which shall be customizable. This tray shall be of variant sizes according to the bottle sizes of 1cm or 3cm diameter.

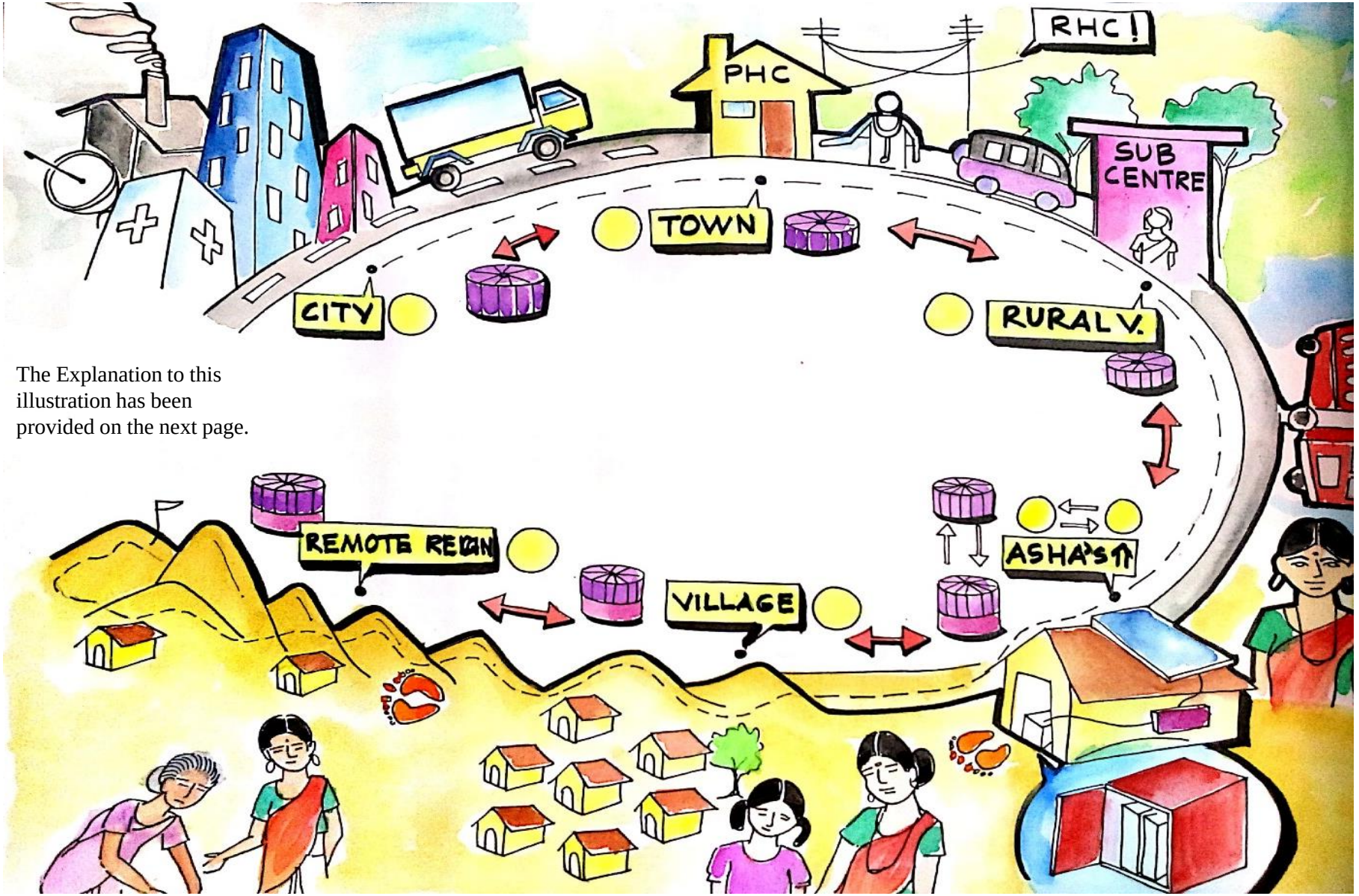
Initial Ideations – Idea 9 :



Ideation 9: In this unit the medicines shall be stored in circular trays at different levels. Each of this tray will have a socket ring along the unit so that each bottle can be fitted into the socket for fitting. The power chamber shall be at the bottom so that the batteries can be serviced or changed based on the need. Also this will be user friendly and will provide security. Different medicines of different medicinal temperature needs will be saved at different levels and each bottle will be taken out at different times. After usage each bottle will be placed back in the unit.

This circular outer unit will enhance the internal ray cooling within. Each unit will get a uniform cooling. Only a certain portion can be accessed by rotating the disc will up store the temperature within.

Concepts	Portability	Med stack ability	Cooling	Safety	Total
Concepts 1	1	1	0	0	2
Concepts 2	1	0	1	0	2
Concepts 3	0	0	1	1	2
Concepts 4	1	1	0	1	3
Concepts 5	1	1	0	1	3
Concepts 6	0	0	1	0	1
Concepts 7	1	0	0	1	2
Concepts 8	0	1	0	1	2
Concepts 9	1	1	1	1	**4**



The Explanation to this illustration has been provided on the next page.

P3- Medicine cold storage

The illustration is by the author : Nikita Fatarpekar

The above illustration depicts the scenario of the process of distribution of medicines right from the production to its last end user and patients. The medicines shall be produced in an industry or a pharmaceutical company in either a isolated area or in the city. From there it shall be transported to pharmacies and medicinal stores majorly in cities. The journey from its production from rural set up to cities or from city production to city pharmacy is through a procedure transportation that provides cooling on its transport.

The next step of transporting medicines and vaccines from pharmacy in city to a Primary health center located in a town is again through a channelized cooling usually Government funded as PHC – Primary health centers are government run Hospitals. This form of transportation is usually a mass transportation to various PHC's in the route.

From PHC – Primary health center the transportation to a sub center health services takes place through a organizational vehicular which shall have maximum only two sub centers. Hence the need of medicines also decrease but the supply of the medicines has to be on weekly basis.

The government has proposed the scheme of a Asha worker who can reach to the remotest part of the country for which the medicines to her/his home are supplied from this Sub Centre which is in a rural setup. Asha workers home shall be in village consisting of a population but is slightly inaccessible to either PHC or Sub Centre and hence this Asha worker can provide medication in case of emergency to a particular area she has been allotted (usually her vicinity area).

For this the Asha worker shall travel to from her area to the Sub Centre she has been allotted to and collect the medicines and travel by the public transport usually the Government State buses. At this point at the sub center she has been allotted a carton box of the medicines for a certain period of usage, which does not have cooling.

From here onwards to her home and further to a village and even remotest village there is no proper transportation and no cooling provided to the medicines she has been carrying. The journey from her home to a nearby village usually 20-30 kms usually on foot or some Industrial vehicular of construction material distribution and then on to the remotest parts of our country is totally on foot which are usually mountainous regions. She along with the doctor at times has to travel 20-30 kms of mountainous slope to reach to patients in these parts.

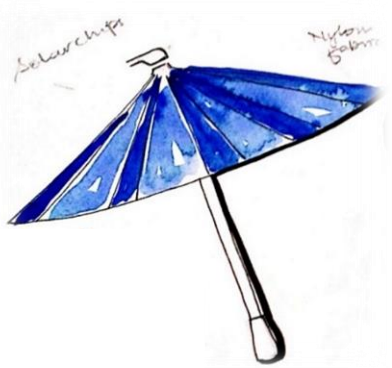
Which means the latest cooling that can provided to the medicines can be in the Asha worker's home. From here onwards there is a need of constant cooling on the path travelled by foot, over which it has to sustain in the remotest part for a day or two.

The approximate distance as taken from the example visited : Mokhada in Palghar District which is 163.6 Kms away from Mumbai its approximated that the distance
From City Pharmacy to a Town Primary Health Centre to
From Town's Primary Health Centre to Rural Town's Sub Centre to
From Rural Town's Sub Centre to Asha worker's village to
From Asha worker's village to Rural village Patient to
From Rural village Patient to Remote Village Patient is

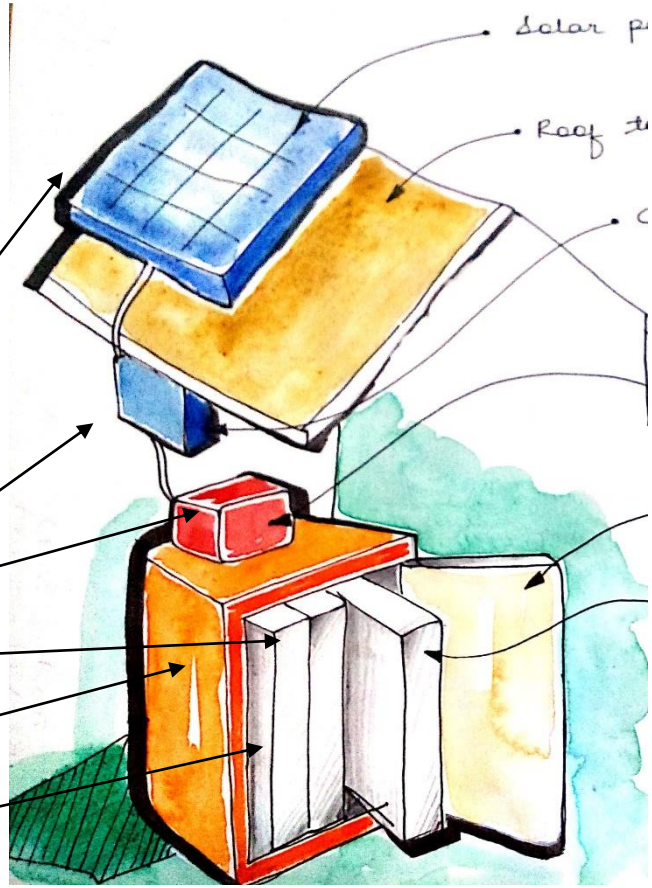
All equal to same distance and of different geographical regions.

1. At Asha's House

- Sub center's delivered medicine will be stored in the refrigerator
- Later transferred in the portable cold storage box



Solar Umbrella



2. While traveling to a village and 3. On Site

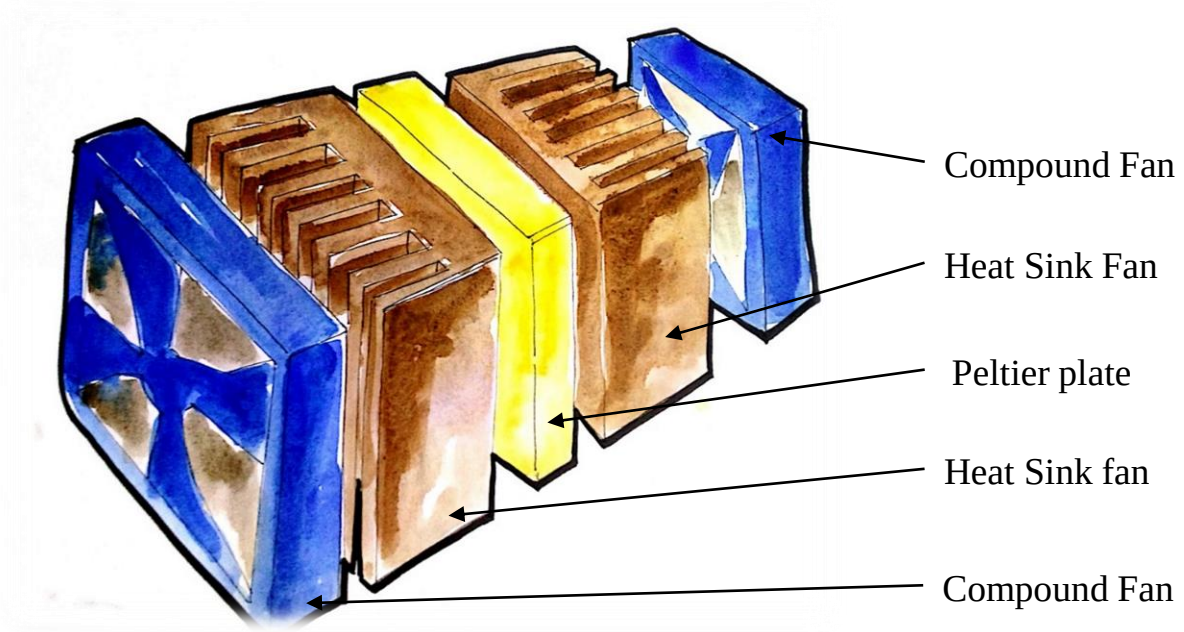
- Carry the Cold Storage box
- Solar Umbrella

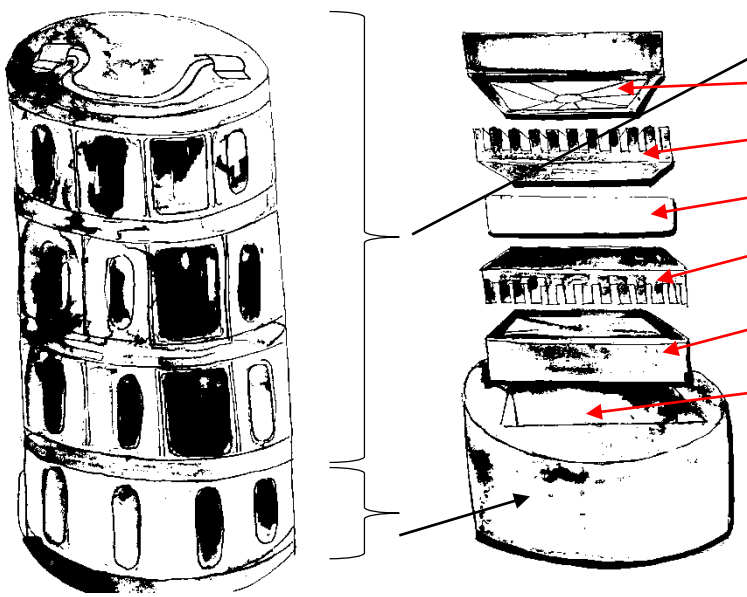
Cold Storage Box

Solar Umbrella

Peltier Effect : Thermoelectric cooling

The device has two sides,
and when a DC electric current flows through the device, it brings heat from one side to the other,
so that one side gets cooler while the other gets hotter.
The "hot" side is attached to a heat sink so that it remains at ambient temperature, **while the cool side goes below room temperature.**





Cold storage units

Fan

Heat sink

Peltier plate

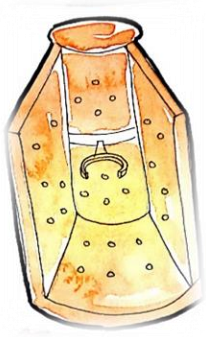
Simple Heat sink

Fan

Battery

Four batteries at four sides of a square cut out

Internal Partition



Air perforation

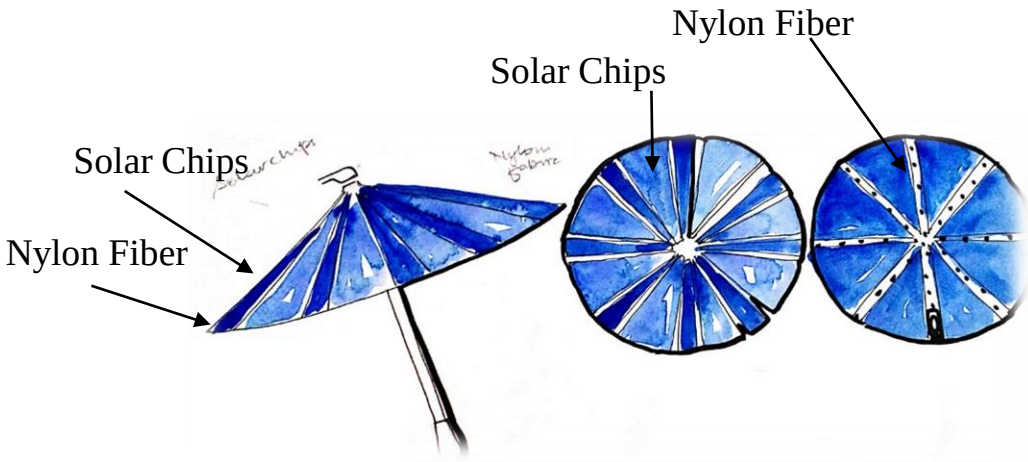
So that the cooling is let out from the core channel from all sides

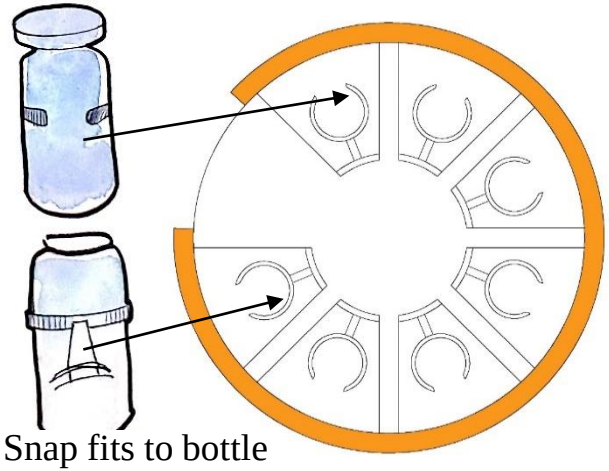
Air Movement

The core , partition plates and supporting circular plates are all connected for internal cold air movement

Handle

Less junctions
Welded for no corners





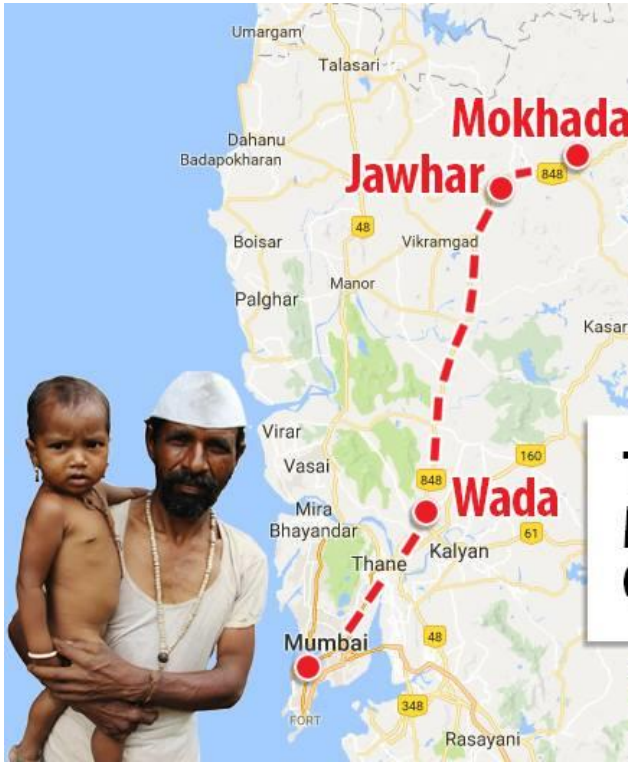
Solar Umbrella

The solar umbrella shall have be made of nylon fiber over solar cells shall be embedded on it.

The nylon fiber shall be enclosed on a ribbed metallic shock proof structure over which the solar cells shall be embedded. The solar cells shall go through

Mokhada

- **Visited Mokhada** which is a census town in Jawhar subdivision of Palghar district of Maharashtra state in Konkan division.



Villages in Mokhada Taluka :

1 Adoshi
2 Amale
3 Ase
4 Beriste
5 Botoshi
6 Brahmagaon
7 Charangaon
8 Chas
9 Dandwal
10 Dhamani
11 Dhamanshet
12Dhondmaryachimet
13 Dhudgaon
14 Dolhare
15 Ghanval
16 Ghosali
17 Gomghar
18 Gonde Bk.
19 Gonde Kh.
20 Hirve
21 Jogalwadi
22 Kaduchiwadi
23 Kalamgaon
24 Karegaon
25 Karol
26 Kashti
27 Kevanale
28 Khoch
29 Khodala
30 Kiniste
31 Kochale
32 Koshimshet
33 Kurlod
34 Lakshiminagar
35 Mokhada
36 Morhande
37 Nashera
38 Nilmati
39 Osarvira
40 Pachaghar
41 Palsunde
42 Pathardi
43 Pimpalgaon
44 Poshera
45 Rajivnagar
46 Sakhari
47 Saturly
48 Sawarde
49 Sayade
50 Shastrinagar
51 Shirasgaon
52 Shirson
53 Shivali
54 Suryamal
55 Swaminagar
56 Udhale
57 Vashind
58 Wakadpada
59 Washala

In the village of Mokhada interacted to the following people from four different villages **Dhandwal, Mokhada, Morande and Wakadpada**

	Name :	Designation	Place		Name :	Designation	Place
1.	Dr. Niketh Jadhav	Medical Officer	Mokhada RHC	10.	Surekha Thombare	Clerk	Moranda PHC
2.	Dr. Sonavme	Medical doctor	Mokhada RHC	11.	Snehal Jarowar	ANM	Moranda PHC
3.	Dr. Kandave	Medical Doctor	Moranda PHC	12.	S.S. Ugade	ANM	Moranda PHC
4.	Mr. Toke	MPW	Moranda PHC	13.	M.K. Panch Kudawa	ANM	Moranda PHC
5.	Dr. Ulhas Patil	Medical Doctor	Moranda PHC	14.	Bigi walkoli	ANM	Moranda PHC
6.	Lata Rao	Sarpanch	Moranda	15.	K R. Gare	ANM	Moranda PHC
7.	Mr. Patil	MPW	Moranda PHC	16.	Mr. Yele Bhau	SF worker	Baldachapada
8.	Mr. Machindra Badade	SF worker	Mokhada	17.	Mrs. Yele	Asha worker	Baldachapada
9.	Mrs. Parvati Shidha	Anganwadi Sevika	Baldachapada	18.	Mrs. Shraddha	CEO of SF	Mokhada

ANM - Auxiliary nurse midwife , MPW - Multipurpose Workers

With Patients :








Interacted with Patients in the village of Mokhada, about the ways they decide to consult a health service, instructions of medicines, Travelling to one of them , mode of transport, opinion of medication in their respective area. The photos are taken in Primary Health Centre, Mokhada, Baldachapada and Mokhada houses of Patients and Relatives of Patients in the village of Mokhada.

With Medical Workers :








Interacted with officials, workers and officers in the village of Mokhada, about the ways they decide to give a health service, instructions of medicines, Travelling to one of the village or a patient , mode of transport, opinion of medication ways. The photos are taken in Primary Health Centre, Mokhada, Baldachapada and Mokhada houses of Patients and Relatives of Patients in the village of Mokhada.

P3- Medicine cold storage

With Villagers :







Interacted with leaders, sewaks and mukhiyas in the village of Mokhada, about the ways they decide to give a health service or promote medication from health services, instructions of medicines, Travelling to one of the village or a patient , mode of transport, opinion of medication ways. The photos are taken in their respective above swaks houses in Mokhada, Baldachapada and Mokhada houses of Patients and Relatives of Patients in the village of Mokhada.

Visit to Baldacha pada :

- Crossing across Zhambal gao

- Several settlements of 600 people

- Recent construction through zhambal gao

P3- Medicine cold storage

1. Refrigerator on Inverter at PHC and RHC

2. Electricity Fluctuating

3. Low Voltage

4. No electricity at Health centres

E. AFFORDABILITY

- A family of 12 has 1 working person
- Mainly daily wage work
- Agriculture 20%

Ways how medicines are taken by an individual

	Kinds	Source
1.	Saline	PHC / RHC / Asha
2.	Injection	PHC / RHC / Asha
3.	Tablets	Self / Parents
4.	Oral	Asha

Medicinal needs for different diseases prominent in Mokhada taluka

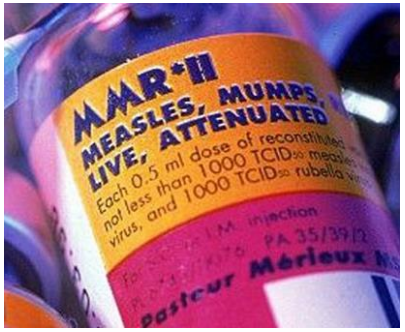
Based on the data from RHC & PHC , Health workers :

BCG Vaccine

- Store at – 2-8 degree Celsius

DPT Vaccine

- Store at – 2-8 degree Celsius



Measles Vaccine

- Keep cool – 8-15 degree Celsius

Oxytocin

- Keep cool – 8-15 degree Celsius

Polio Vaccines

- Keep cool – 8-15 degree Celsius

Rubella Vaccine

- Store at – 2-8 degree Celsius

TT Vaccine

- Room temperature – 15 - 25 degree Celsius

Dry Carbondioxide

Frosty – Ethanol

Deemed Solar

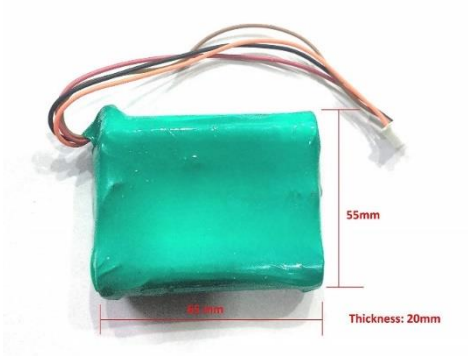
Cryogenic Storage - Dewar

Lpg Cylinders

Sr.	Technology	Disadvantages
1.	Wind Energy	Only certain region
2.	Hydro Energy	Scarcity of Water
3.	Liquid Nitrogen	Boils and Freezes
4.	Dry Ice	Exposure to skin can cause damage
5.	LPG /CFC	Transportation
6.	Cryogenic Storage	Dangerous if exposed to air
7.	Ethanol	Evaporates in high temperatures
8.	Ammonia	Transportation
9.	Vapour Compression	Heavy

P3- Medicine cold storage

Peltier Set : in market

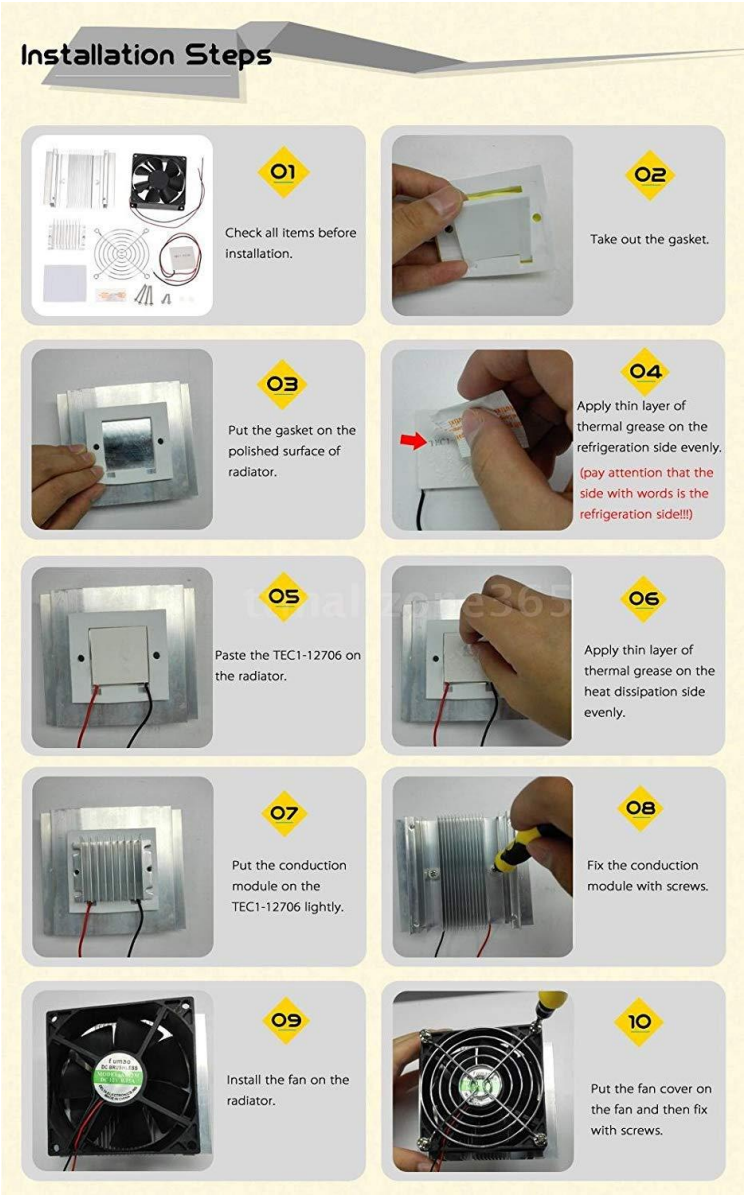


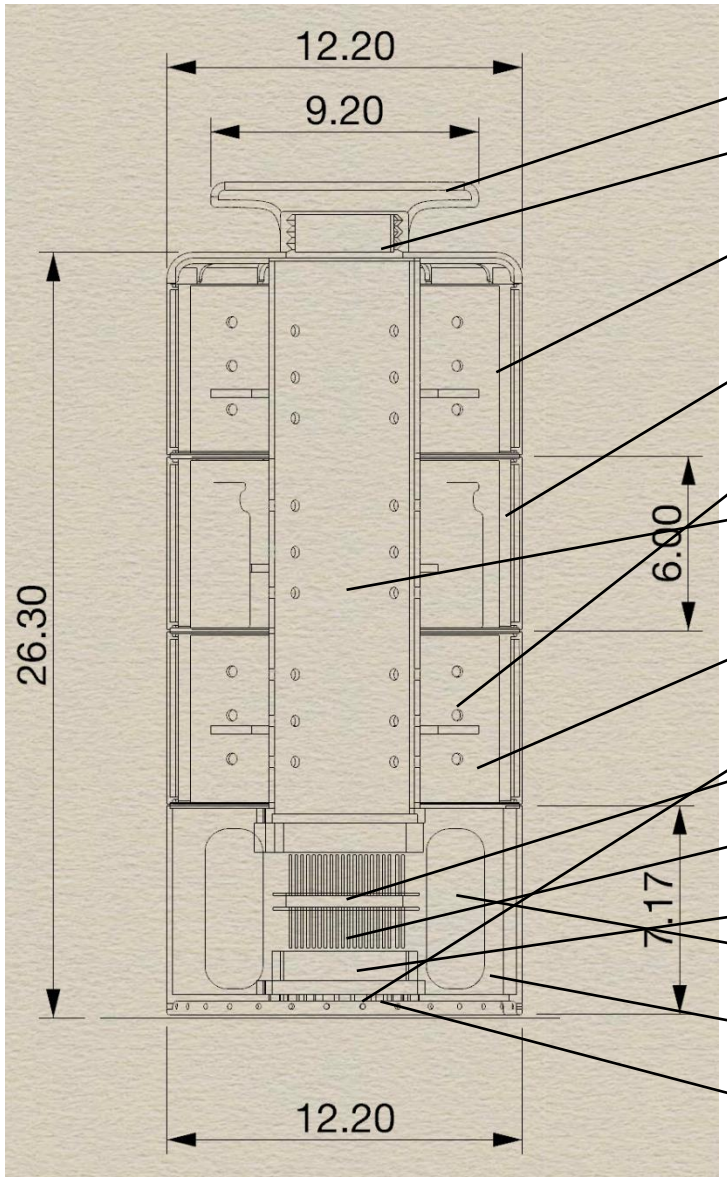
Battery

Fans used in Peltier effect

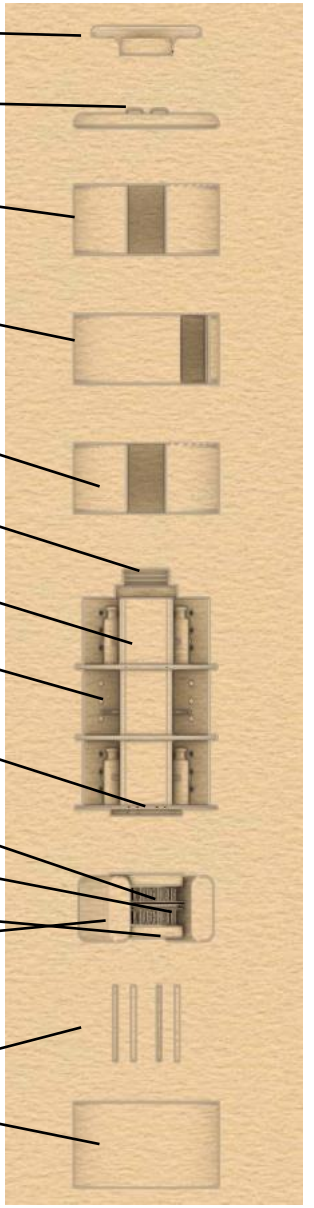
Peltier plate

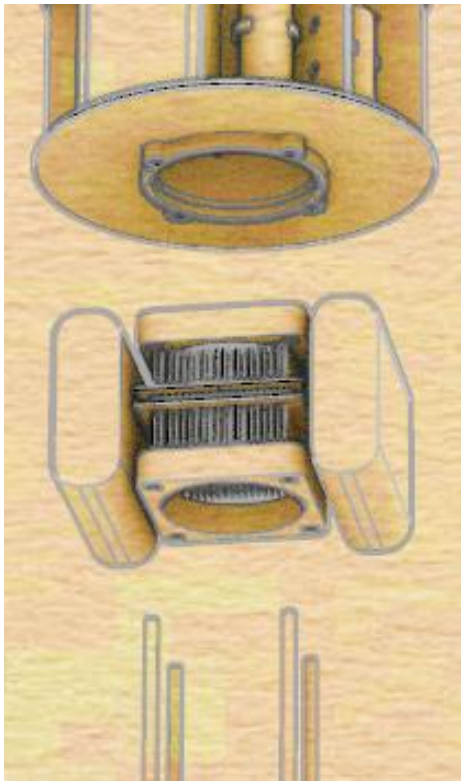
Whole set up



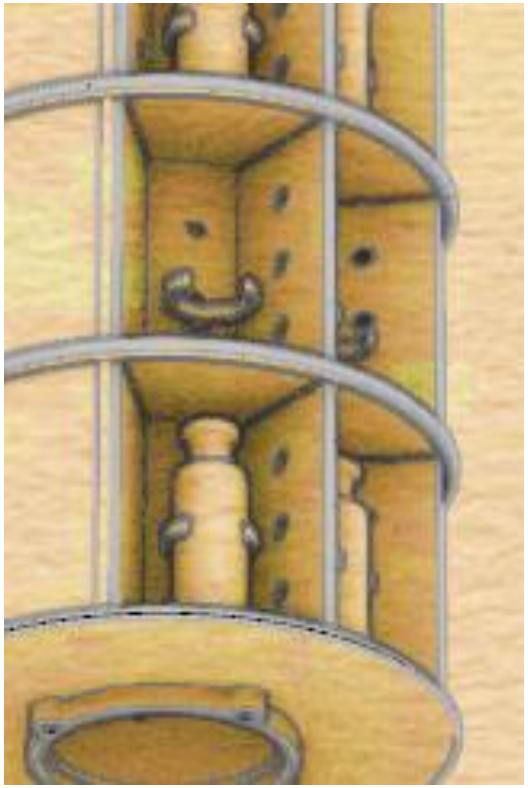


Handle
Clamps
Cover 1
Cover 2
Cover 3
Thread
Core
Panels
Base outlet
Peltier plate
Heat sink
Fan
Battery
Bottom Cover 4
Bolts

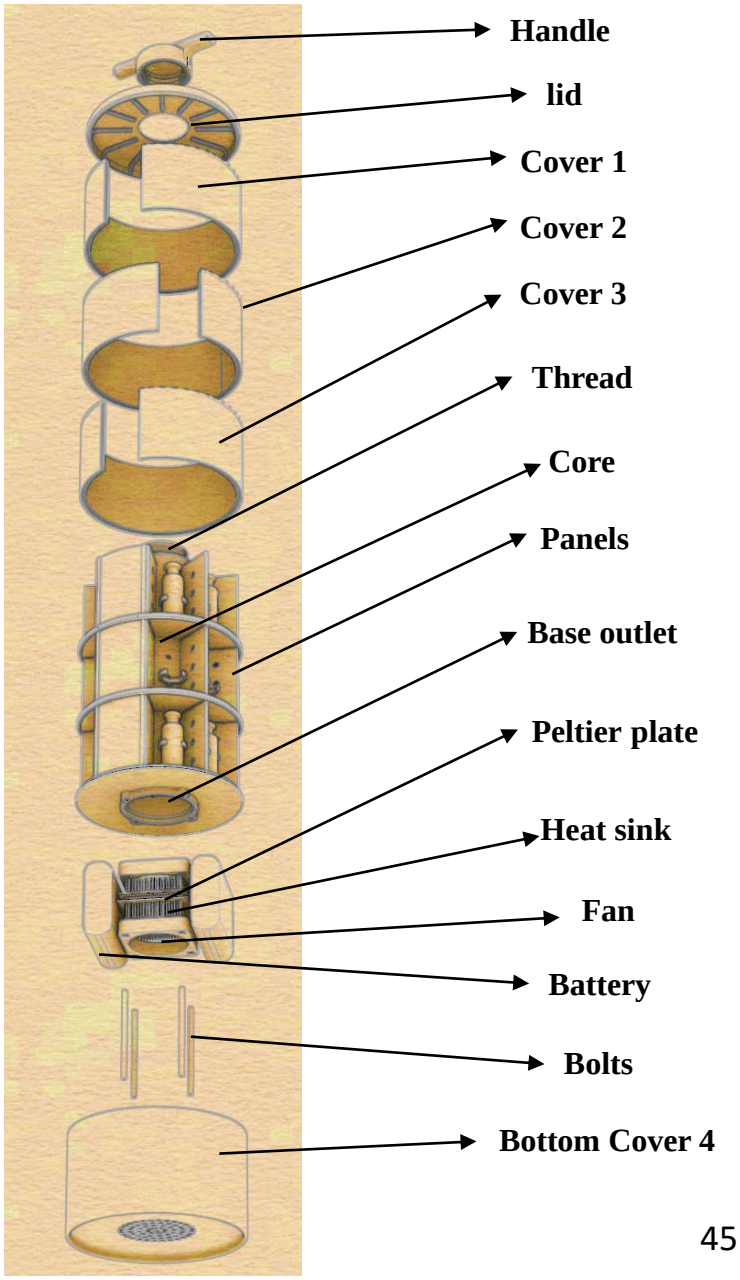




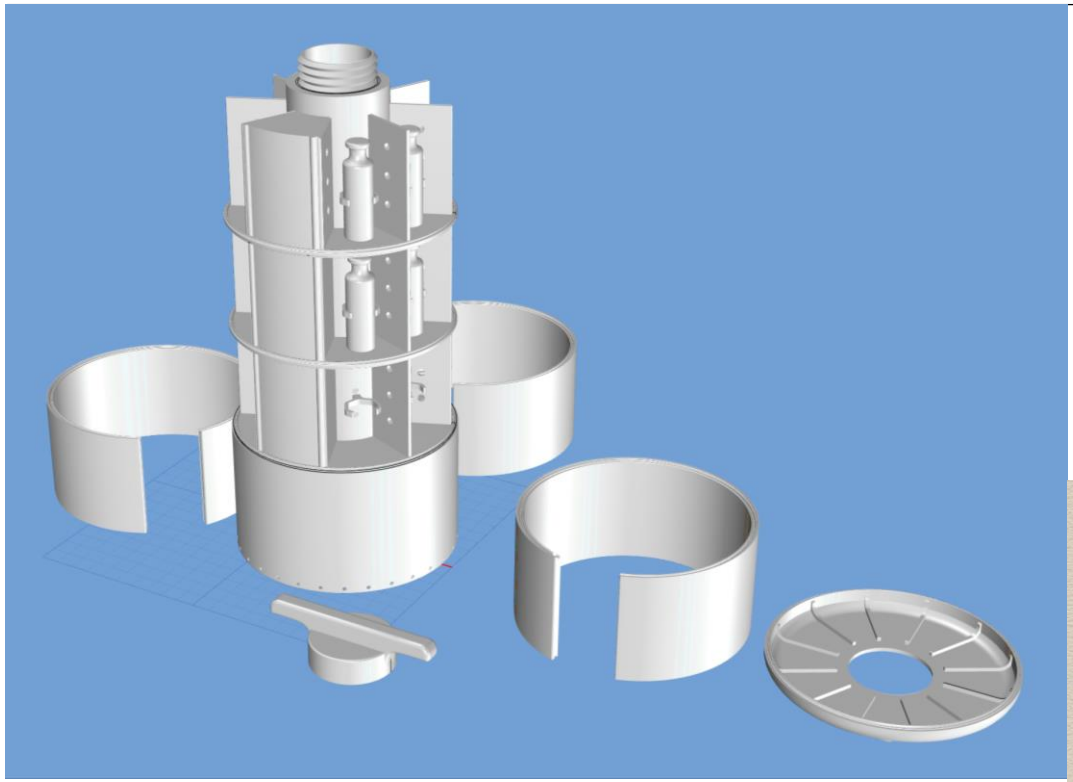
Detail of bolting :



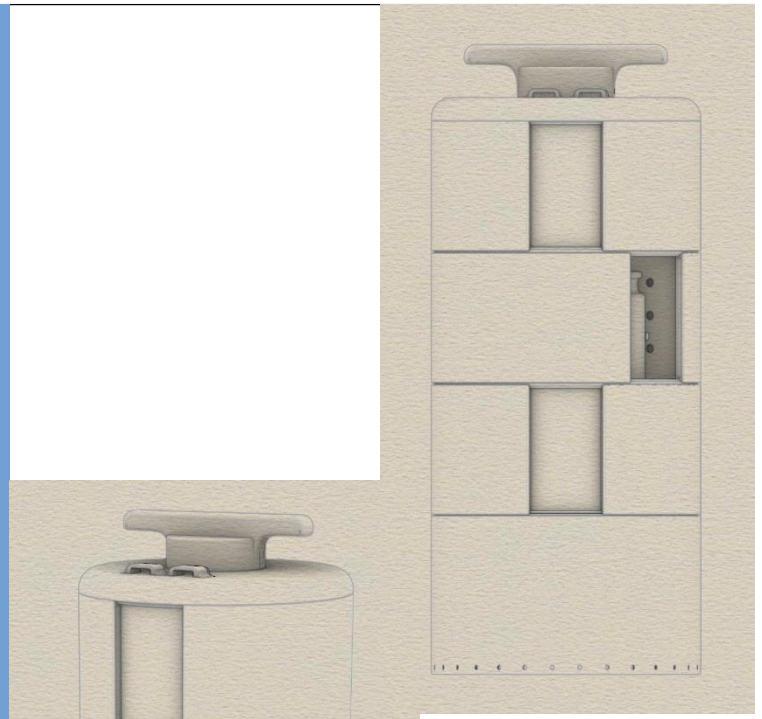
Snap fitting clamp for bottles :



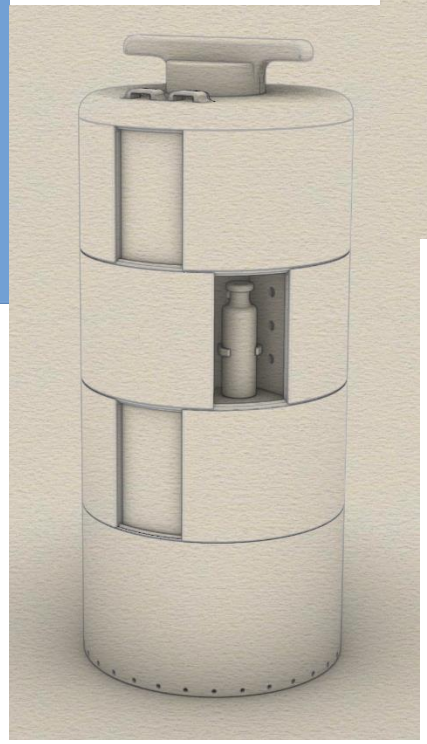
Final Model



3D View



3D View



3D View

http://www.sciencemag.org/news/2014/07/mit-grad-brings-new-refrigeration-system-rural-india
https://www.sciencedirect.com/science/article/pii/S0960148197000360
http://iosrjen.org/Papers/vol4_issue3%20(part-3)/F04333842.pd
http://www.irdindia.in/journal_ijmer/pdf/vol5_iss3_4/5.pdf
https://www.innosight.com/client_impact_story/godrej/
http://www.altenergy.org/Glossary/cool.html
https://www.drugs.com/answers/drugs-that-require-cold-storage-166784.html
https://www.ibef.org/research/case-study/the-coolest-little-refrigerator-for-rural-india
https://ijarcsse.com/docs/papers/Volume_7/5_May2017/SV7I5-0224.pdf
https://www.mnn.com/green-tech/research-innovations/blogs/new-refrigerator-cools-food-without-electricity
https://www.researchgate.net/publication/318930958_Peltier_Based_Eco-Friendly_Smart_Refrigerator_for_Rural_Areas
https://permaculturenews.org/2017/07/26/alternative-refrigeration-techniques-food-storage/
http://www.cityruralrefrigeration.com.au/
https://repository.tudelft.nl/islandora/object/uuid:dc5195bb-800b-48ed-bff0-ba8402cf2d3f
http://www.ijariie.com/AdminUploadPdf/Green_Refrigeration___Cooling_Techniques_for_Food_Preservation_in_Rural_and_Livelihood_Sector__ijariie6384.pdf
https://www.theswitchers.eu/en/switchers/moroccan-entrepreneur-tackling-food-waste-energyless-fridge/

14th feb
http://apps.who.int/medicinedocs/en/d/Js4885e/6.5.html
http://www.careinspectorate.com/images/documents/1915/Temperature%20Reqs%20for%20Medicine%20Storage_HCR0316099.pdf
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1079525/
https://www.opatoday.com/medication-storage-tips
https://www.specialtypharmacytimes.com/publications/specialty-pharmacy-times/2013/nov_dec-2013/temperature-sensitive-medications/p-2
https://wms.org/magazine/1183/index.html
https://www.dorsetccg.nhs.uk/wp-content/uploads/2018/04/Standard-E1-storage-safe-custody-of-medicines.pdf
https://www.theatlantic.com/health/archive/2011/09/why-you-should-never-store-medications-at-high-temperatures/245011/
https://www.verywellhealth.com/how-temperature-can-affect-medication-stability-3233264

https://www.nytimes.com/2011/08/16/health/16consumer.html
http://wildernessmedicinemagazine.com/1170/Temp-Management-of-Medication
http://wildernessmedicinemagazine.com/1113/Medication-Transport-in-the-Wilderness

https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/Pharmacy/guidelines/Fridge%20Medication%20and%20Vaccine%20Storage%20and%20Administration.pdf

15 February 2019
https://en.wikipedia.org/wiki/Phase-change_material
https://en.wikipedia.org/wiki/Solar-powered_refrigerator
https://en.wikipedia.org/wiki/Off-the-grid
https://en.wikipedia.org/wiki/Absorption_refrigerator
http://www.ejournal.aessangli.in/ASEEJournals/MECH129.pdf

03.03.19
http://techpedia.in/blog/steri-freez-flash-freeze-sterilization/
https://www.biospectrumindia.com/features/21/13179/medicine-turns-to-cold-chain-warehouses-for-its-storage-needs.html
https://coldstoresolutions.wordpress.com/2016/02/22/different-cold-room-storage-terms-for-medicines/
https://en.wikipedia.org/wiki/Cold_chain

https://www.google.com/imgres?imgurl=https%3A%2F%2Fmain.ccghe.net%2Fsites%2Fdefault%2Ffiles%2Fassets%2Fimages%2F2018-05-22-Diabetes-shutterstock_128394035-CROP.jpg&imgrefurl=https%3A%2F%2Fmain.ccghe.net%2Fcontent%2Fdiabetes-and-pre-diabetes-among-household-contacts-tuberculosis-patients-india-it-time&docid=IJj43I1NI0d3TM&tbnid=HOid0NDzTOYcLM%3A&vet=10ahUKEwj4m_vH797fAhWJpI8KHXTnAP4QMwi3ASheMF4..i&w=1080&h=640&bih=657&biw=1366&q=tb%20patient%20in%20india&ved=0ahUKEwj4m_vH797fAhWJpI8KHXTnAP4QMwi3ASheMF4&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.oneindia.com%2Fimg%2F2016%2F10%2Ftb-22-1477120899.jpg&imgrefurl=https%3A%2F%2Fwww.oneindia.com%2Findia%2Fsuccess-tb-treatment-india-could-lower-than-reported-why-that-matters-2251951.html&docid=IYfa0Y_7ZuoTRM&tbnid=6eKabTrd3oWW1M%3A&vet=12ahUKEwjupLTj797fAhUJ3o8KHVwCBn44ZBAzKDkwOXoECAEQOg..i&w=600&h=450&bih=657&biw=1366&q=tb%20patient%20in%20india&ved=2ahUKEwjupLTj797fAhUJ3o8KHVwCBn44ZBAzKDkwOXoECAEQOg&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fc8.alamy.com%2Fcomp%2FDR4M32%2Fjan-24-2009-india-tb-health-workers-of-the-womens-ngo-sewa-who-were-DR4M32.jpg&imgrefurl=https%3A%2F%2Fwww.alamy.com%2Fstock-photo-jan-24-2009-india-tb-health-workers-of-the-womens-ngo-sewa-who-were-65871766.html&docid=tkLE_tGEdP3WxM&tbnid=HYA7Apo8I-WeWM%3A&vet=10ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhCKAQwBA..i&w=1300&h=956&itg=1&bih=657&biw=1366&q=tb%20patient%20house%20in%20india&ved=0ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhCKAQwBA&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fc8.alamy.com%2Fcomp%2FDR4M1P%2Fjan-24-2009-vautha-village-gujarat-india-bhimabhai-vasava-a-tb-patient-DR4M1P.jpg&imgrefurl=https%3A%2F%2Fwww.alamy.com%2Fstock-photo%2Ftb-patient.html&docid=EzixsSpj7MBlKM&tbnid=UbcOexbaz-aH8M%3A&vet=10ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhDKAUwBQ..i&w=1300&h=956&bih=657&biw=1366&q=tb%20patient%20house%20in%20india&ved=0ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhDKAUwBQ&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=http%3A%2F%2Fwww.stoptb.org%2Fassets%2Fimages%2Fnews%2FMr%2520Arumugam%2520in%2520front%2520of%2520his%2520new%2520house.jpg&imgrefurl=http%3A%2F%2Fwww.stoptb.org%2Fnews%2Ffrompartners%2F2014%2Ffp14_091.asp&docid=lmqx6oGNLhCJHM&tbnid=dVtdfCK17DfnpM%3A&vet=10ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhpKB4wHg..i&w=300&h=225&bih=657&biw=1366&q=tb%20patient%20house%20in%20india&ved=0ahUKEwjal-eE8N7fAhVMLY8KHVdJBYEQMwhpKB4wHg&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fimages-na.ssl-images-amazon.com%2Fimages%2FI%2F515OqKn37TL._SX466_.jpg&imgrefurl=https%3A%2F%2Fwww.amazon.com%2FRefrigerator-Dormitories-Apartments-Eco-Friendly-Refrigerant%2Fdp%2FB07B6491CC&docid=q7KpmvRX3lgpJM&tbnid=hdfgJti_L22TIM%3A&vet=10ahUKEwjLv4SJ9d7fAhWMLI8KHa0OCg8QMwhqKAEwAQ..i&w=466&h=466&bih=657&biw=1366&q=refrigerator&ved=0ahUKEwjLv4SJ9d7fAhWMLI8KHa0OCg8QMwhqKAEwAQ&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.ikea.com%2Fus%2Fen%2Fimages%2Fproducts%2Fnutid-french-door-refrigerator__0530525_PE646733_S4.JPG&imgrefurl=https%3A%2F%2Fwww.ikea.com%2Fus%2Fen%2Fcatalog%2Fproducts%2F30377925%2F&docid=bAC6KJkXAipMFM&tbnid=7Pjtoo5qD1WBZM%3A&vet=10ahUKEwilhPbc9N7fAhWKKY8KHYgpCfIQMwhrKAEwAQ..i&w=500&h=500&bih=657&biw=1366&q=refrigerator&ved=0ahUKEwilhPbc9N7fAhWKKY8KHYgpCfIQMwhrKAEwAQ&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.wipo.int%2Fexport%2Fsites%2Fwww%2Fwipo_magazine%2Fimages%2F2013_06_art_3_1.gif&imgrefurl=https%3A%2F%2Fwww.wipo.int%2Fwipo_magazine%2Fen%2F2013%2F06%2Farticle_0003.html&docid=CfG0SyVIUubLFM&tbnid=ebCbsbTn0yOExM%3A&vet=10ahUKEwj2sPzJ-N7fAhVCiHAKHfc7AVwQMwhCKAcwBw..i&w=768&h=614&bih=657&biw=1366&q=chotukool%20by%20godrej&ved=0ahUKEwj2sPzJ-N7fAhVCiHAKHfc7AVwQMwhCKAcwBw&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fmedia.mnn.com%2Fassets%2Fimages%2F2015%2F10%2FWindChillUnit.jpg.653x0_q80_crop-smart.jpg&imgrefurl=https%3A%2F%2Fwww.mnn.com%2Fgreen-tech%2Fresearch-innovations%2Fblogs%2Fnew-refrigerator-cools-food-without-electricity&docid=esfjuewV9jmCUM&tbnid=4POLvtbyO_WHSM%3A&vet=10ahUKEwj2m9a6-N7fAhUUiHAKHUeiBE4QMwg-KAAwAA..i&w=653&h=294&bih=657&biw=1366&q=windchill%20refrigerator&ved=0ahUKEwj2m9a6-N7fAhUUiHAKHUeiBE4QMwg-KAAwAA&iact=mrc&uact=8

https://www.google.com/imgres?imgurl=https%3A%2F%2Fs3-ap-southeast-1.amazonaws.com%2Fassets.skyfilabs.com%2Fimages%2Fblog%2Fmini-refrigerator.jpg&imgrefurl=https%3A%2F%2Fwww.skyfilabs.com%2Fproject-ideas%2Flatest-projects-based-on-Peltier-cooler&docid=cuj-MGNR3R8zlM&tbnid=mUmLYL-jBaupIM%3A&vet=12ahUKEwj889Sf-d7fAhXDsY8KHYepChA4ZBAzKCAwIHoECAEQIg..i&w=615&h=410&bih=657&biw=1366&q=peltier%20refrigerator&ved=2ahUKEwj889Sf-d7fAhXDsY8KHYepChA4ZBAzKCAwIHoECAEQIg&iact=mrc&uact=8

https://www.amazon.in/MORADIYA-FRESH-LABEL-Thermoelectric-Refrigerator/dp/B07CQMPNYD?tag=googinhydr18418-21&gclid=Cj0KCQiAsdHhBRCwARIsAAhRhsnIF1mrWxh0pPZ4OkbyfdjtfARpAQCyHMuQ-B7HTiGH5_2G4zMAWY8aAo90EALw_wcB

https://mitticool.com/product/mitticool-clay-refrigerator50-liter/

https://www.google.com/imgres?imgurl=https%3A%2F%2Fvignette.wikia.nocookie.net%2Fsolarcooking%2Fimages%2F3%2F3f%2FPot_in_pot_cooler_1.jpg%2Frevision%2Flatest%3Fcb%3D20070905192606&imgrefurl=http%3A%2F%2Fsolarcooking.wikia.com%2Fwiki%2FPot-in-pot_cooler&docid=UVTM3rEC7YLACM&tbnid=7Fvtf7_AbubRAM%3A&vet=10ahUKEwiImPvK-d7fAhUYinAKHdGeBSkQMwhNKAEwAQ..i&w=1711&h=1334&bih=657&biw=1366&q=clay%20pot%20refrigerator&ved=0ahUKEwiImPvK-d7fAhUYinAKHdGeBSkQMwhNKAEwAQ&iact=mrc&uact=8#h=1334&imgdii=7Fvtf7_AbubRAM:&vet=10ahUKEwiImPvKd7fAhUYinAKHdGeBSkQMwhNKAEwAQ..i&w=1711

http://solarcooking.wikia.com/wiki/Pot-in-pot_cooler

https://www.indiamart.com/proddetail/double-section-miller-chiller-12196125488.htm

https://www.google.com/imgres?imgurl=https%3A%2F%2Fim.rediff.com%2Fnews%2F2016%2Foct%2F03malnutrion-palghar1.jpg&imgrefurl=https%3A%2F%2Fwww.rediff.com%2Fnews%2Fspecial%2Four-children-have-only-hunger-written-in-their-destiny%2F20161004.htm&docid=tKRf0RvXr9FecM&tbnid=0htKhX8tbxqJqM%3A&vet=10ahUKEwiT9-3n58TgAhUGAXIKHQ1yAZoQMwhIKAowCg..i&w=670&h=528&bih=657&biw=1366&q=mokhada%20on%20map&ved=0ahUKEwiT9-3n58TgAhUGAXIKHQ1yAZoQMwhIKAowCg&iact=mrc&uact