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Multidisciplinary Design: A prototype for a mobile peritoneal dialysis unit

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Thailand is ranked 3rd in Southeast Asian with the highest chronic kidney disease rate after Malaysia and Singapore.

In 2016, **17.6% of the Thai population (8 million patients)** have been diagnosed with chronic kidney disease. Half of which are at **stage 3 to 4** which require Haemodialysis at the hospital or peritoneal dialysis treatment at home which cost large amount of money

Underprivileged kidney patient’s house
(Kuttaphet village, Lopburi, Thailand)

Due to **poverty and difficulty accessibility** to, underprivileged kidney patients in rural areas cannot afford frequent visit to nearest hospital and receive proper medical treatment.

Thailand Universal Healthcare Coverage scheme (UCS)
co-payment of 30 Thai baht hospital visits

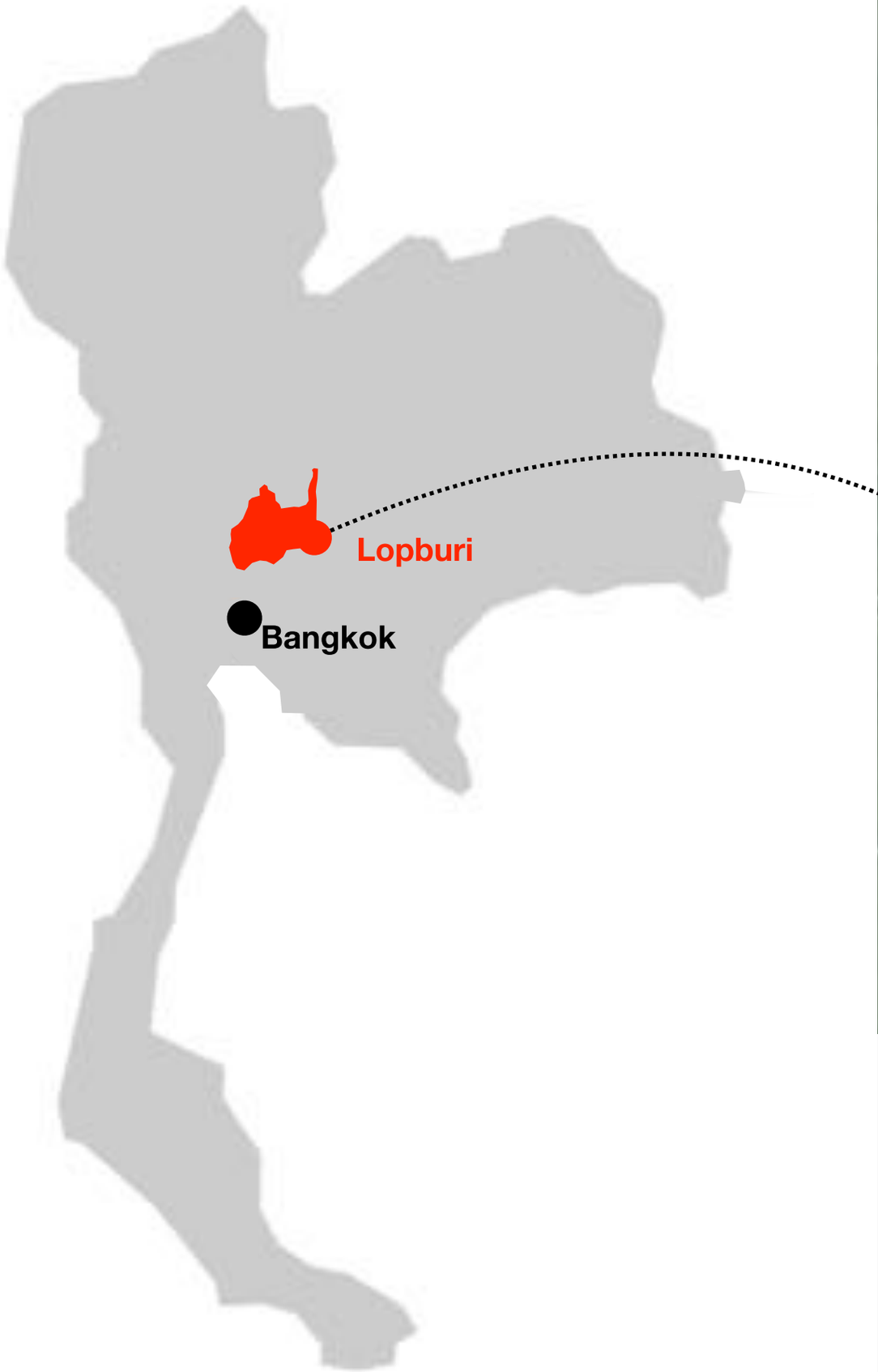
Out Patient Department area
Lamsonthi community hospital, Lopburi, Thailand

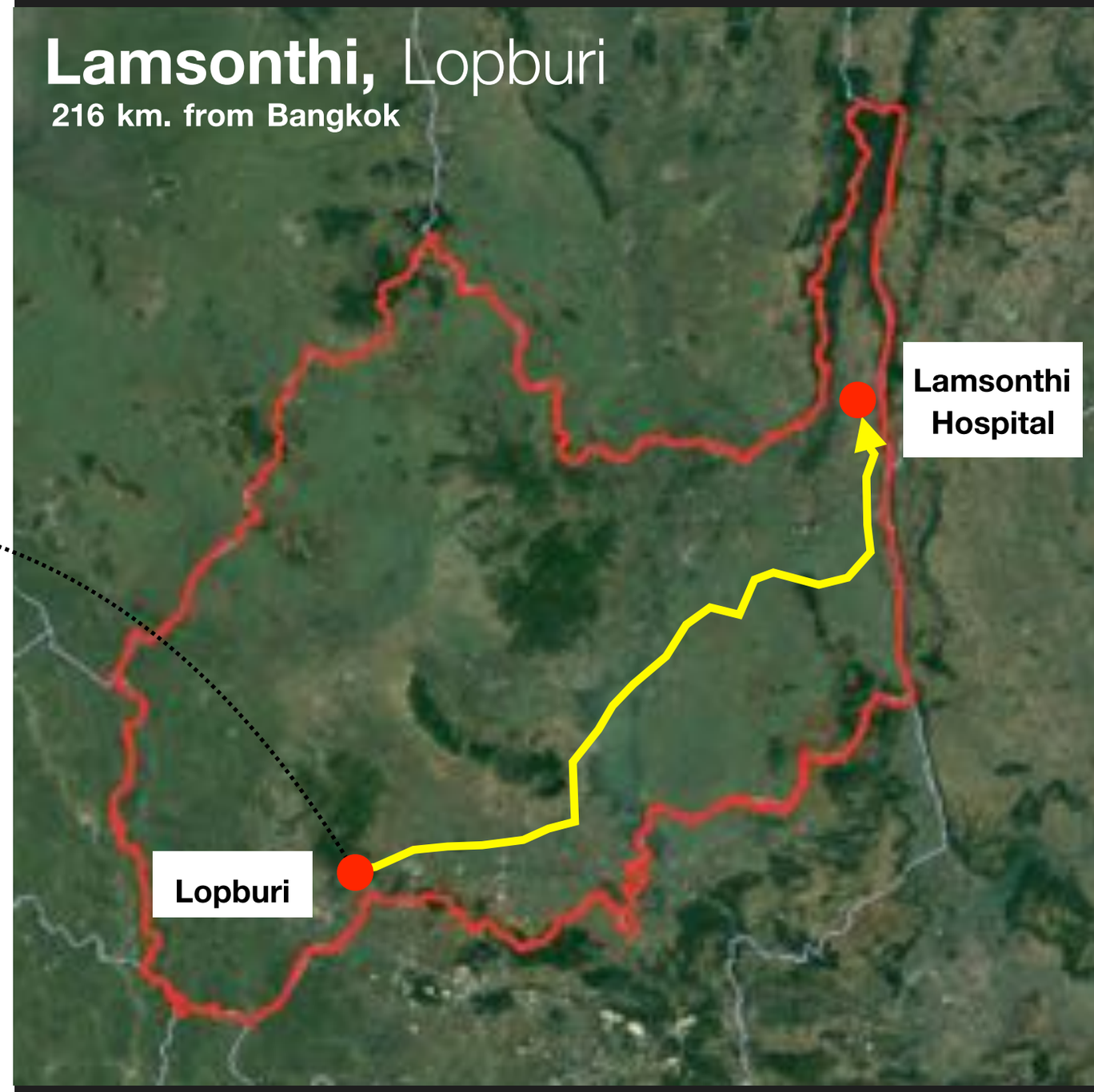
The Thai National Health Security Office attempts to reduce costs by encouraging patients to perform their own peritoneal dialysis at home. They aim to reduce the cost of peritoneal dialysis to each patient to at least 250,000 Thai baht (5,000 GBP) per year.

Peritoneal dialysis equipment is provided free of charge under Universal Healthcare Coverage scheme

Multidisciplinary design becomes a key in developing the mobile peritoneal dialysis unit. This represents the convergence of medicalization and architectural design which transforms and merges healthcare services and built environments.

It provides a particular solution for the healthcare service which somehow cannot be solved by using ordinary healthcare system.





‘Lamsonthi model’ attempts to reduce patients’ revisit to the hospital and to overcome a shortfall of the family caregiver for long-term patients.

In this model, a **coordinated health, long-term care system, and social care has been established in collaboration as care team** with the Local Administrative Organisation (LOA) and multi-disciplinary team of the hospital such as doctor, family nurse, palliative care nurse, psychologist, physiotherapist, occupational therapist, nutritionist, construction technician, as well as community caregivers.

Care team from Lamsonthi hospital visit patient’s house

Inside a mobile peritoneal dialysis unit

150 kidney patients
30-40 at stage 1-3
16 reach stage 4
14 reach stage 5

The peritoneal dialysis treatment costs each patient at least GBP 5,000 per year. But they earn GBP 1,000-1,400/ annually, so they cannot afford frequent visit to the hospital. Moreover, their existing dwellings make it not always possible for modifications to meet standard of hygienic environment for home treatments.

A prototype for a mobile peritoneal dialysis unit to be reused and transferred was developed as a part of the **Action design course**, taught at Faculty of Architecture, Kasetsart University, Bangkok, in collaboration with Lamsonthi hospital in Lopburi province, as well as Built Environment for Health research unit.

A study model of a mobile peritoneal dialysis unit made by students as a part of action design course

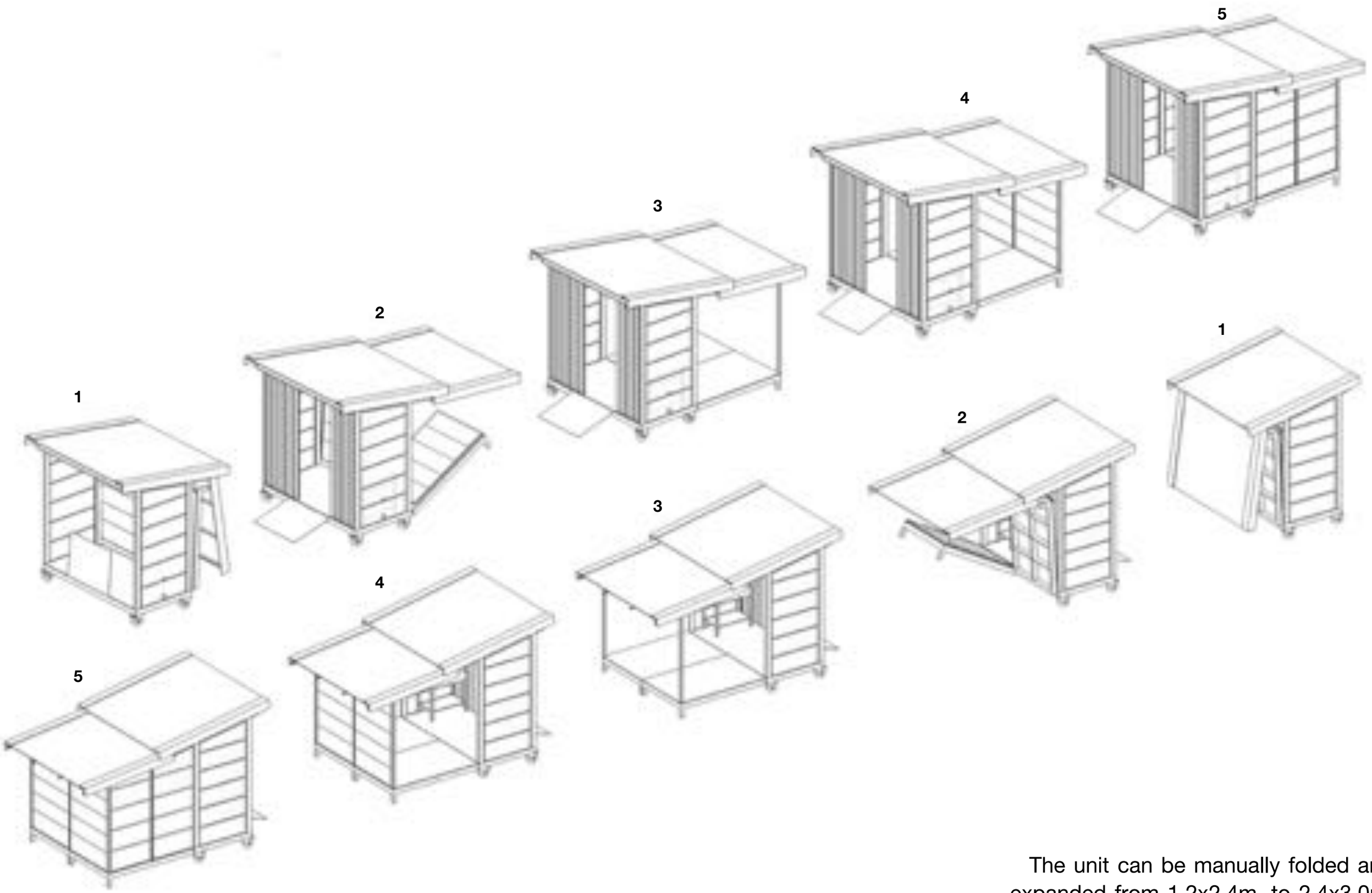
Ta-noi’s house
(Nong-ree village, Lopburi, Thailand)

Participatory design process: observing the patient's behavior, interviews with the caregiver, works with physical therapists and medical team from Lamsonthi hospital.

Architectural students developed a 1:1 layout plan for experiments with Ta-Noi in order to adjust the unit design to the appropriate size and layout.

Students test 1:1 layout plan with real patient and compare with their study model in order to get exact and appropriate size and spatial layout

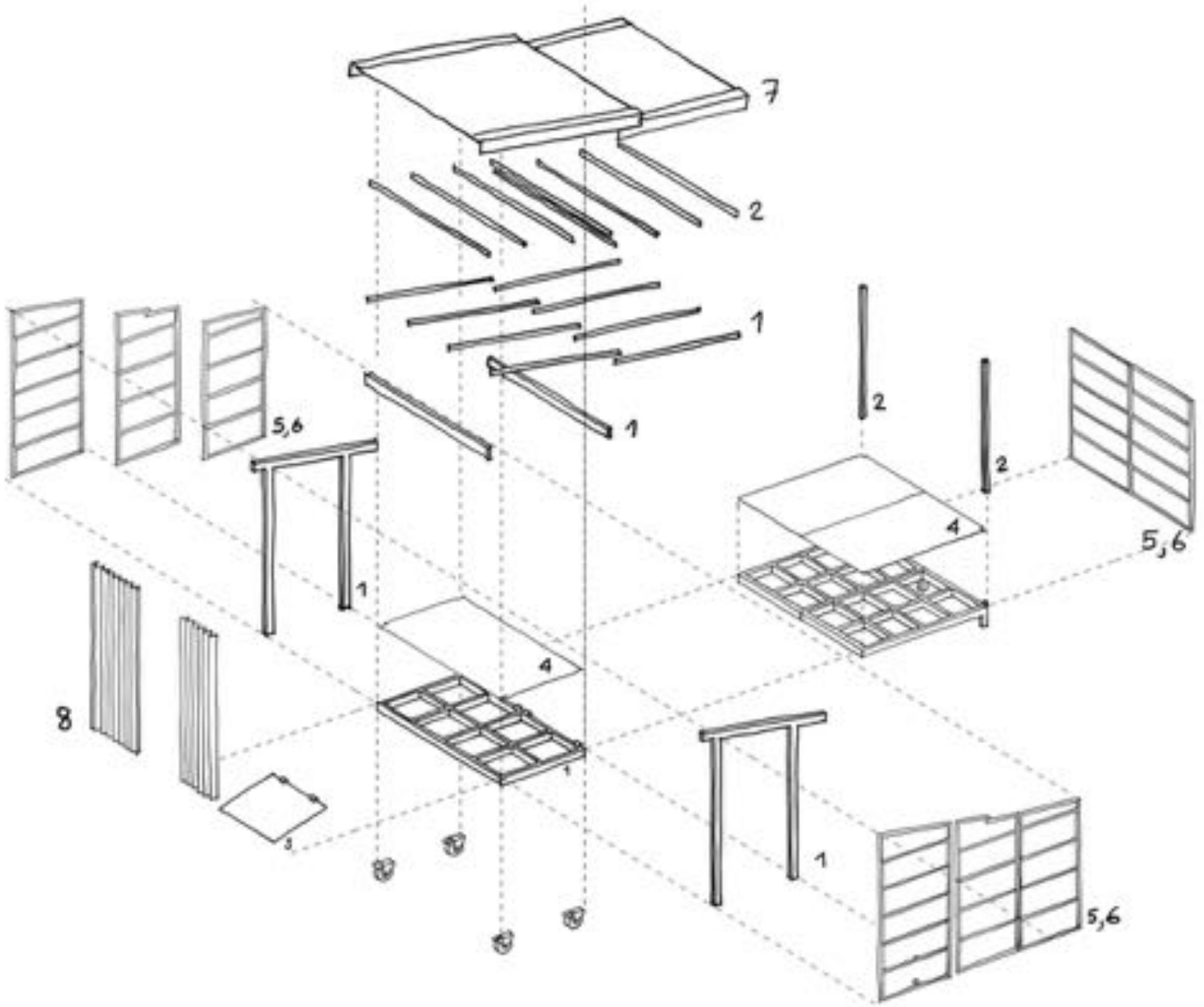
The first preliminary design of Ta-Noi's unit focused on affordability and movability. The smallest unit to accommodate a patient with wheelchair was designed.



The unit can be manually folded and expanded from 1.2x2.4m. to 2.4x3.0m.

Structure of the unit was developed, focusing on affordability and movability

A completed unit of mobile peritoneal dialysis



Structure

1: Carbon steel rectangular pipes (50 x 25 mm.), (75 x 45 mm.)

2: Carbon steel square pipes (19 x 19 mm.), (40 x 40 mm.)

3: Checker plate (3 mm.)

4: Fiber cement boards (16 mm.)

Wall

5: Carbon steel square pipes (19 x 19 mm.)

6: Polycarbonate hollow sheet

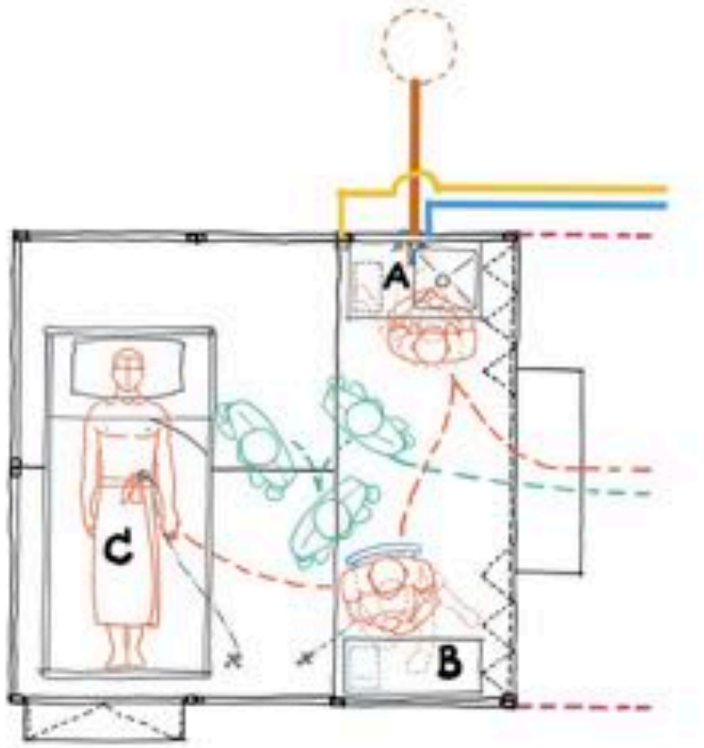
Roof

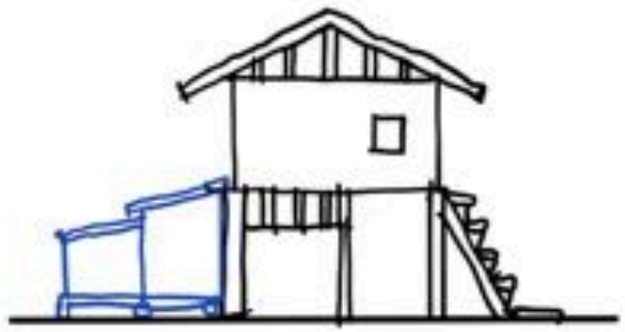
7: Metal sheets

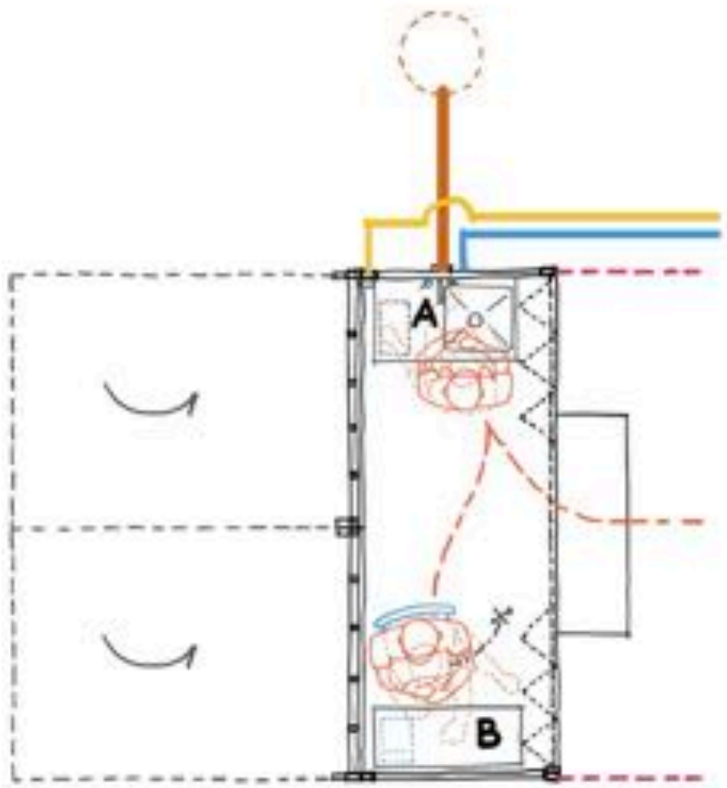
8: Polyethylene sheets

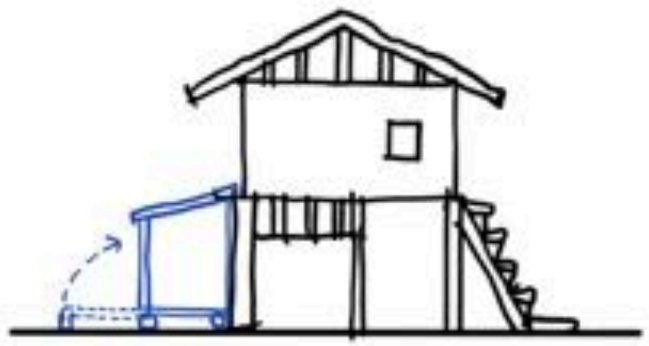
Door&Opening

9: Vinyl folding door
Aluminum sliding door
Polycarbonate window







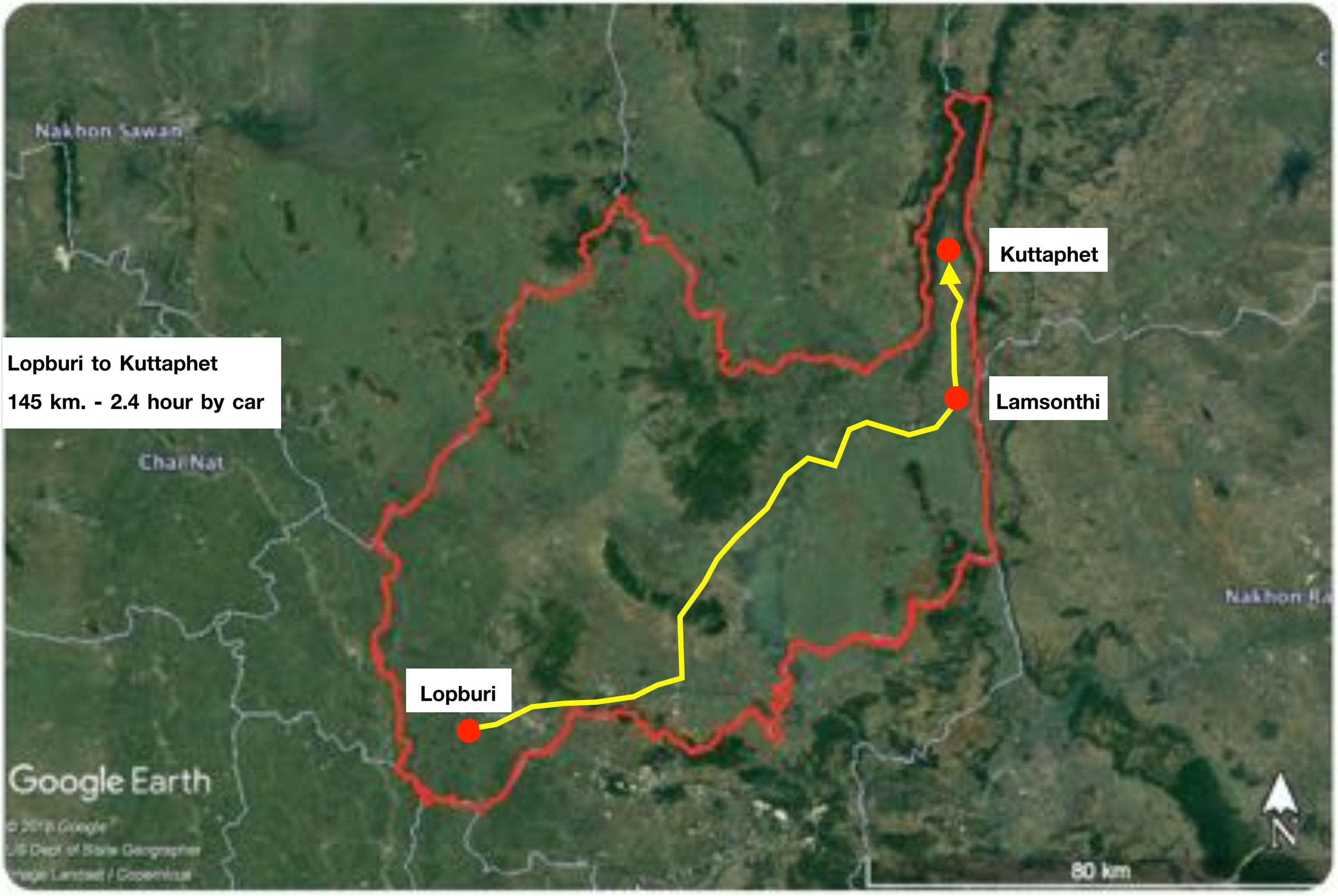


The internal space of the unit is attempted to follow the **steps of Continuous Ambulatory Peritoneal Dialysis** (CAPD) from ‘A’ to ‘B’ and ‘B’ to ‘C’,

A: a hand washing area

B: a position of a shelf for the transfer sets which kept in 7 slots with different colors for daily use

C: is a resting area during peritoneal dialysis process.


Nakhon Sawan
Chai Nat
Kuttaphet
Lamsonthi
Lopburi
Lopburi to Kuttaphet
145 km. - 2.4 hour by car
Google Earth
80 km
N

‘Maew' aged 25, requires self-peritoneal dialysis treatment four times a day. He initially denied a treatment due to the estimated cost and the difficulty access to the healthcare facility.

The unit was transported from Bangkok to Kuttaphet in Lopburi for Maew, who urgently need peritoneal dialysis treatment.

Setting up the unit at patient’s house

1

2

3

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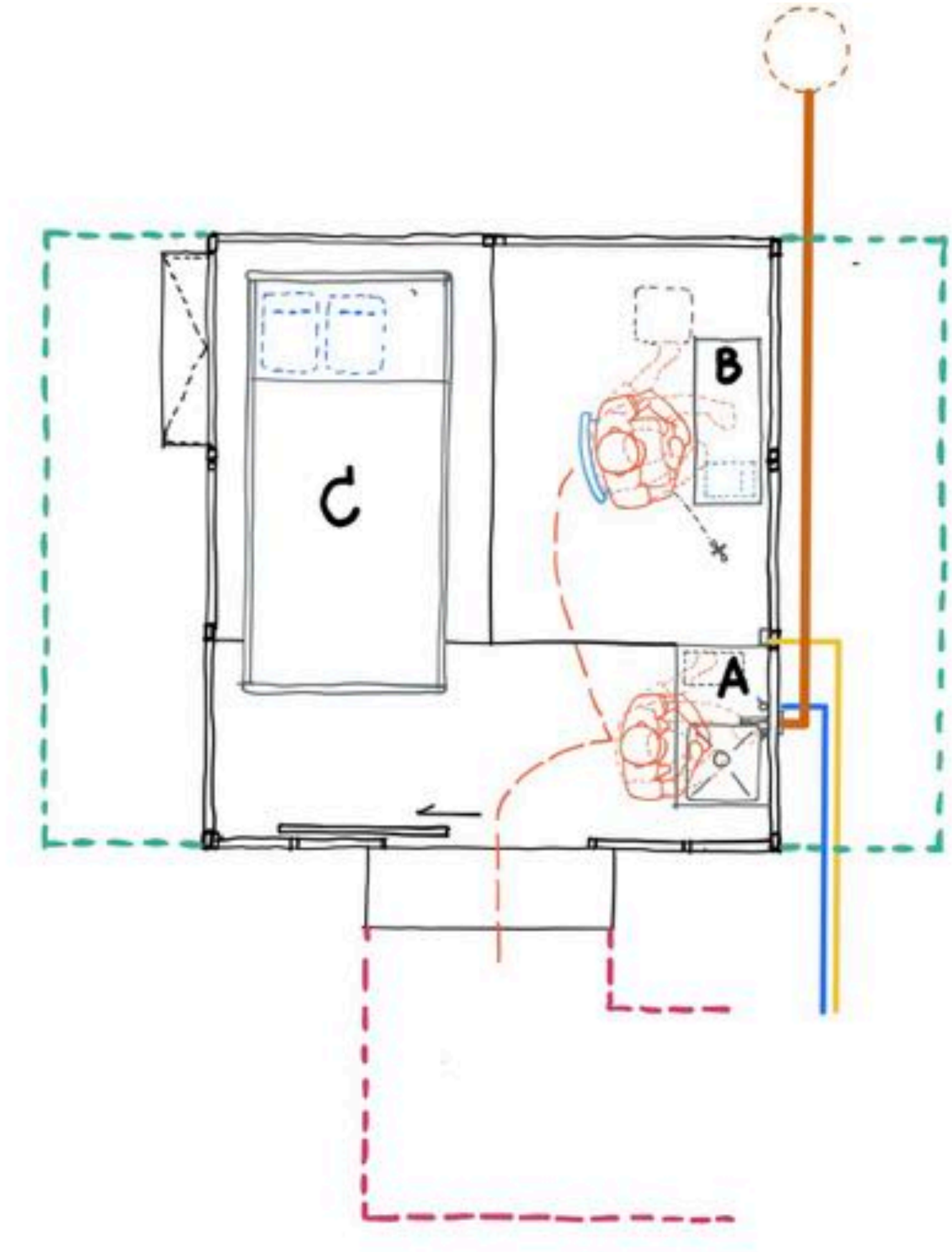
He requires self-peritoneal dialysis treatment four times a day, which are at 6 AM., 12 PM., 6 PM., and 10 PM. Each treatment takes 40 minutes. Sometime he stays overnight after the last treatment.

Patient’s record after the treatment

The unit set on site



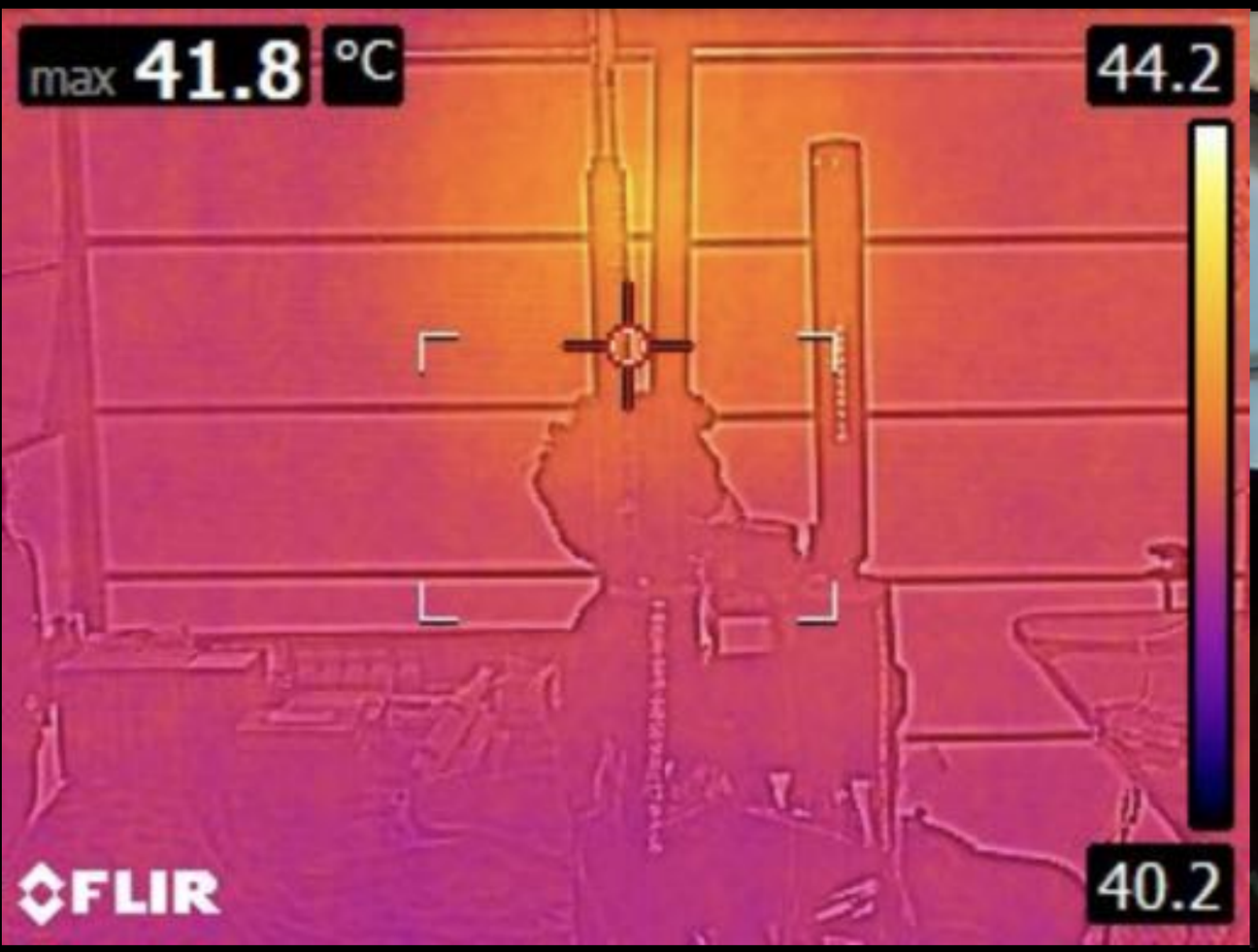
The spatial organisation of the unit was also follow the CAPD and adjusted by the patient for his own convenience and everyday routine.

Interior space of the unit

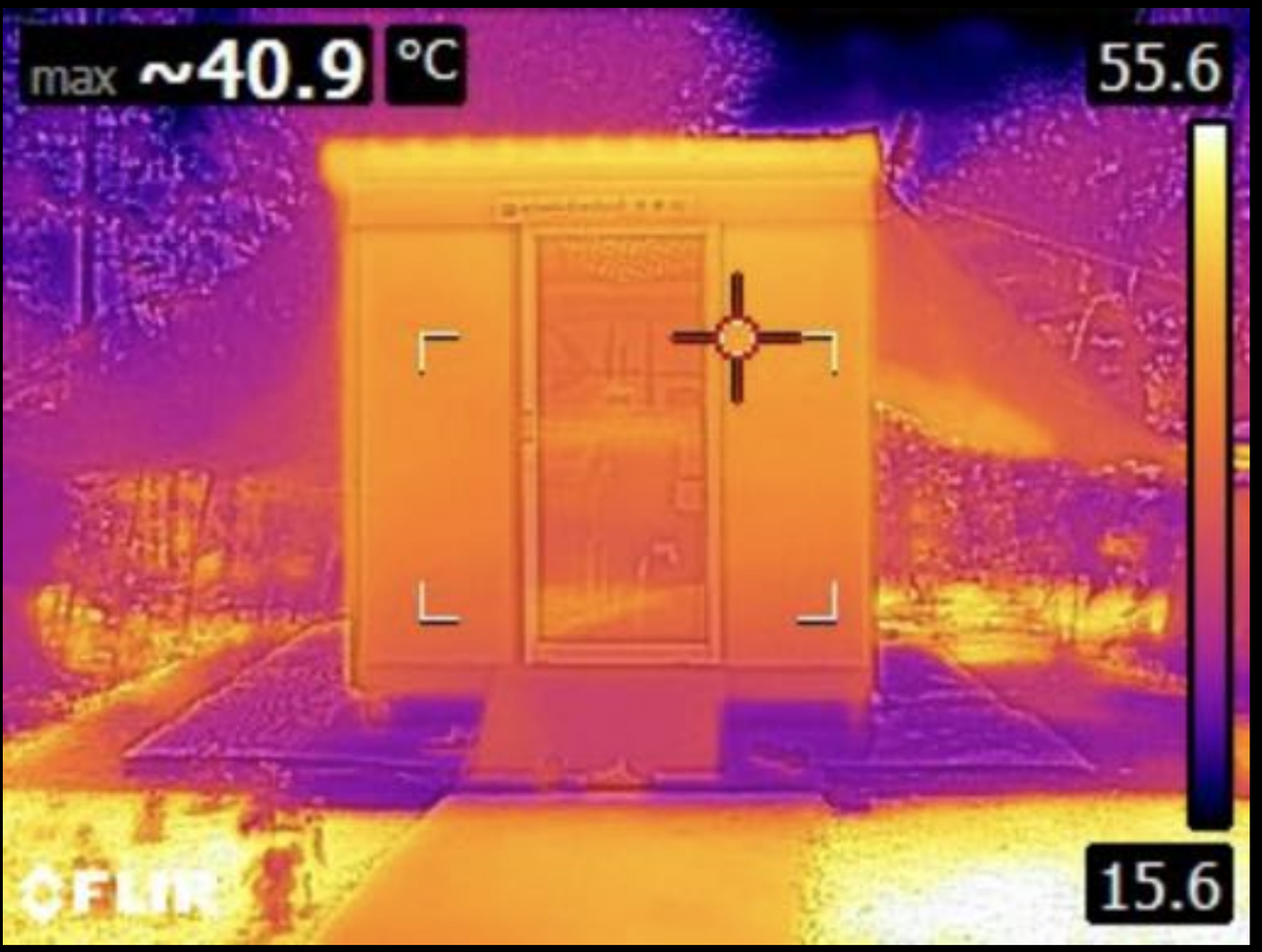
The equipments were adjusted by patient’s convenience but still base on CAPD process


Electricity
Shading
New Panels
Sliding door
Water Treatment
Sanitary
Ramp
Ground

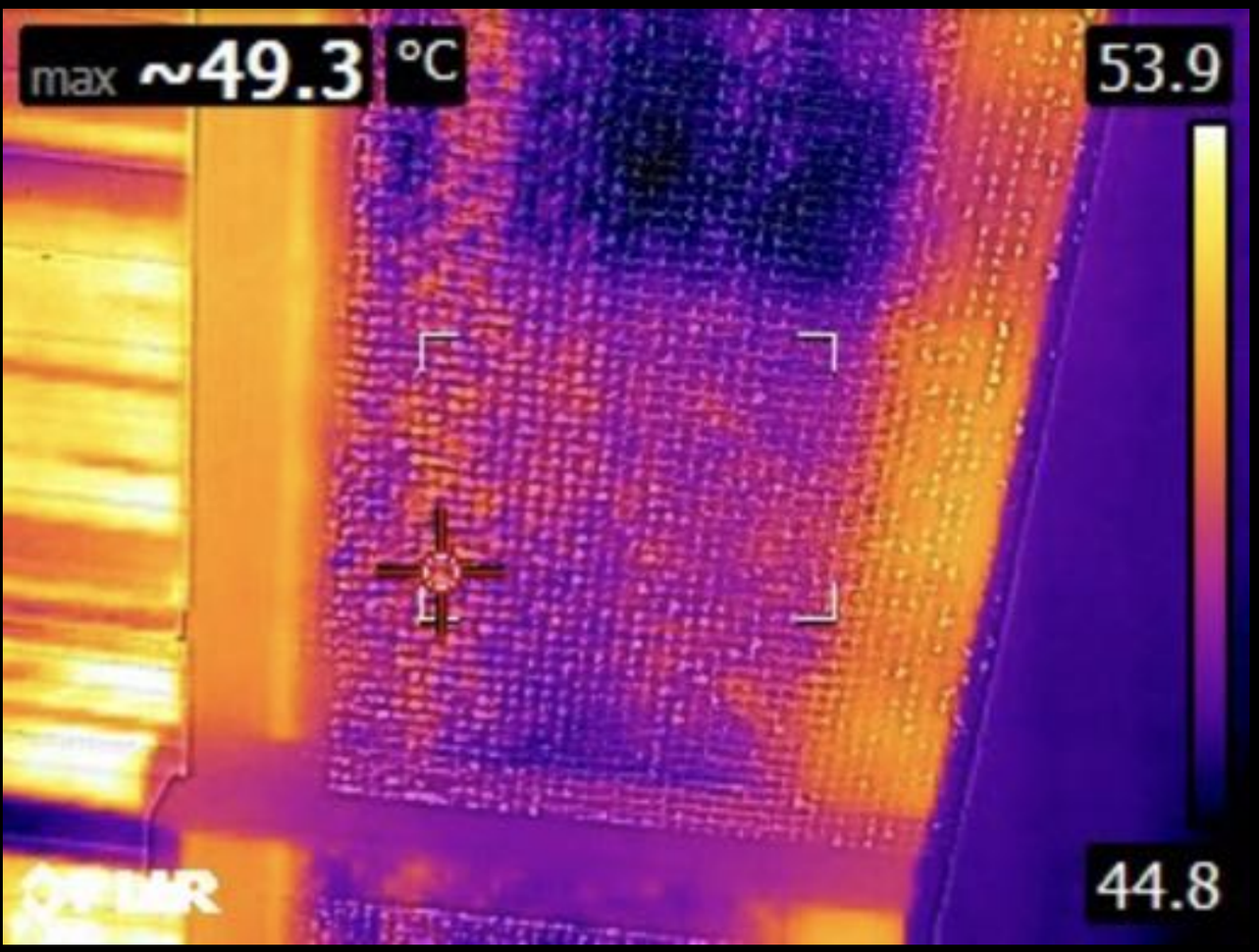
The revisit after 6 months delivery



Average air temperature in the unit was 41-42 celsius and the average relative humidity was 53-56%.



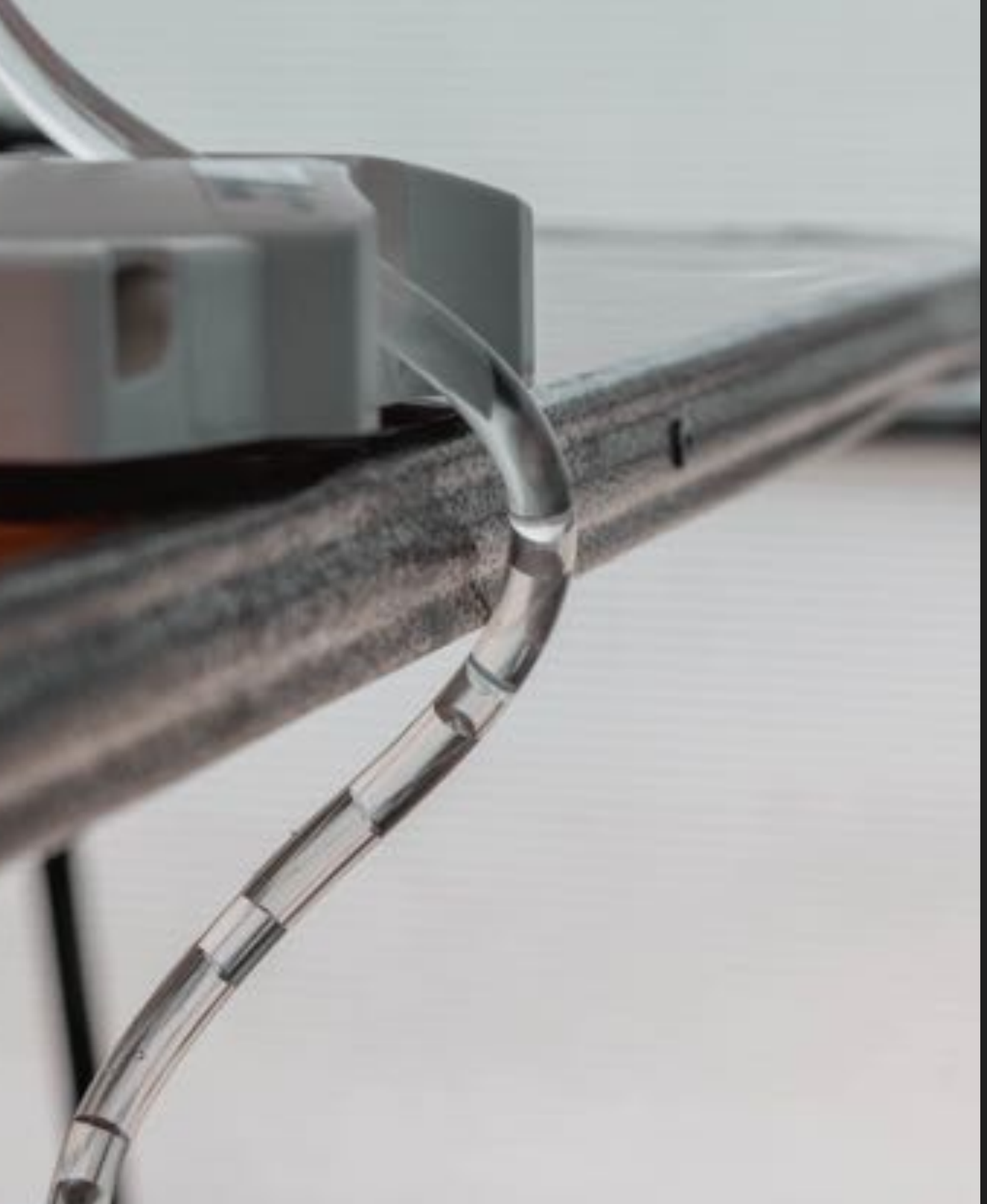
External air temperature was at 36.5 celsius, while the outside surface temperature of was 40-42 celsius.



The roof surface temperature was 53 celsius, while the temperature under PE ceiling insulation inside was at 48 celsius.

The invention of the mobile peritoneal dialysis unit prototype could not have been executed and accomplished by a group of experts under a single umbrella of expertise alone.

Instead, the long and complicated process has been brought to completion through **multidisciplinary collaborations, between academic and professional personnel in healthcare and design.**



The **collaborations** involved applications of knowledge, information, opinions, experiences, and participation from a number of collaborators that have been raised, **exchanged, discussed and negotiated** through repeated back-and-forth reviews, tests and revisions in order to **find an agreement for the most optimal solutions** from different points of view of either side.

Participatory design enabled the holistic design of the mobile peritoneal dialysis unit that filled in the medical service margin. ...

Not only was physical form of the unit invented, but **mental and social aspects of the treatment were addressed.**

When it comes to underprivileged patients with limitations of accessibility to services including budget and living distance to healthcare facilities, standard textbook solutions which are mostly adopted from western approaches may not fully fit the needs and constraints. Such marginal patients require different sets of care to serve different life assets and conditions, in particular social dimension.

The “imperfect” invention is able to adequately fulfill essential health requirements while minimizing negative complications and paying more attention to healing power of social care.