01.101: Technologies for Sustainable Global Health (AY 2023 Term 7)

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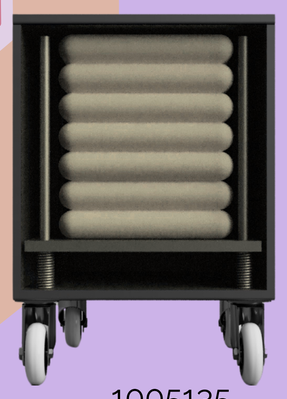
NKF

A Cabinet Named

Spring Back



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Mentor

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Need Statement

Our solution aims to make Peritoneal Dialysis (PD) easier and more organised for low-income seniors to ease their transition to life with PD and increase PD take up rate.

Identify

Disease

Chronic Kidney Disease: kidneys have been **irreversibly damaged** and the extent of the damage will only increase over time

Stakeholders

Patients
Independence, convenience, and comforts of PD usage
NKF
Encouraging PD by **empowering patients**
MOH
Encourage PD

Treatment

- Treatment for kidney failure **Haemodialysis/ Peritoneal Dialysis**
- **HD: 3X per week at dialysis centers**
- **PD: 2X per day at home**

healthhub.com

Market

Singapore ranked **3rd** for kidney failure

30% PD uptake among new dialysis patients by 2025

Gap Between current situation and patients' need

CHALLENGES	CURRENT SITUATION	PROPOSED SOLUTION
STORAGE	Patients must store **30 boxes** of solution bags monthly. This poses significant storage challenge, especially in smaller living spaces.	Implementing more compact or efficient storage solutions designed for limited space.
WEIGHT	**Each solution bag weighs ~ 5kg**, and each dialysis session requires 2 bags, posing a physical challenge for many seniors.	Introducing mechanisms to assist with shifting PD bags

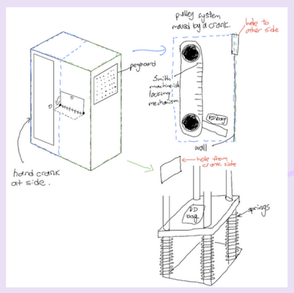
Must-haves Save Space, Organisation, Hygienic, Ease of operation

Good-to-haves Tracking, Training, Convenience, Contingencies

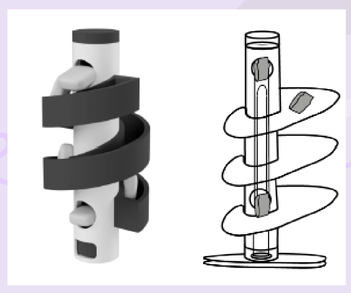
Concept Ideation and Prototyping

Concept Generation & Screening (Gen 1)

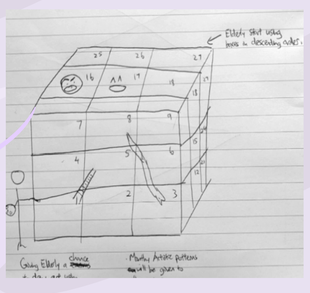
1: EZ-Cabinet



2: Slide Shelf

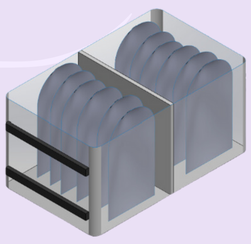


3: Art Box

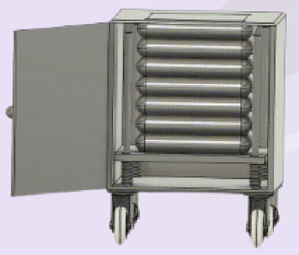


Filtering and Selection (Gen 2)

Above Trolley



Below Bed



Next to Trolley

Final Product

Key Features

Spring-Supported Design: The storage box is equipped with a spring mechanism at its base. This feature assists in lifting the bags, making it easier for seniors to retrieve them without bending down too much or straining themselves.

Intuitive Easy Tracking: The box is tailored to hold **7 days worth PD bags**, which is strategically chosen to align with a weekly tracking system, making it easier to schedule and monitor.

Testing

Functionality

- Weight Capacity & Stability: Cabinet is able to hold up to 240kg (3x more than required)
- Easy Usage: Spring pushes bag to the height optimal for retrieval
- Safety: Bags are held steadily and elevation is controlled

Usability

- Ease of Use: Reduced Borg RPE Scale score from 15 to 12 with our solution
- Hygiene: Enclosed cabinet to protect contents from external contaminants & easy to clean after removal of bag platform

Calculations

Wheel Safety Factor:	Spring Safety Factor:	Spring Stiffness:
60kg load tolerance	τ_a = 110.1 MPa	F = kx
x 4 wheels = 240kg	S_{sa} = 386.5MPa	98.1N = 1.76x
SF = 240kg/80kg = 3	SF = 386.5/110.1 = 3.51	x = 5.6cm per day

Conclusion

Summary and Analysis

"Spring Back", supported by **NKF** and guided by **Dr. Xiaojuan Khoo and Dr. Yajuan Zhu**, can innovatively help improve PD bag management for seniors. The storage box, holding a week's supply of PD bags, is spring-supported for easy access and safety. It can withstand the required weight and offers a user-friendly experience. It is a testament to the feasibility of providing effective PD support solutions for seniors, addressing both physical and cognitive burdens of managing PD treatment at home.

Future Considerations

- Collect and analyse **feedback from real-world use** to refine the design
- Develop additional features to **enhance the accessibility** of the storage box for users with varying levels of physical ability
- Assess the environmental impact of the storage box and seek ways to use recyclable materials to support **sustainability**