Development of an Artificial Intelligence (AI) driven interactive calculator chatbot app (Met Bot) for caregivers of children with inborn errors of metabolism (IEM) requiring protein restriction

As Artificial Intelligence (AI) technology becomes more ubiquitous, we hypothesized that caregivers can be empowered to be self-reliant in monitoring and adjusting their child’s diets. Hence, we developed an AI-driven interactive calculator chatbot app (Met Bot), for a proof of concept (POC) trial on caregivers of children with Inborn Errors of Metabolism (IEM) requiring protein and amino acid restrictions. The study team searched for Apps specifically designed for patients with IEM, as well as popular Apps for monitoring nutrition intake in general to identify key features to include in the Met Bot.

Phases in Met Bot Development:

1. **Phase 1 (Designing Met Bot & trial within study team)**
   - **Met Bot comprises of (1) Nutrition Calculator with**
     - Customized standard database using United States Department of Agriculture (USDA) nutrient database, Singapore Food database & commercial supermarket foods
     - Personalized dashboard and management plan for patients based on their metabolic condition
   - **(2) Interactive chatbot “Lynn” providing informing on**
     - nutrient content per 100g of a specified food
     - weight of a specified food to eat for a particular amount of nutrient
     - suggestions on what to eat for a specified amount of nutrient.
   - Prototype Met Bot (for trial by study team before piloting in phase 2)

2. **Phase 2 (Pilot Trial of Met Bot with 3 experienced caregivers)**
   - **Recruitment of 3 caregivers with > 4yrs experience in managing their children (Oct 2019)**
   - **Pilot Trial (Dec19 – Mar20)**
     - (i) 1 face to face session Dec 2019 (take consent and demonstration on use of Met Bot, caregivers record their child’s food intake for 2 weeks and ask the chatbot 3 questions)
     - (ii) 1st group feedback session Jan 2020 (caregivers gave feedback on improving the App, and caregivers instructed to record their child’s intake for 3 days and ask the chatbot 3 questions)
     - (iii) 2nd group feedback session planned for Mar 2020 but conducted “Oct 2020 (caregivers gave feedback on improving the App via zoom)
   - Met Bot (for rollout in phase 3)
   - *Delay due to Covid 19 and also technical issues in development*

3. **Phase 3 (Rollout of Met Bot to 28 caregivers)**
   - **Recruitment of 28 caregivers (Nov 2020-Jan 2021)**
   - **English speaking, with smartphone/PC and data plans**
   - **16 consented to participate**
   - **Rollout Study (27 Feb – 2 Sept 2021)**
     - (i) 1 face to face session (take consent and demonstration on use of Met Bot)
     - (ii) 1 face to face session (take consent and demonstration on use of Met Bot)
     - (iii) Caregivers to use Met Bot for 6 months
     - (iv) Complete post-study survey

Study Outcomes:
1. Caregivers’ confidence in adjusting their child’s diets
2. Usefulness of App

**Met Bot Key Features:**

- **Prescription**
  - Customized standard database
  - Incorporating supermarket foods
- **Intake**
  - Nutrient calculator for a specified food
  - Weight of a specified food
  - Nutrition guide for children
- **Food Diary**
  - Automatic food intake monitoring
  - Additional features
- **Food Protocols**
  - Customized nutrient databases
  - Flavoured water/ice
  - Calcium supplement
- **Met Bot Outcomes**
  - Nutrient intake analysis
  - Personalized diet plan
  - Chatbot guidance

STUDY OUTCOMES:

- 69% of caregivers completed the trial.
  - (i) 36% reported at least a 1-point increase in confidence in giving their child new foods, on a 5-point Likert scale
  - (ii) 73% rated the Met Bot as moderately to extremely useful
  - (iii) 36% were using the Met Bot to monitor their child’s diet at the end of the study

Conclusion: Whilst our caregivers are already empowered and confident in adjusting their child’s diet, they still found the Met Bot useful. We intend to enhance the Met Bot and extend the POC trial to other metabolic conditions by May 2022