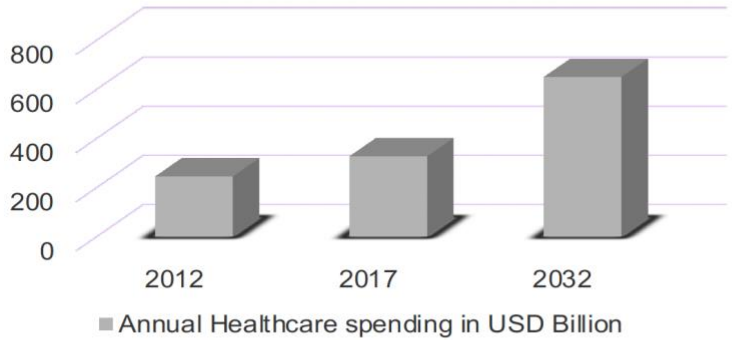
Detecting early onset of Cardiometabolic Syndrome

The Problem

- **CardioMetabolic Syndrome(CMS)** is the umbrella term given to diseases arising out of *metabolic dysfunction*
- *Diabetes, Atherosclerosis, Strokes, liver & kidney diseases* are some conditions that can be traced back to CMS
- Despite multifarious appearances it can be characterized by *insulin resistance , impaired glucose tolerance , dyslipidemia & hypertension*

Analysing the economic impact of diabetes only, *ignoring other CMS morbidities*



- In 2032 , annual healthcare spending on diabetes would amount to $634.12 Bn
- So , including other morbidities , CMS will be a cause of *multi-trillion-dollar loss of value in US alone*

Extrapolating healthcare spending on diabetes till 2032 ,using historic rise of 26% from 2012 to 2017
Reference : https://care.diabetesjournals.org/content/early/2018/03/20/dci18-0007

Current detection protocols

To determine CMS presence 3 factors are to be established from the following:

Obesity
BMI > 30

Glucose
Fasting > 100 mg/dl

Elevated systolic & diastolic

TRIGLYCERIDES
> 150 mg/dl

< 40 mg/dl Men
< 50mg/dl Women

However , its already late if these problems are present.

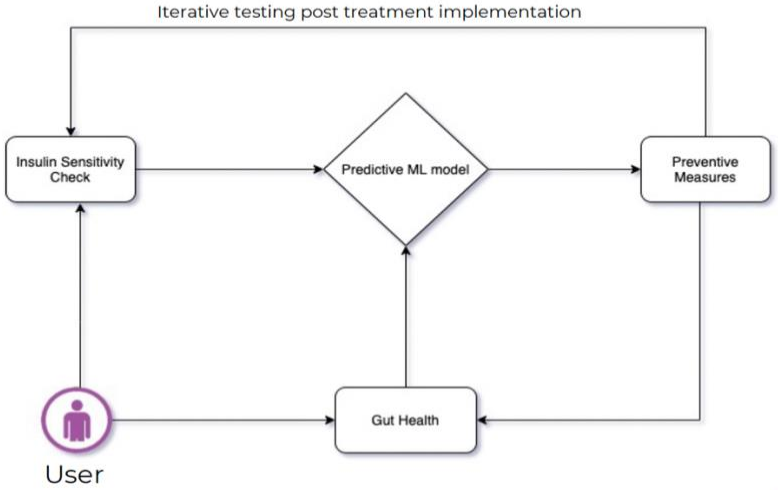
These are the downstream effects of something more fundamental :
"Low grade Chronic Inflammation" alongwith "Insulin Resistance"

Inflammation - *'friendly foe'*

- Inflammation is immune system's response to injury or foreign pathogens
- Critical for human survival
- Certain factors cause a persistent form of systemic inflammation- more chronic in nature
- Prolonged inflammation causes overproduction of pro-inflammatory cytokine proteins
- Such cytokine storms , cause damage to healthy tissues
  e.g., pancreatic β-cell death in Type 1 Diabetes
- Gut dysbiosis has emerged as a gateway that leads up to this low-grade systemic inflammation

Proposed Solution

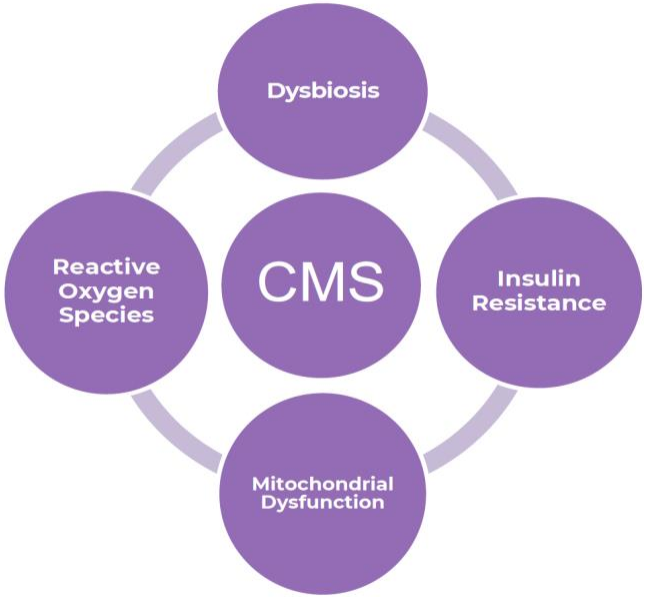
Taking a dual-pronged approach for determining onset of CMS , we propose a continuous check on Insulin levels to determine insulin resistance & reinforcing this biomarker with data from gut – flora composition *(ratio of firmicutes , bacteroidetes , & actinobacteria)* , check on LPS production & other metabolites.



Model Explained

upHealth app :

- Uses a combination of unsupervised & reinforcement learning.
- Difficult to quantify chronic inflammation (or its causes); But individuals can be segregated as inflamed or not using biomarkers such as CRP , Homocysteine
- Underlying unsupervised learning model trained on unlabeled dataset containing metabolically healthy & unhealthy individuals.
- Once identified , preventive treatment -*medicinal* , *lifestyle or dietary interventions* - can be offered
- Each individual responds differently to different modalities
- Reinforcement learning to deliver precision care for each individual
- Provides a significantly improved self-care tool than conventional CGM(Continuous Glucose Monitor) or other HealthTech wearables & accompanying apps



Working :

Phase 1 : Can be implemented with present state of technologies

- Insulin in Blood test to assess insulin sensitivity
- Stool test to determine gut flora composition
- UpHealth app assigns a “HealthScore” based on its model
- Provides suggestion for score improvement & next testing time
- Can be used with the guidance of a healthcare practitioner
- Tests undertaken again to assess changes in metabolic health
- Continuous process to improve & monitor your metabolic functioning

Phase 2 : Requires focused investment in biosensor tech

- Insulin measurement from a non-invasive biosensor
- Gut composition & functioning assesed from a biosensor – perhaps IMBED or an external sensor
- Real time health insights , suggestions & care
- Bulk data from all the users in real time
- Make the prediction model more accurate

Potential Roadblocks :

- Needs voluminous , precise dataset
- Data governance
- D2C without prescriptions for mass adoption
- Phase 2 has critical R&D dependencies
- Untested Protocol
- Inertia in adoption by medical practitioners

Opportunities :

- Problems faced by billions
- Multi billion-dollar market
- Establishing a new paradigm - preventive care instead of diagnostic care
- Capitalizing on rise in awareness among individuals who want more democratized & personalized healthcare

Making disease optional

By focusing on prevention of endemic CMS morbidities, control of health can be transferred onto individuals , easing the burden on healthcare providers & offering a quality long-life for the users.