1. Develop a complete pharmacokinetic model for predicting orally administered drug release profile
   - Drug Release Model + Compartmental Absorption and Transit (CAT) model.

2. Personalized Tablet
   - Suggest optimal geometry of drug tablet
   - Exploit Personal Pharmacokinetic characteristics (e.g. peak plasma concentration; area under the curve (AUC); bioavailability needed to obtain desired plasma concentration profiles within therapeutically required range).

3. Design polymer carrier & excipients for the drug using molecular modeling.

4. Identify and incorporate appropriate pharmacodynamics model into the design framework.
MAIN ORAL DRUG DELIVERY STEPS

- Drug dissolution and degradation
- Gastric emptying
- Intestinal transit, intestinal permeation and transport
- Intestinal metabolism and hepatic metabolism

**DISSOLUTION MODEL**

- Polymer comes into contact with water (bodily fluid)
- Two distinct fronts
  - Swelling interface at R
  - Polymer-water interface at S
  - Drug diffusion out of gel layer

- R decreases because of drug release
- S decreases because of polymer dissolution

2L = Thickness of the tablet
2R = Thickness of the tablet at any time “t”
2S = Thickness of the swollen tablet

1. Geometry of drug tablet

2. Pharmacokinetic characteristics:
   - Peak Plasma Concentration
   - Area under the curve (AUC)
   - Bioavailability needed to obtain desired plasma concentration profiles within therapeutically required range.
   - First pass metabolism (liver)

• Dissolution model combines Unreleased & Undissolved layers
Case Study – Cimetidine (or Tagamet)

- Treatment of duodenal and gastric ulcers, gastro esophageal reflux disease (GERD/acid reflux or heart burn)
- Drug inhibits stomach acid production by inhibiting the secretion of gastric glands

Aqueous solubility = 6 mg/ml
Bioavailability = 60 – 70%
Human permeability = 0.35 x 10^-4 cm/sec

Min J = \int_{0}^{T} \left[ C_{\text{model}}(t) - C_{\text{exp}}(t) \right]^2 dt \Rightarrow AUC
s.t.

Pharmacokinetic Model

PLASMA PROFILES (AUC)

1. Geometry of drug tablet

2. Pharmacokinetic characteristics:
   - Peak Plasma Concentration
   - Area under the curve (AUC)
   - Bioavailability needed to obtain desired plasma concentration profiles within therapeutically required range).
   - First pass metabolism (liver)

(b) 15% methacrylate copolymer cimetidine tablet
(c) 26% methacrylate copolymer cimetidine tablet
To Discuss

- Area of research
- Findings to date
- Specific ways/ideas that research can contribute towards the mission of CAR
- Current working relationships with resources available
- Collaborations and resources needed for multidisciplinary research