

# Binder Consumption as a Function of Time: A Linear Model for Lowering Elevated Phosphorus Levels by Improving Binder Timing

Mark Livingston, LLMSW, *DaVita Inc.*

## INTRODUCTION

Failure to properly time binders to “catch” phosphorus-laden foods, pre-absorption, can cause patients to experience hyperphosphatemia and the complications that accompany it. Defining the parameters of mealtime and explaining proper binder timing are often excluded from conversations with non-adherent patients when discussing elevated phosphorus and binder dosing.

Nutritional practice with patients at DaVita’s® Downriver Kidney Center in Allen Park, MI) emphasized the need for a strict regimen to time binder consumption during each meal to maximize per-pill binding potential.

## METHODOLOGY

- Based on gastric emptying research of patients with and without dyspeptic symptoms typically associated with gastroparesis, two [linear/ step function] mathematical models were developed for properly timing binder consumption
- These models account for marginal phosphorus binder consumption during meals/snacks to ensure a continuous supply of phosphate binders throughout meals/snacks by properly time phosphate binding
- Using the time (t) interval of 20 minutes as the standard significant emptying time interval, binders might be taken at time t<sub>0</sub>, t<sub>0</sub>+20, t<sub>0</sub>+40, ...t<sub>0</sub>+20n, where t<sub>0</sub> represents the time immediately following the first bite of food and 20 minute intervals are added to the time t<sub>0</sub> at which time an additional binder would be consumed

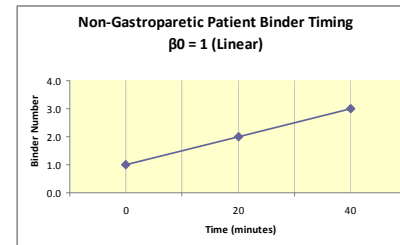
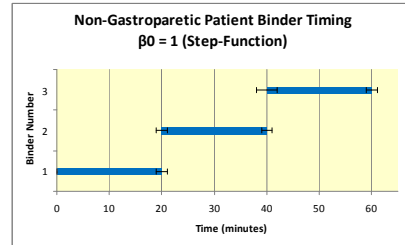
## RESULTS

- Our results showed that structured education based on our mathematical models (1 and 2) of proper per meal binder timing resulted in an approximate 40% reduction in the phosphorus levels for chronically non-adherent patients, defined as at least 3 months of phosphorus lab values >8

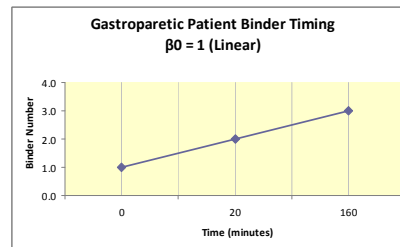
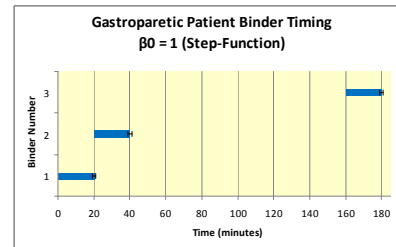
- Model 1 (w/o Gastroparesis)**  
 $N(t) = \beta_0 + t/20 + \alpha, t > 0$

- Model 2 (w/Gastroparesis)**  
 $N_G(t) = \beta_0 + t/20 + \beta_{t+60\mu} + \alpha, t > 0$

### Patients without Gastroparesis



### Patients with Gastroparesis



## KEY FINDINGS

- These models are not meant to imply that a patient ought to take a pill every 20 minutes without limit
- They are meant to illustrate that appropriate binder timing must be included in dosage decision-making and subsequent communication with patients
- The variable of “time” must be added to the discussion of conventional dosing variables such as height, weight, present phosphorus level, and anticipated phosphorus consumed
- What might be done by clinicians?
  - ✓ Define “mealtime”
  - ✓ Discuss patients’ mealtime symptoms
  - ✓ Educate patients on gastric emptying & binder timing
  - ✓ Ensure Social Worker provides ongoing counsel to patients
- Further research is recommended

We thank the patients who participated in this study. We also thank DaVita Clinical Research® (DCR) for their support with this poster. DCR is committed to advancing the knowledge and practice of kidney care.



Correspondence: marlivings@aim.com  
National Kidney Foundation Spring Symposium, March 26-29, 2009.