Critically ill patients are often hyperglycemic and extremely diverse in their dynamics. Consequently, fixed protocols and sliding scales can result in error and poor control.

A two-compartment glucose-insulin system model that accounts for time-varying insulin sensitivity and endogenous glucose removal, and saturation kinetics is developed and verified in proof-of-concept clinical trials to control hyperglycemia.

### Clinical Control Protocol

- **Real-time bolus based set-point glycemic control**
- **Adaptive control algorithm capable of capturing patient specific, time-varying system dynamics**
- **Real-time identification of insulin sensitivity variation due to drug therapy**

### Physiological Model

\[
\dot{G} = -p_G G - S_i (G_i + G_e) \frac{Q}{1 + \alpha Q} + P(t)
\]

Two compartment glucose-insulin system model with \( I(t) \) and \( P(t) \) inputs to blood plasma, and measured blood glucose change output \( G(t) \). Each input to the plasma is broken into exogenous and endogenous sources.

### Trial A

Glucose Concentration

### Trial B

Glucose Concentration

### Trial C

Glucose Concentration

This study demonstrates the potential of adaptive control for set-point regulation of hyperglycemia across a range of critically ill patients. Further investigation into glucose clearance saturation should permit better performance. Overall, the research presented is a significant step towards more fully automated control of hyperglycemia in critically ill patients.