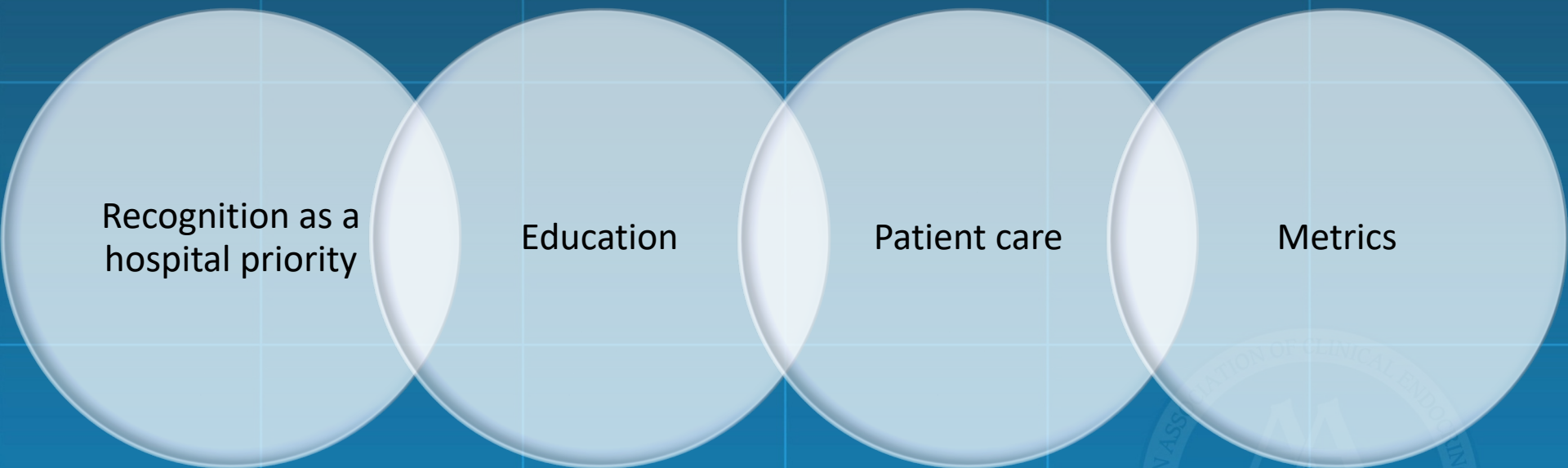


# **Glucometrics**

## **Assessing Quality in Inpatient Glycemic Management**



# The 4 Spheres of a Quality Inpatient Glucose Management Program



# **Glycemic Management: Why Should This Be a Hospital Priority?**

- Enhance quality and patient safety
- Competitive advantage
- Cost savings
- Indirect educational impact on our trainees
- The Joint Commission



# Institution-Wide Educational Efforts

- Physicians
- Nursing staff
- Pharmacists
- Dietitians
- Medical assistants





# Patient Care

- Identification (and proper coding) of patients
- Policies and procedures
  - Point-of-care blood glucose (BG) testing
  - Institutional glycemic targets (ICU, wards)
  - ICU IV insulin protocols
  - Standardized SC insulin order sets
  - Hypoglycemia protocol
  - Patient education tools
- Inpatient diabetes management team/service
- Transition to outpatient care (access)



# Metrics Frequently Used in the Inpatient Glucose Literature

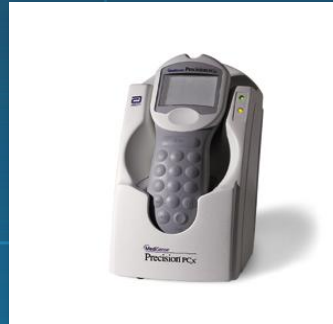
- Raw blood glucose (BG) average
- % of BGs within a prespecified range (80-110, 100-150, <180, <200 mg/dL)
- % of patients with a certain % of BGs within a prespecified range
- Hypoglycemia rates (<40, <50, <60, <70 mg/dL)
  - % of BGs
  - % of patients
- Hyperglycemic excursions (>180, >200, >300 mg/dL)
  - % of BGs
  - % of patients

Malmberg, 1997; Queale, 1999; Capes, 2000, 2001; Bhattacharya, 2002; van den Berghe, 2001, 2006; Funary, 2003; Krinsley, 2003; Goldberg, 2004, 2005; Baldwin, 2005; McCallister, 2005; Kosiborod, 2006.

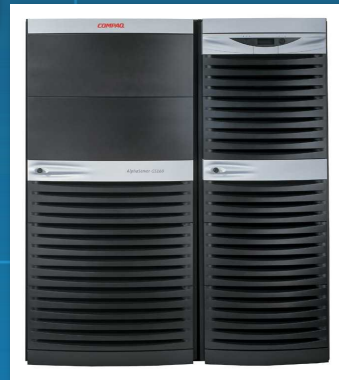
# Generation of Inpatient Glucometrics



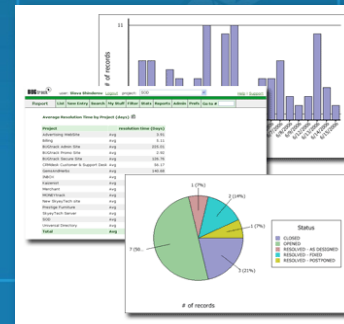
**POC testing**



**POC meter docking interface**



**Computer data repository**



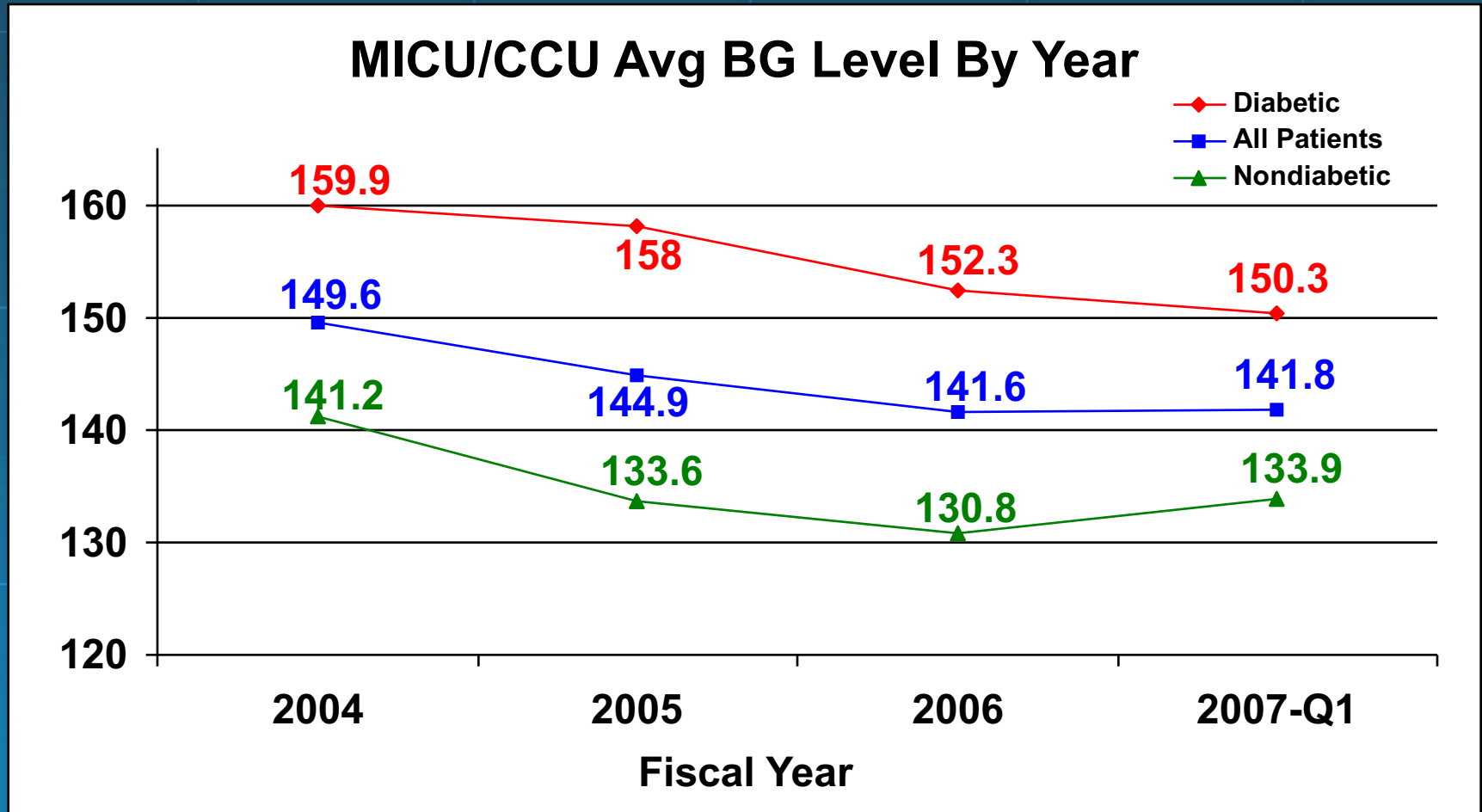
**Glucometric reports**

# Measuring Inpatient Glycemic Control: Special Issues

- Sample site (finger sticks, lab plasma glucose)
- Multiple measures during hypoglycemic or hyperglycemic events
- Varying time intervals of measurement
- Timing in relationship to meals
- Effects of IV fluids (dextrose)
- How to collect glucose measurements
- How to analyze them
- How to present data to clinicians/administrators

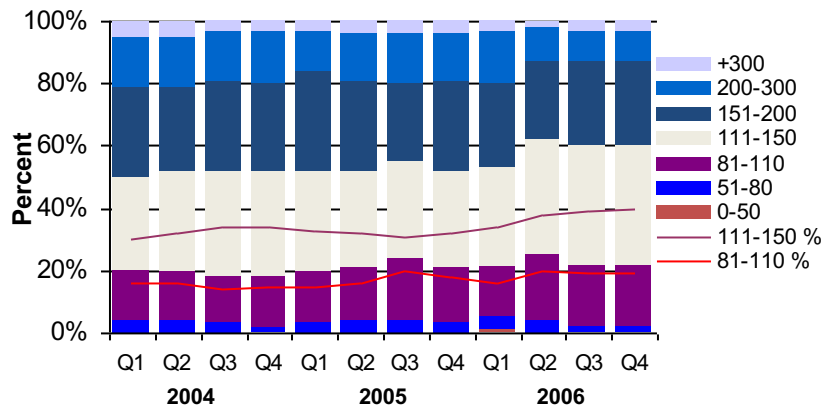


# Example of Graphic Display of Glucometrics Data

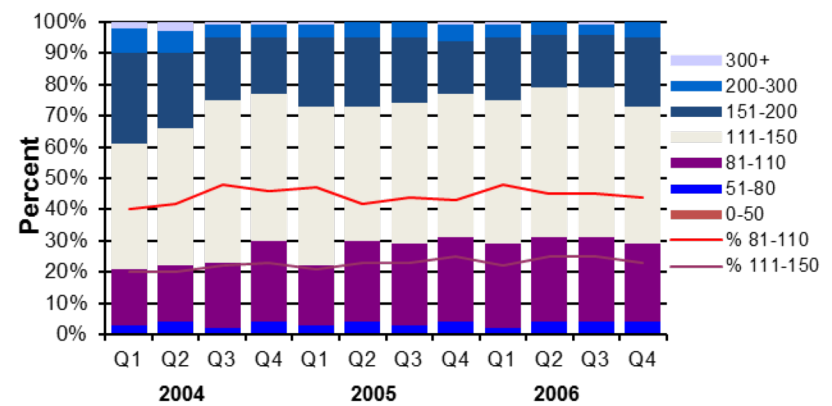


# Example of Graphic Display of Glucometrics Data

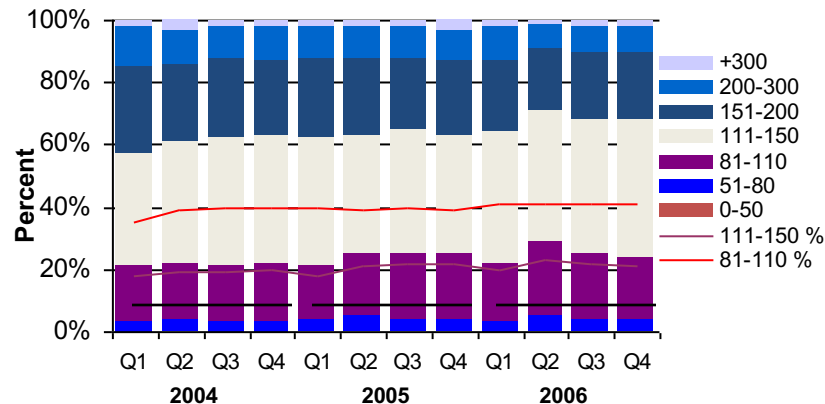
## Diabetic Patients



## Nondiabetic Patients



## All Patients





# Glucometrics Project: Methods

## Sample

- Yale-New Haven Hospital blood glucose (BG) data downloaded into relational database for analysis
  - BG values
  - Date/time
  - Patient ID
  - Hospital ward
- Sample: One general medical ward's March 2004 BG results (n=1552)

## Metrics Tested

- Mean/median BG
- % BG in “favorable” range (80-139 mg/dL)
- % Hyperglycemia (>300 mg/dL)
- % Hypoglycemia (<60 mg/dL)



# Glucometrics Project: Units of Analysis



Ward

n=1552



Patient Stay

n=118

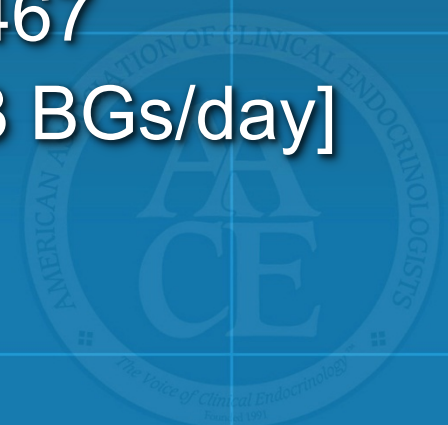
[13.2 BGs/stay]

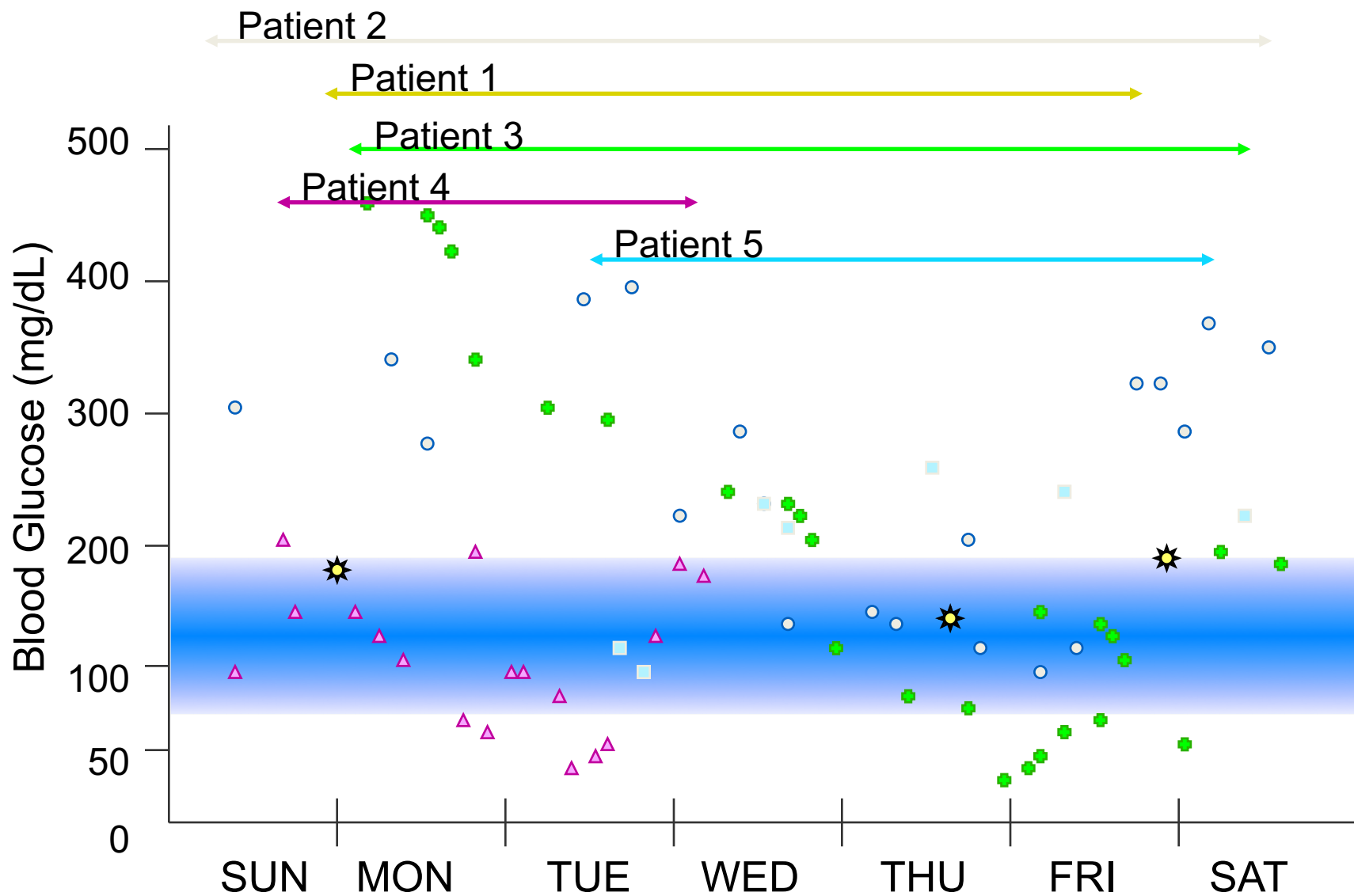


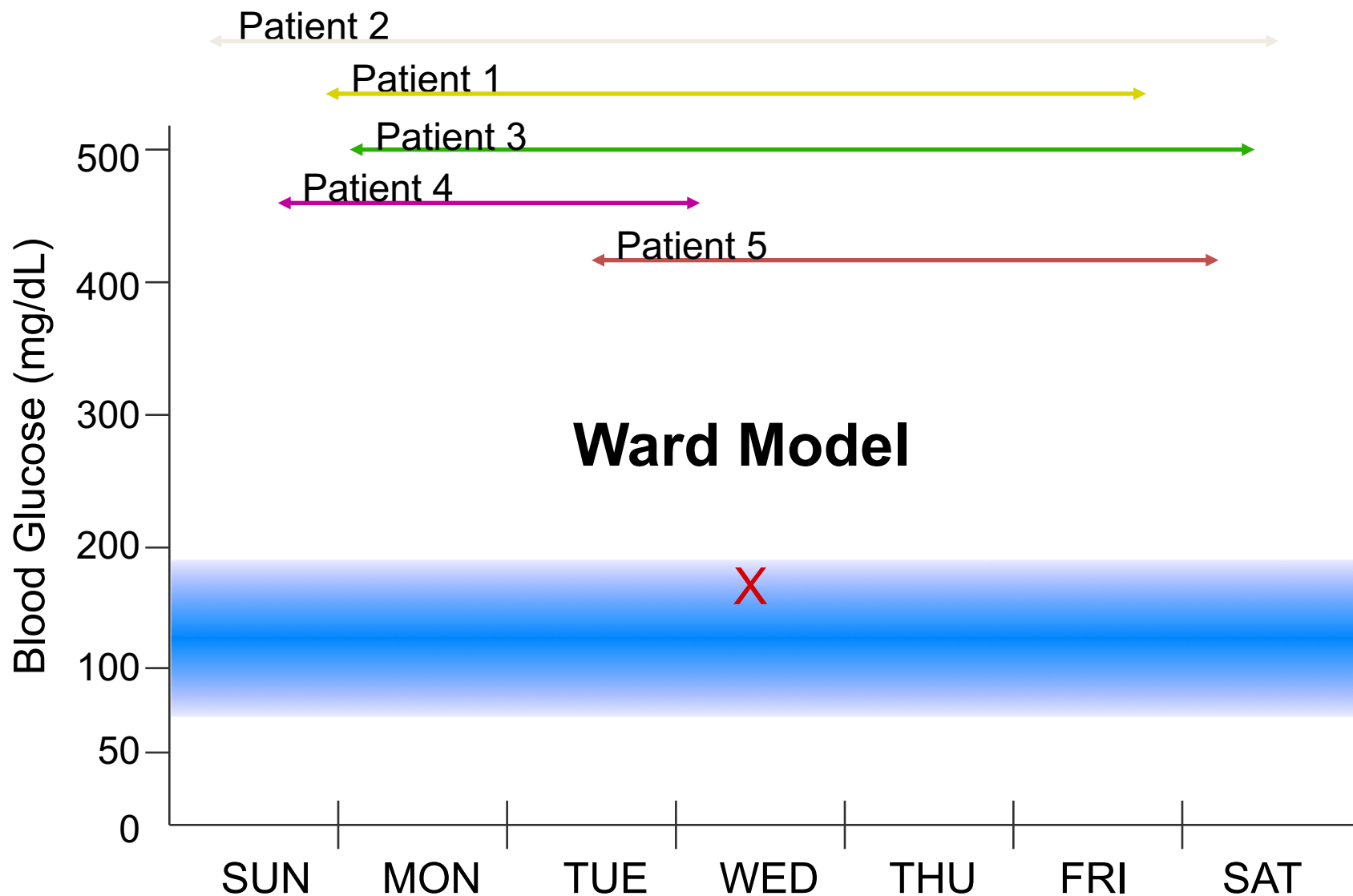
Patient Day

n=467

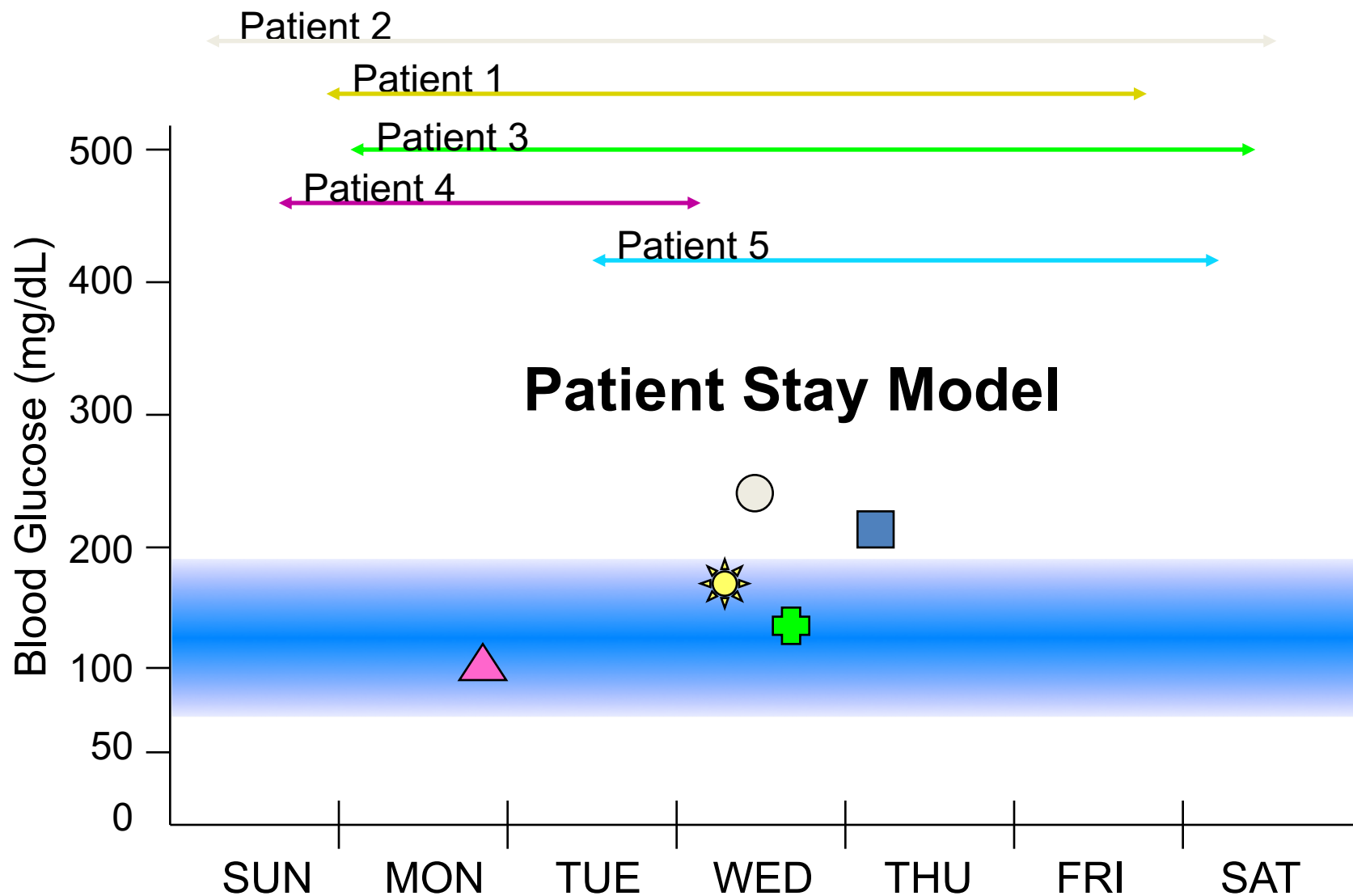
[3.3 BGs/day]



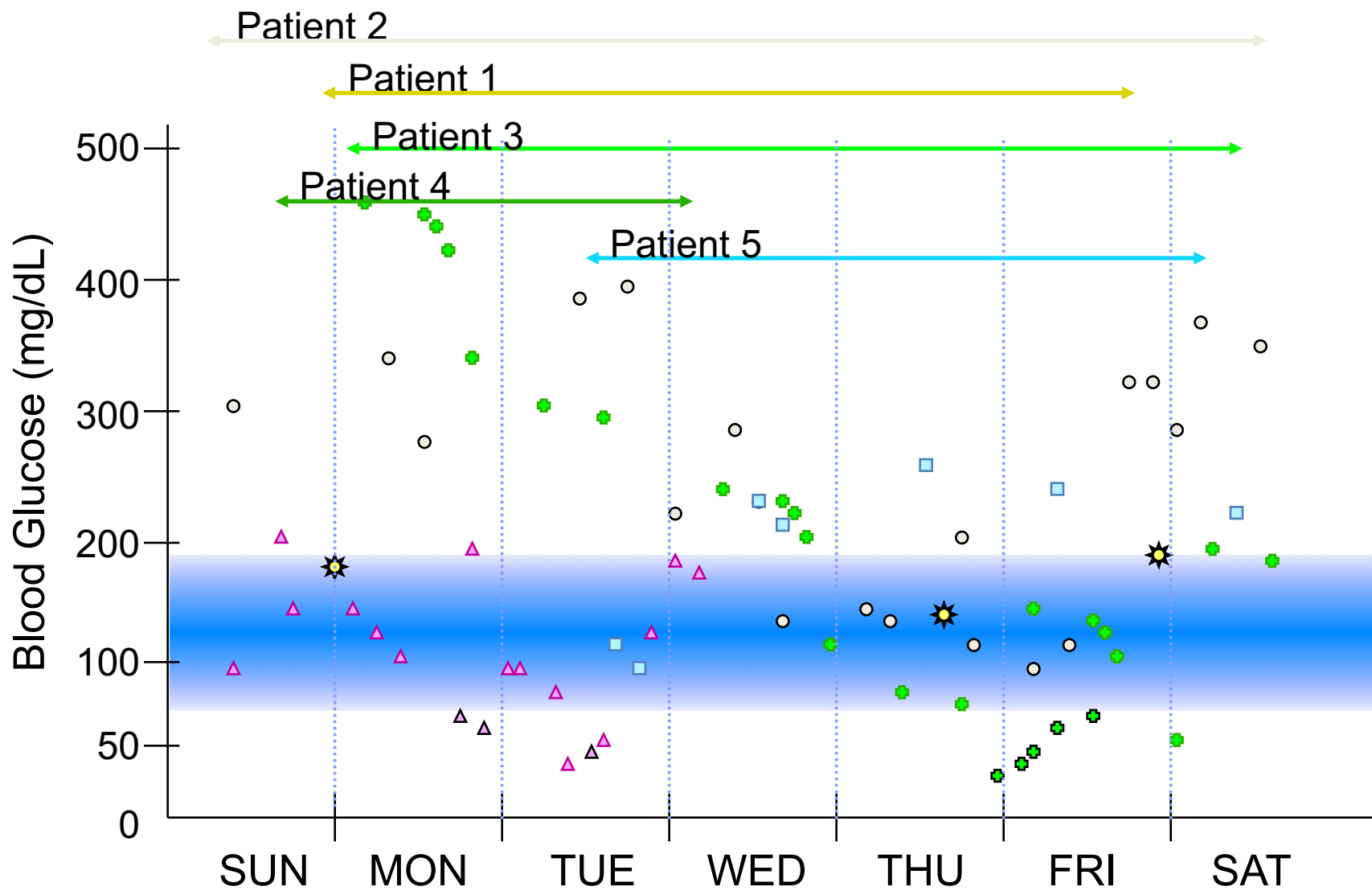


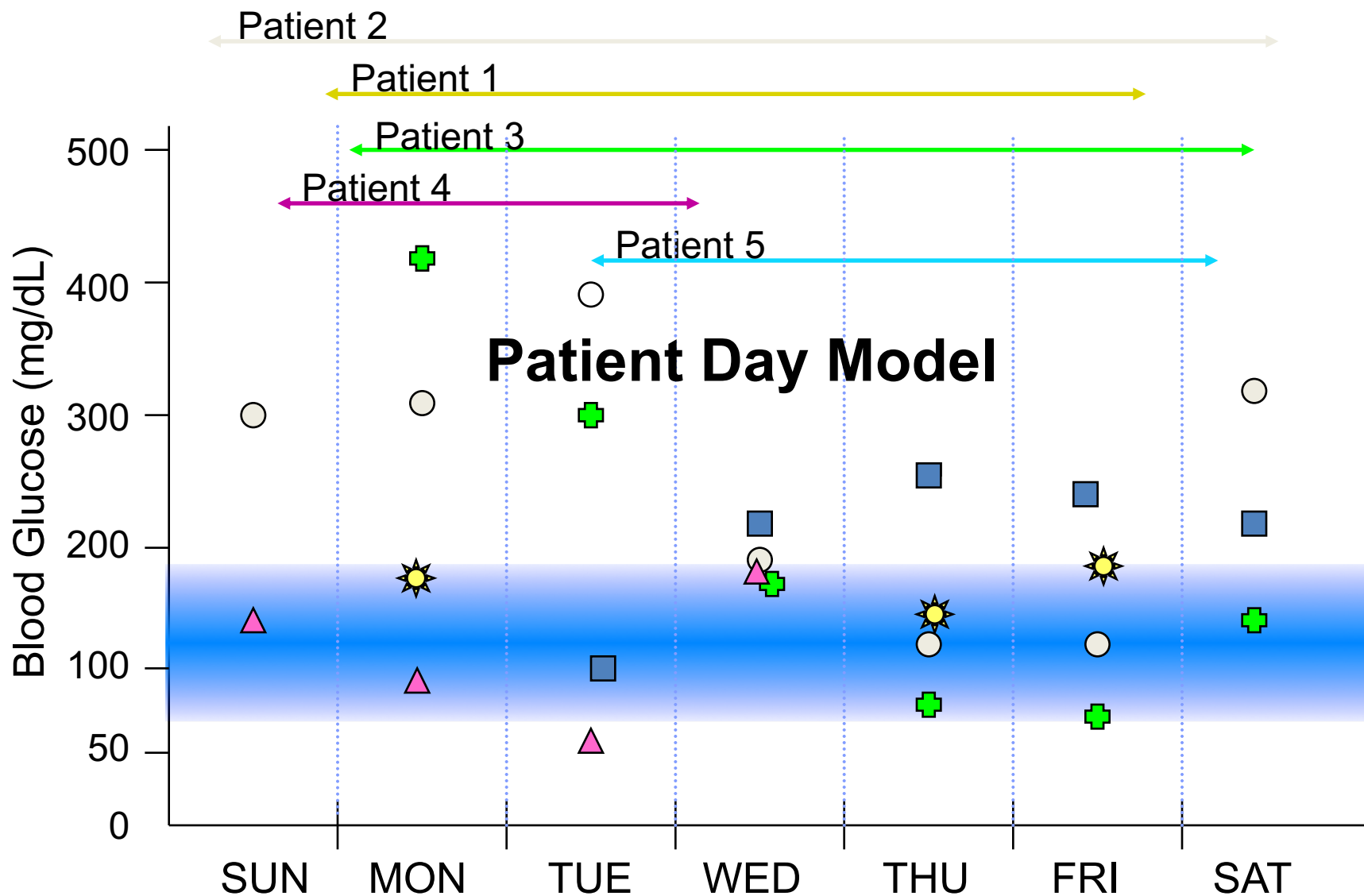




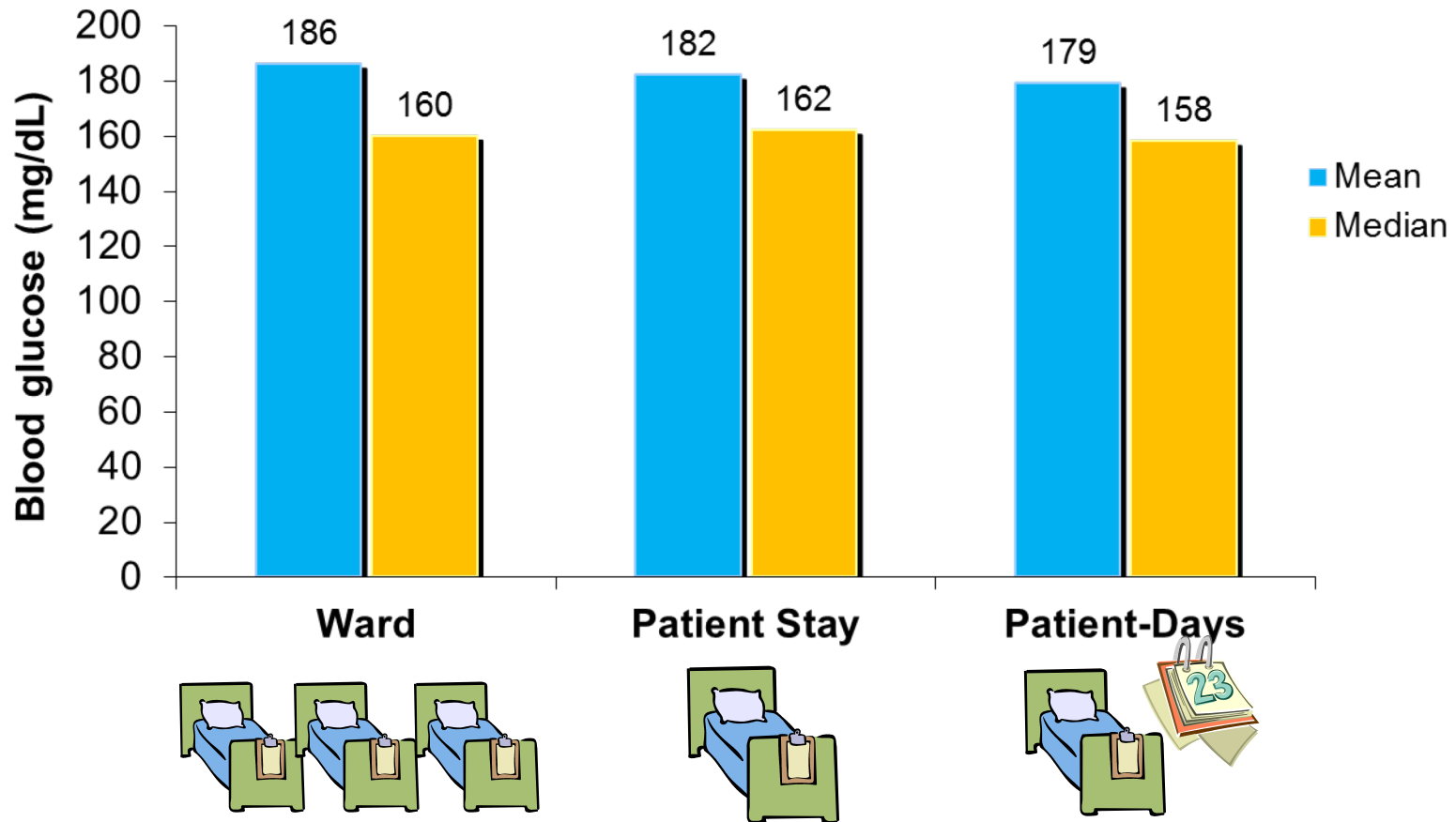






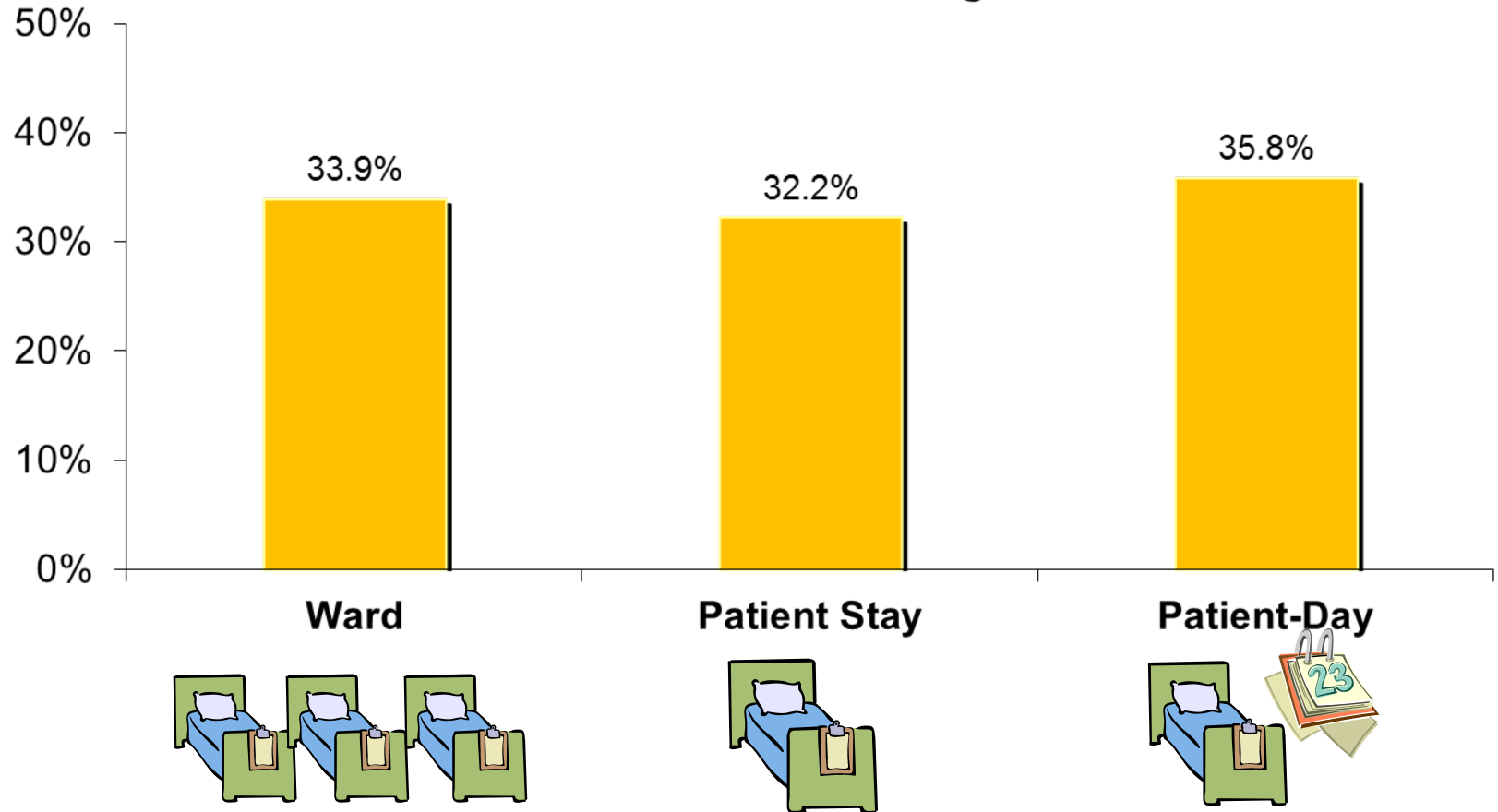


# Glucometrics Project: Mean and Median Blood Glucose

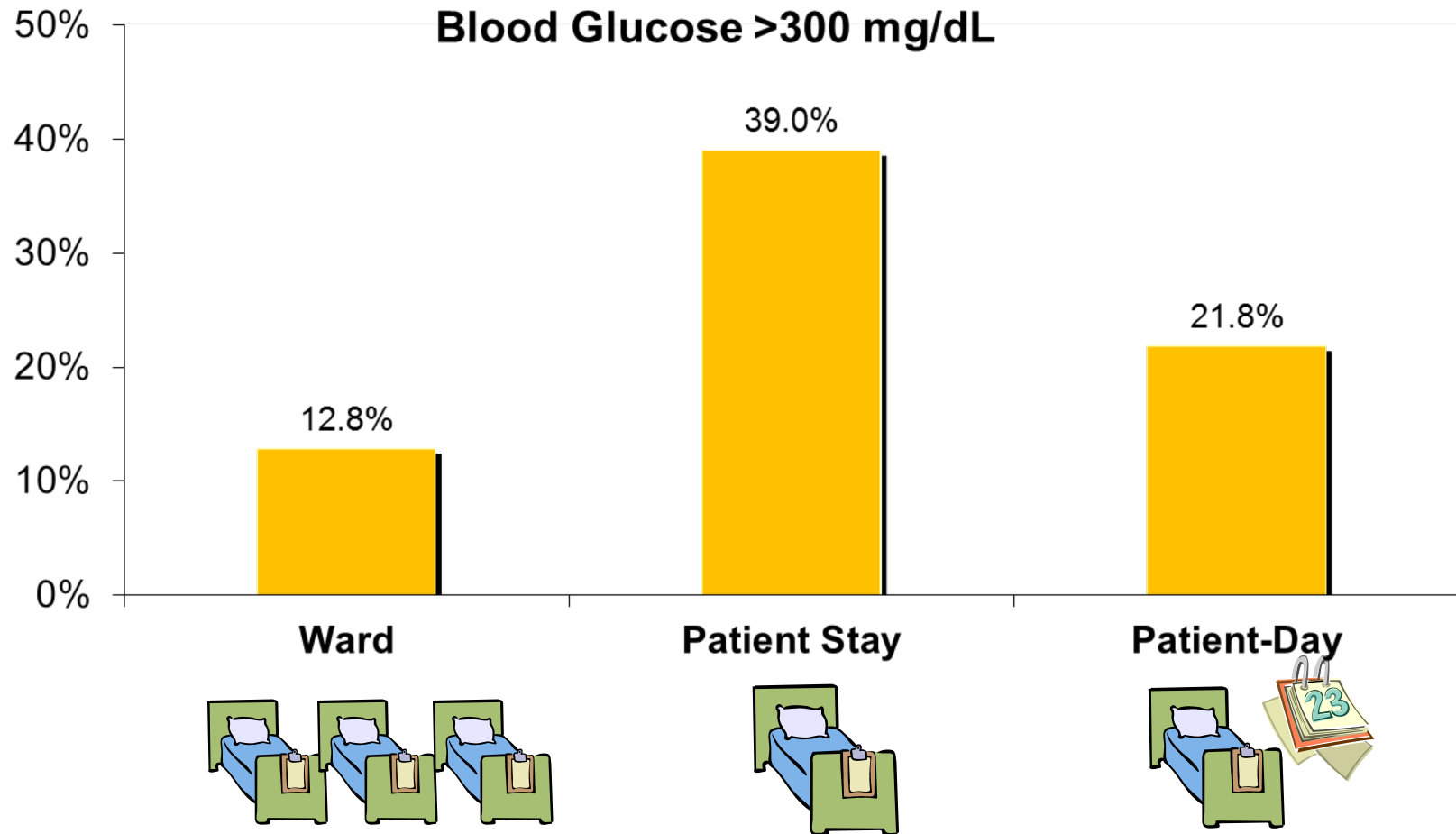


# Glucometrics Project: Blood Glucose Within Target Range

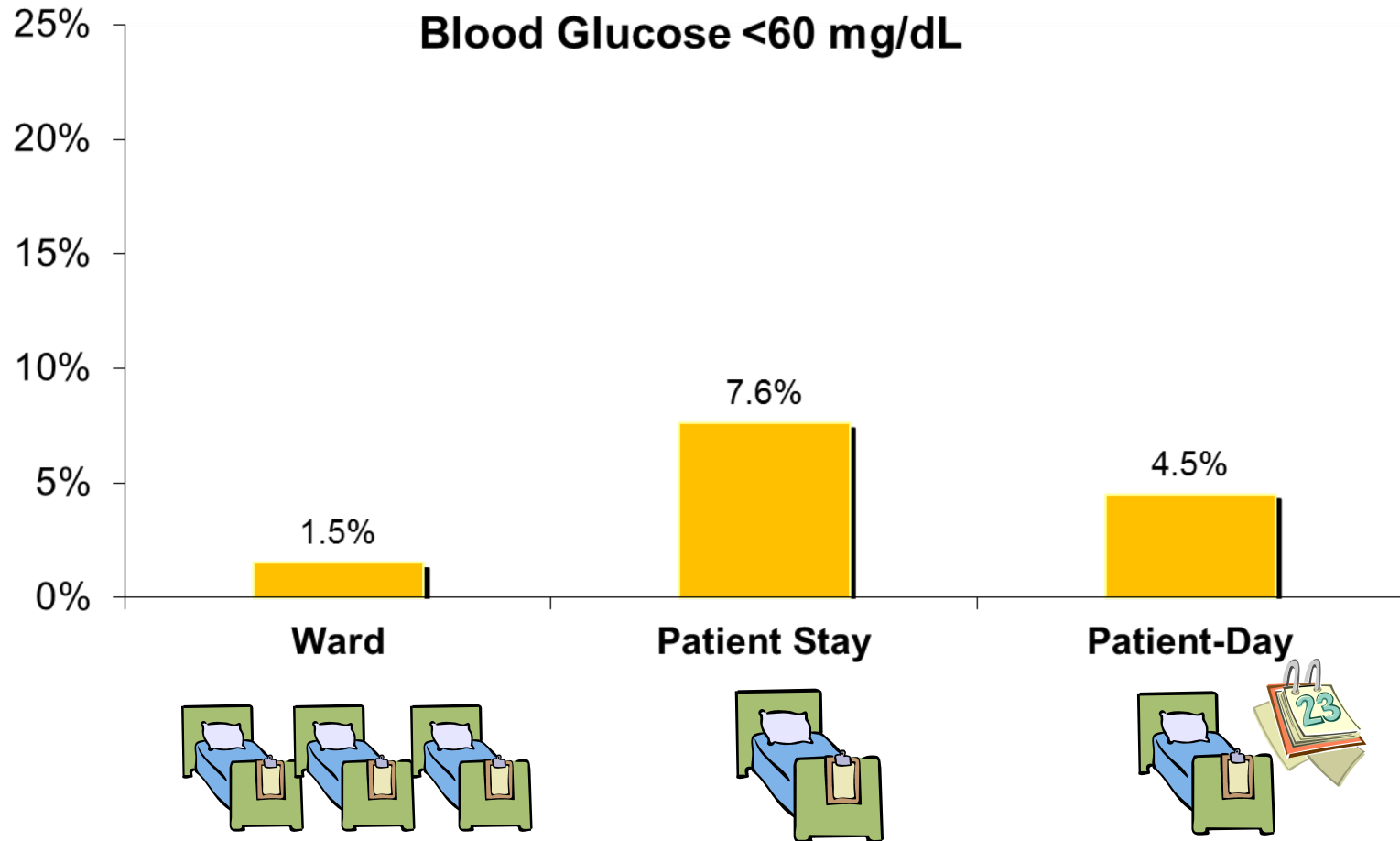
Blood Glucose 80-139 mg/dL



# Glucometrics Project: Hyperglycemic Events



# Glucometrics Project: Hypoglycemic Events





# Glucometrics Project: Summary

- Metrics for mean blood glucose (BG), median BG, and the percentage in target range are similar for all 3 analytical models
- There were substantial differences between the models for percent hyperglycemia and percent hypoglycemia
  - Ward model had lowest percentage
  - Patient stay model had highest percentage
  - Patient day model was intermediate



# Glucometrics Project: Other Findings

- Addition of venous plasma lab glucose measurements to finger stick data
  - Slight reduction in mean glucose values but not clinically meaningful
- Deletion of 1st hospital day of blood glucose
  - Slight reduction in mean glucose values but not clinically meaningful
- Applying glucometrics to the ICU (with IV insulin infusion), the realistic maximum percentage of patient days within target range is probably ~80%

# Glucometrics Project: Conclusions

- Glucometrics are useful intermediate outcomes measures of inpatient hyperglycemia management
- Perception of performance and quality may depend upon the unit of analysis
- All 3 units of analysis provide useful information
  - Ward model is the simplest; may be most useful in operational analyses
  - Patient stay model perhaps most useful to consumers (and risk management)
  - Patient day model may be the most actionable by providers



# Inpatient Diabetes Management Team: Impact on Glucometrics (Before vs After)

Patient Day Metric	Before Consult	After Consult	Absolute Change	Relative Change
Mean BG	225.1 mg/dL	182.7 mg/dL	-42.4 mg/dL	-18.8%
% in target range (70-149 mg/dL)	16.7%	35.3%	+18.6%	+111.4%
% Hyperglycemia (>299)	46.7%	22.8%	-23.9%	-51.2%
% Hypoglycemia (<70)	12.9%	13.0%	+0.1%	+0.8%

# Inpatient Diabetes Management Team: Example of Impact on Glucometrics

	IDMT	Non-IDMT
Mean BG reduction	-49.5 mg/dL <i>P</i> <0.01	-16.4 mg/dL <i>P</i> =NS
Increased cases in target range (70-149 mg/dL)	<i>P</i> =0.03*	<i>P</i> =NS
Reduction in hyperglycemia (>299)	<i>P</i> <0.01	<i>P</i> =NS
Increase in hypoglycemia (<70)	<i>P</i> =NS	<i>P</i> =NS

\* McNemar's Test

# Summary

- “Quality” in inpatient glucose management needs to be better defined
- Achieving it requires efforts in 4 spheres: prioritization, education, patient care, and metrics
- Measures of inpatient glucose management are dependent on the analytical methods employed
- It is important for the diabetes community, hospitals, clinical investigators, and QI experts to work together to better define and validate standardized glucometrics which are meaningful, fair, and actionable

