

Glytec®

TIME TO TARGET

The Future of Glycemic Management

CMS Measures: Preparing Your Health System

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Chief Medical Officer

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10.26.2022



Now is the time to prepare for the CMS Severe Hypo/Hyper eCQMs

CMS is making it clear that **severe hypoglycemia related to insulin should be a never event** and hospitals should work towards that goal.

Hospitals will also need to prioritize early treatment and optimal management of **severe hyperglycemia**.

CMS Glycemic Management Measures

As part of the Hospital Inpatient Quality-Reporting (IQR) Program, hospitals that fail to meet all program requirements may be “subject to a one-fourth reduction in their Annual Payment Update under the IPPS.”

To avoid payment penalties, hospitals must report on 4 of 11 eCQM metrics.

Measure Announcement: August 2021

Hospitals will need to start collecting data on Jan 1, 2023

Two NEW eCQM Metrics:

Severe hypoglycemia:

% patient stays BG < 40 within 24 hours of administration of insulin/anti-hyperglycemic agent

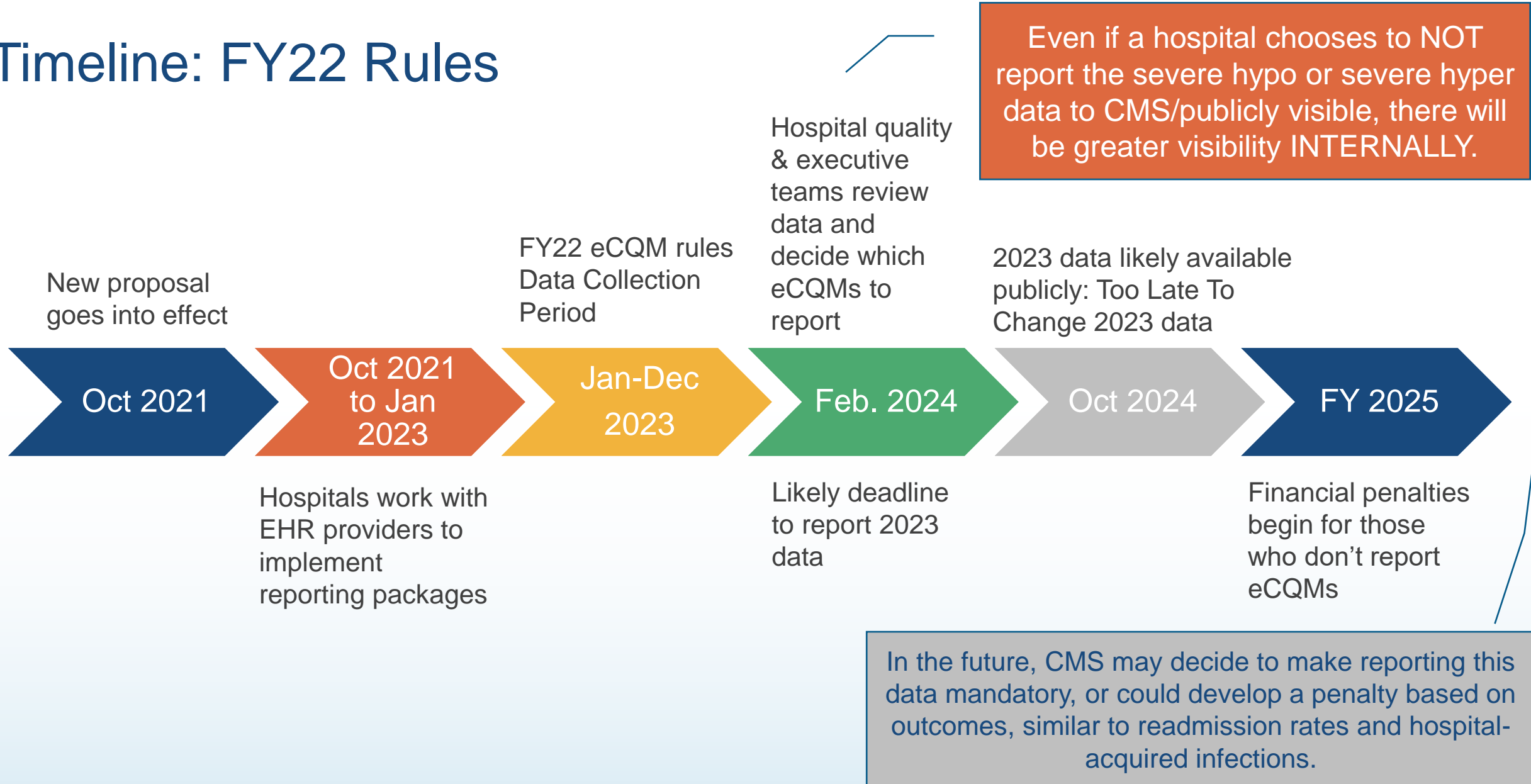
- *Intention: measure hospital-caused adverse drug effects*

Severe hyperglycemia:

% hospital days with one or more BG > 300, excluding the first 24-hour period after admission

- *Intention: measure untreated and prolonged hyperglycemia that could inhibit a patient's ability to recover*

Timeline: FY22 Rules



Clinical Quality Improvement

Driving Change for Patient Safety

- Impact on health systems
 - Establishes meaningful metrics and benchmarks
 - Raises awareness about glycemic management
 - Drives hospitals to implement solutions



Introduction



Curtiss Cook, MD

Professor of Medicine
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**TIME TO
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Glycemic Management*

Inpatient Glucometrics

Definition, Rationale, Benchmarking,
Application, and Future Directions

Curtiss B. Cook, MD
Professor of Medicine
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26 October 2022



Learning Objectives

- Define the different categories of glucometrics
- Review rationale for measuring inpatient glucose control
- Describe current state of national benchmarking efforts
- Provide examples of applied glucometrics
- Discuss future state—beyond glucometrics
 - Forecasting
 - Spatial analysis
 - Insulinometrics

It all started with this....

The New England Journal of Medicine

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INTENSIVE INSULIN THERAPY IN CRITICALLY ILL PATIENTS

GREET VAN DEN BERGHE, M.D., PH.D., PIETER WOUTERS, M.Sc., FRANK WEEKERS, M.D., CHARLES VERWAEST, M.D.,
FRANS BRUYNINCKX, M.D., MIET SCHETZ, M.D., PH.D., DIRK VLASSELAERS, M.D., PATRICK FERDINANDE, M.D., PH.D.,
PETER LAUWERS, M.D., AND ROGER BOUILLON, M.D., PH.D.

Glucometrics

Definition, Categories, and Measures

- Glucometrics: systematic analysis of data on blood glucose levels of inpatients*

Category	Example
Glycemic exposure	
Measures of central tendency	Mean, median, patient day weighted mean
Hemoglobin A1c	Determined at admission, reflects outpatient control but correlated with inpatient outcomes
Efficacy of control	
Targets	Mean glucose, time remaining in target
Frequency	Proportion of measurements, proportion of days
Variability	Various ways to calculate (SD, CV)
Control over time	Statistical process control (control charts)
Outcomes	
Hypoglycemia	Frequency, severity
Readmissions	Proportion readmitted within 30 days of discharge
Infections	Surgical site infections

*Goldberg PA et. al. Diabetes Technol Ther 2006;8(5):560–569

Glucometrics

Rationale: Why should institutions invest time and resources?

- If inpatient hyperglycemia is bad, then we should have a way to measure it, track it, and assess impact of control measures
- Assumption: measuring glucometrics can lead to increased safety and better outcomes
- Measuring glucometrics without *applying* glucometrics (acting on the data) is of little value
 - This requires considerable institutional resources
- Do institutions who monitor glucometrics have better outcomes than those who do not?

?

- Need to measure may now be driven by regulatory expectations

Glucometrics

Goals Of Measurement

- Define current state with respect to desired state (benchmarking)
- Monitor for when/if processes go out of control (aka statistical process control)
- Identify broken processes and areas for improvement
- Follow-up on results of interventions designed to improve hyperglycemia management

Glucometrics

Benchmarking: Requirements

- Implies some industry standard against which comparisons can be made
- Requirements
 - Metric standard
 - Type of measure
 - Method of calculation (numerator/denominator)
 - Patient population
 - Data reporting format
 - Source of glucose sample
 - Blood, POC, or both
 - POC instrumentation
 - Establish the benchmark

Glucometrics

Benchmarking Requirements: Need For National Standard

Reported glycemic target ranges, survey of 269 US hospitals, June to December 2008

Figure 1A: Target Range of Critical Care (e.g., ICU) Unit (mg/dL)

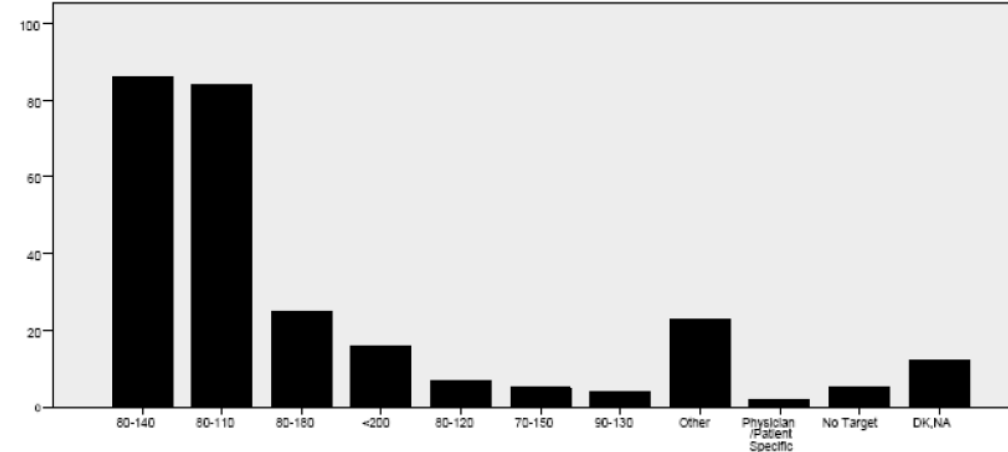
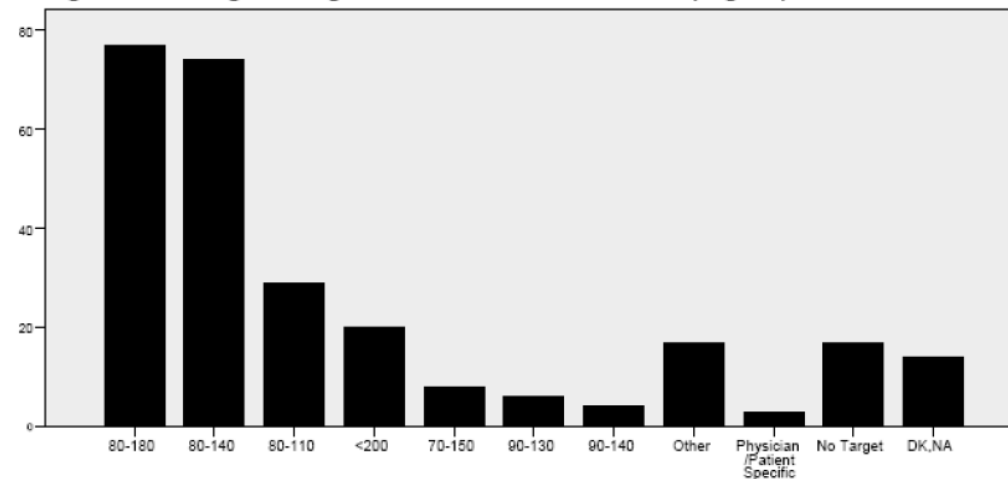


Figure 1B: Target Range of Non-Critical Care Unit (mg/dL)



Glucometrics

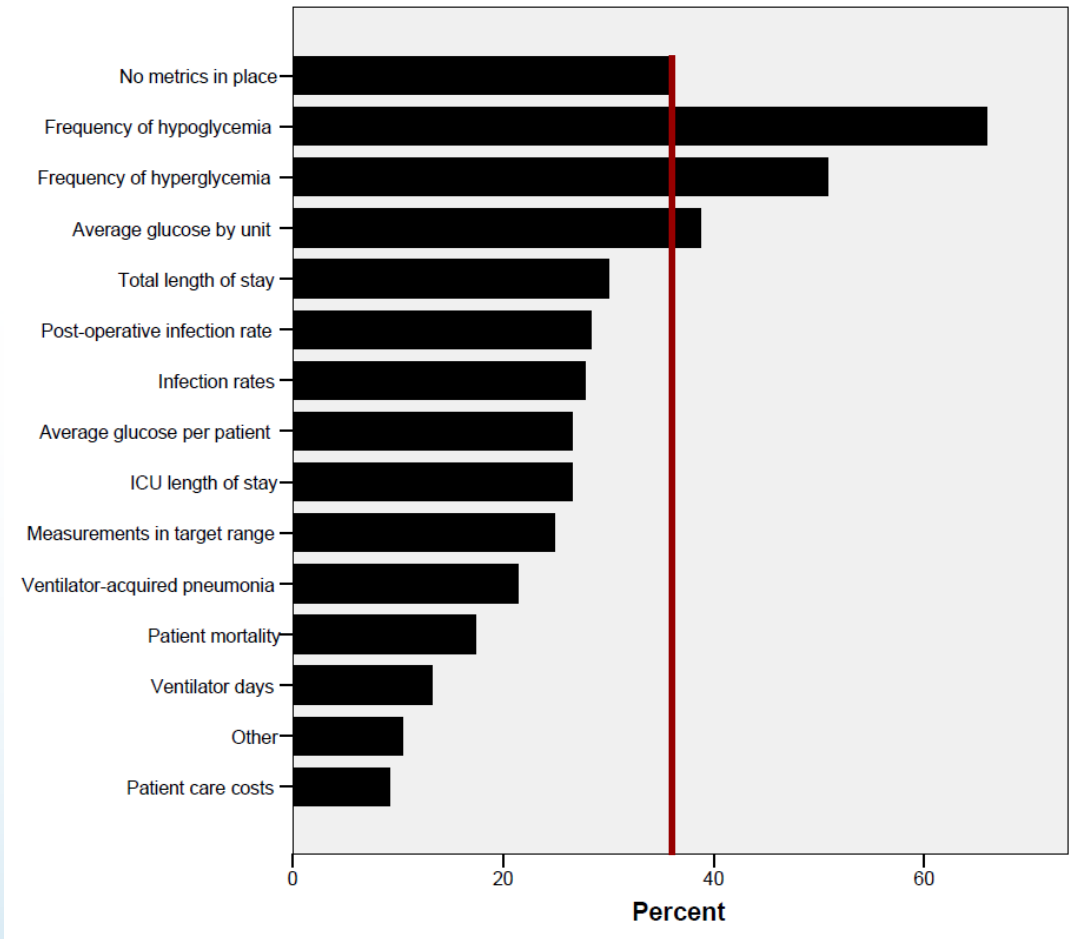
Benchmarking: Requirements

- Establish what is most meaningful to hospitals and their stakeholders
- Determine who will be looking at the data
- Choice of metrics/method of analyzing/reporting should be within the capabilities of the hospital's IT and QA functional areas
- What are the consequences of:
 - Not measuring
 - Not meeting benchmarks

There are significant challenges to managing an acutely ill inpatient with diabetes

Glucometrics

Benchmarking: What Are Hospitals Doing?



**Reported metrics, survey
of 269 US hospitals,
June to December 2008**

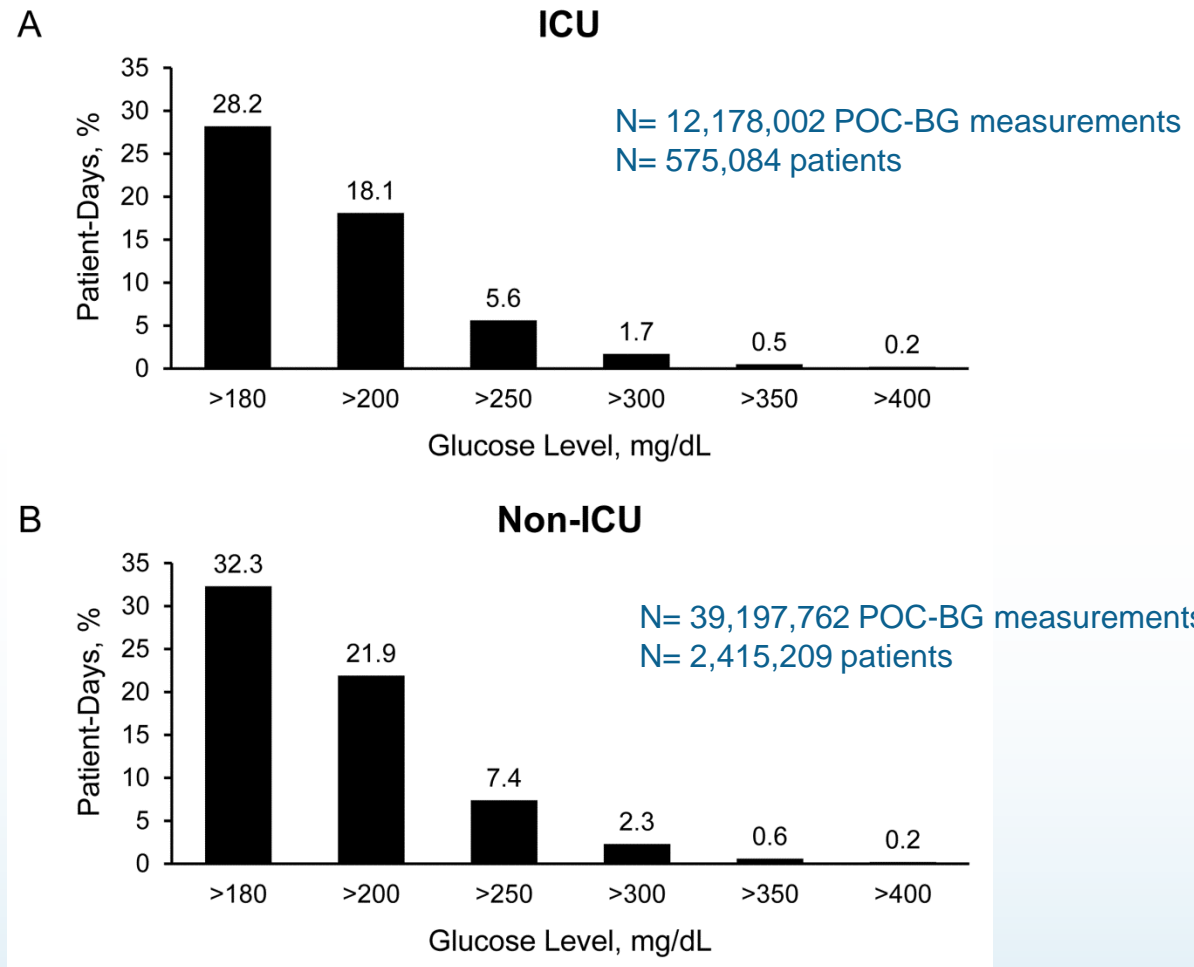
Cook et. al. Endocr Pract. 2010;16:219-230

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Benchmarking: Example 1

Hyperglycemia is common in US hospitals

Frequency of Hyperglycemia in 635 US Hospitals, 2012

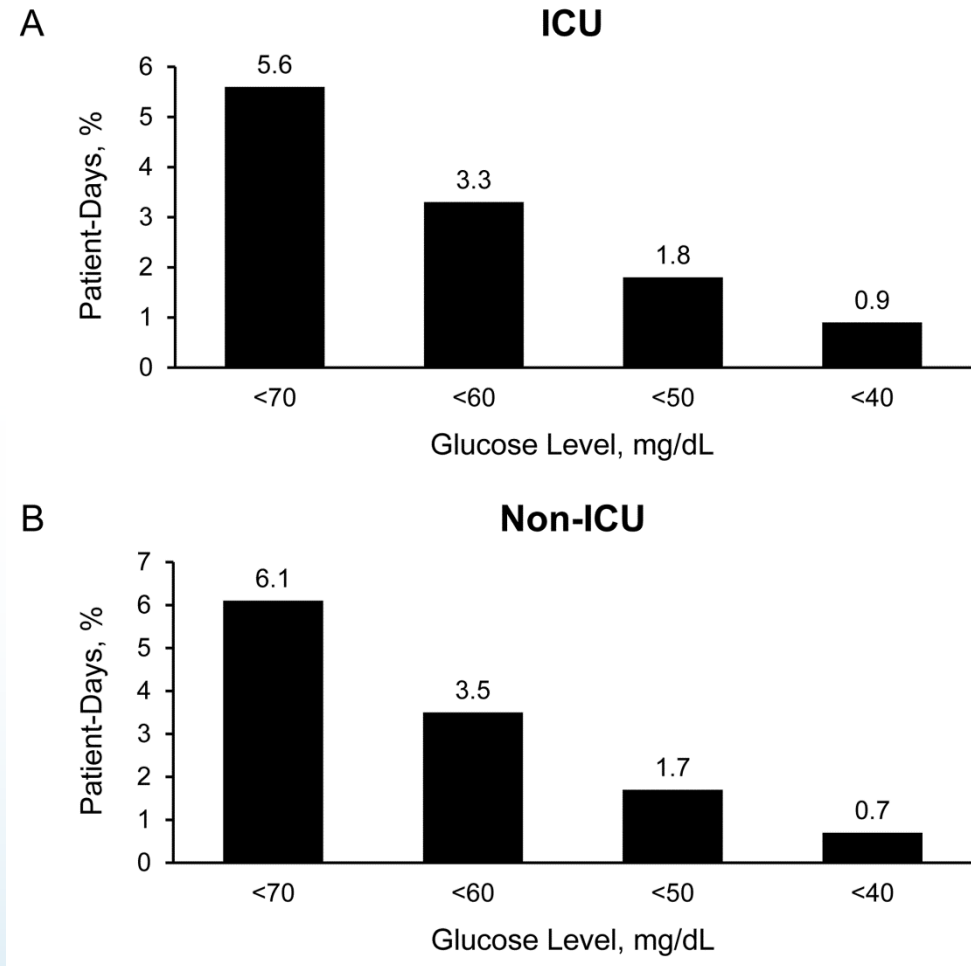


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Benchmarking: Example 2

Hypoglycemia is uncommon in US hospitals

Frequency of Hypoglycemia in 635 US Hospitals, 2012

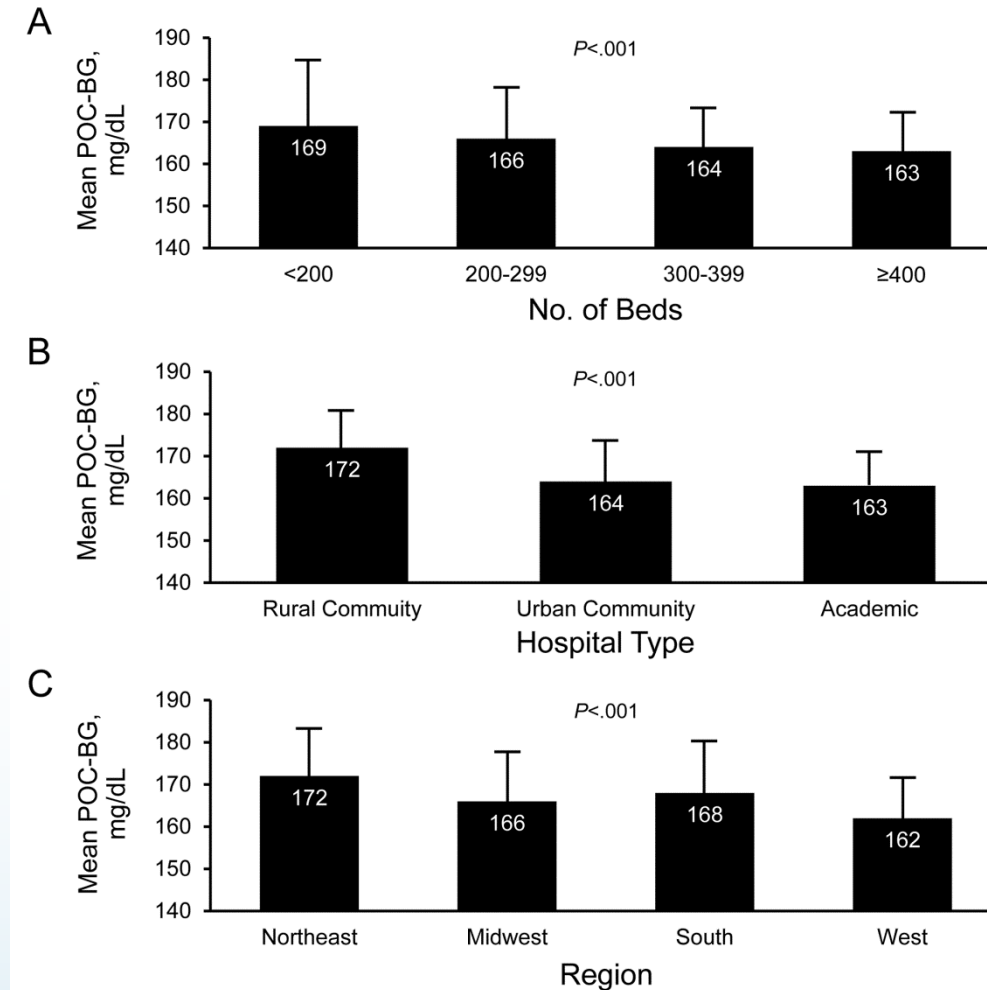


Glucometrics

Benchmarking: Example 3

Create a national compendium to serve as a reference?

Glucose Control in 635 US Hospitals, by Hospital Characteristics, non-ICU, 2012



Bersoux et. al. Endocr Pract. 2014;20:876-883

Benchmarking

Hospital Acquired Conditions

- Section 5001(c) of Deficit Reduction Act of 2005 required identification of conditions that are:
 - High cost, high volume or both
 - Result in the assignment to a DRG that has a higher payment when present as a secondary diagnosis
 - Could reasonably have been prevented
- On July 31, 2008, in the Inpatient Prospective Payment System (IPPS) Fiscal Year (FY) 2009 Final Rule, CMS included 10 categories of conditions that were selected for the HAC payment provision
- Manifestations of Poor Glycemic Control
 - Diabetic Ketoacidosis
 - Nonketotic Hyperosmolar Coma
 - Hypoglycemic Coma
 - Secondary Diabetes with Ketoacidosis
 - Secondary Diabetes with Hyperosmolarity

Benchmarking

Electronic Clinical Quality Measures (eCQMS)

- Uses data electronically extracted from EHRs to measure quality
- CMS uses eCQMs in a variety of quality reporting and value-based purchasing programs
 - Hospital Harm—severe hypoglycemia (NQF 3503)
 - Hospital Harm—severe hyperglycemia
- Voluntary reporting

Benchmarking

Severe Hypoglycemia eCQMS

Population

- Patient ≥ 18 years
- At least one antidiabetic drug (ADD) was administered
- Includes ED/observation patients
- Suffers harm

Numerator

- Glucose result < 40 mg/dL
AND
- ADD administered within 24 hours
AND
- No confirmatory blood glucose with a result > 80 mg/dL within 5 minutes of index value

- Only first event counted, and one per hospital encounter

Denominator

- Hospital encounter

• Limitations

- Does not define harm
- Only count a single event
- Why wait for it to get so low?
- Would require sophisticated programming

Benchmarking

Severe Hyperglycemia eCQMS

Population

- Patients ≥ 18 years
 - Diagnosis of diabetes
- OR
- Administration of at least one dose of an ADD
- OR
- At least one blood glucose value ≥ 200 mg/dL

Numerator

- All encounters with a hyperglycemic event within the first 10 days of the encounter minus the first and last 24h
 - A day with at least one blood glucose value > 300 mg/dL
- OR
- A day glucose was not measured, and it was preceded by two consecutive days where at least one glucose value during each of the two days was ≥ 200 mg/dL.

Denominator

- Hospital days for the qualifying population
- (Total number of hyperglycemic days across all encounters is divided by the total number of eligible days across all encounters)

• Limitations

- Does not define harm
- Does not aim to measure overall glucose control
- Acknowledges no accepted cut-off for severe hyperglycemia
- Would require sophisticated programming

Benchmarking

National Health Care Safety Network Metrics*

- Complementary to CMS measure for hypoglycemia

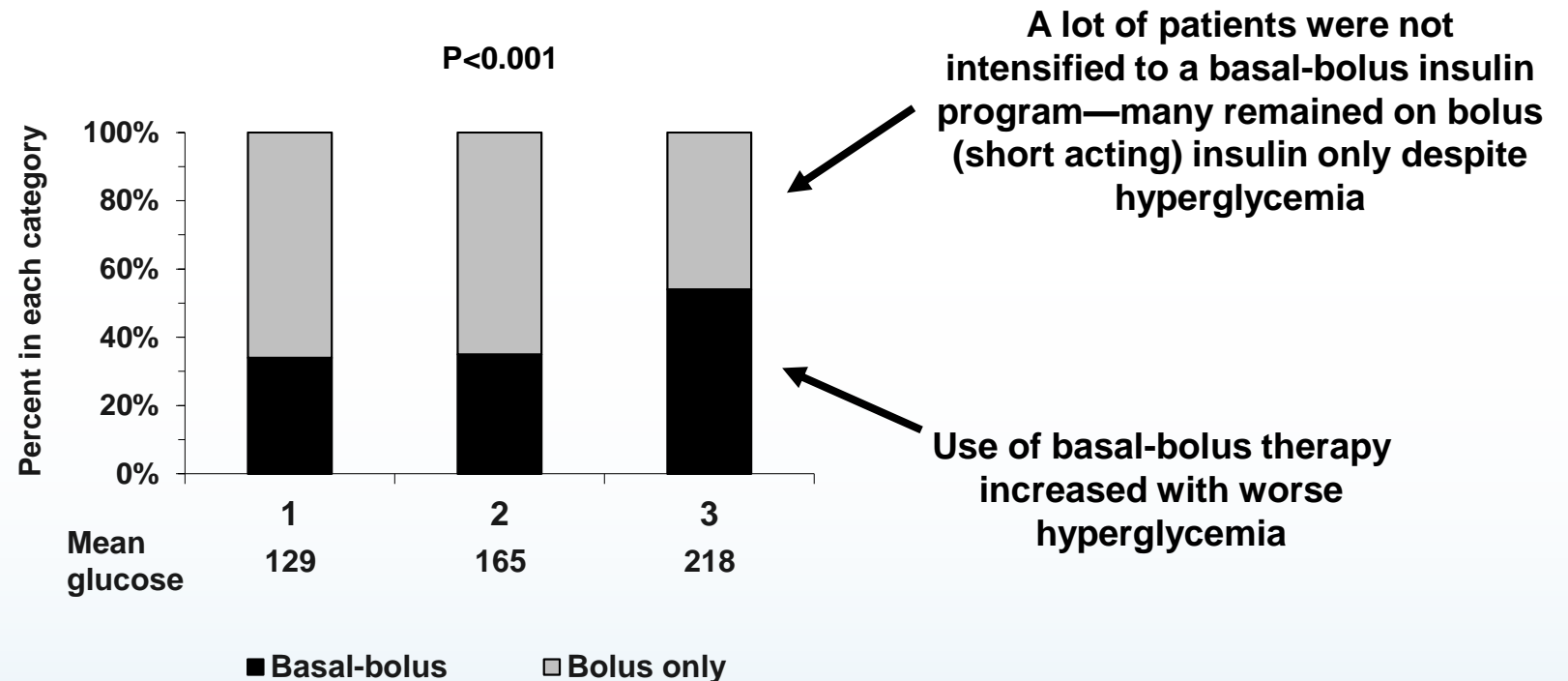
Metric	Numerator	Denominator
Severe Hypoglycemia Days	No. of inpatient days with BG <40mg/dL preceded by ADD (24 hours prior)	No. of inpatient days with ≥1 ADD administered
Percent Hypoglycemia Days	Percent of ADD days with BG <40 mg/dL, 40-53 mg/dL, and 54-70 mg/dL	
Recurrent Hypoglycemia	<ul style="list-style-type: none"> ▪ Percent of patients on ADDs with a recurrent hypoglycemic day ▪ A “recurrent hypoglycemic day” is an inpatient day with a documented hypoglycemia event that is preceded by another inpatient day within a 24-hour period where a hypoglycemia event is also documented ▪ Reported at <40 mg/dL and 54-70 mg/dL 	
Severe Hypoglycemia Resolution	Median time between BG <40 mg/dL and first BG ≥70 mg/dL (hypoglycemia resolution)/ADD days	

*Lantana Group / NHSN CoLab materials, c/o Greg Maynard MD, UC Davis Health (a beta-site partner)

Applied Glucometrics

Example 1: Assessing for clinical inertia

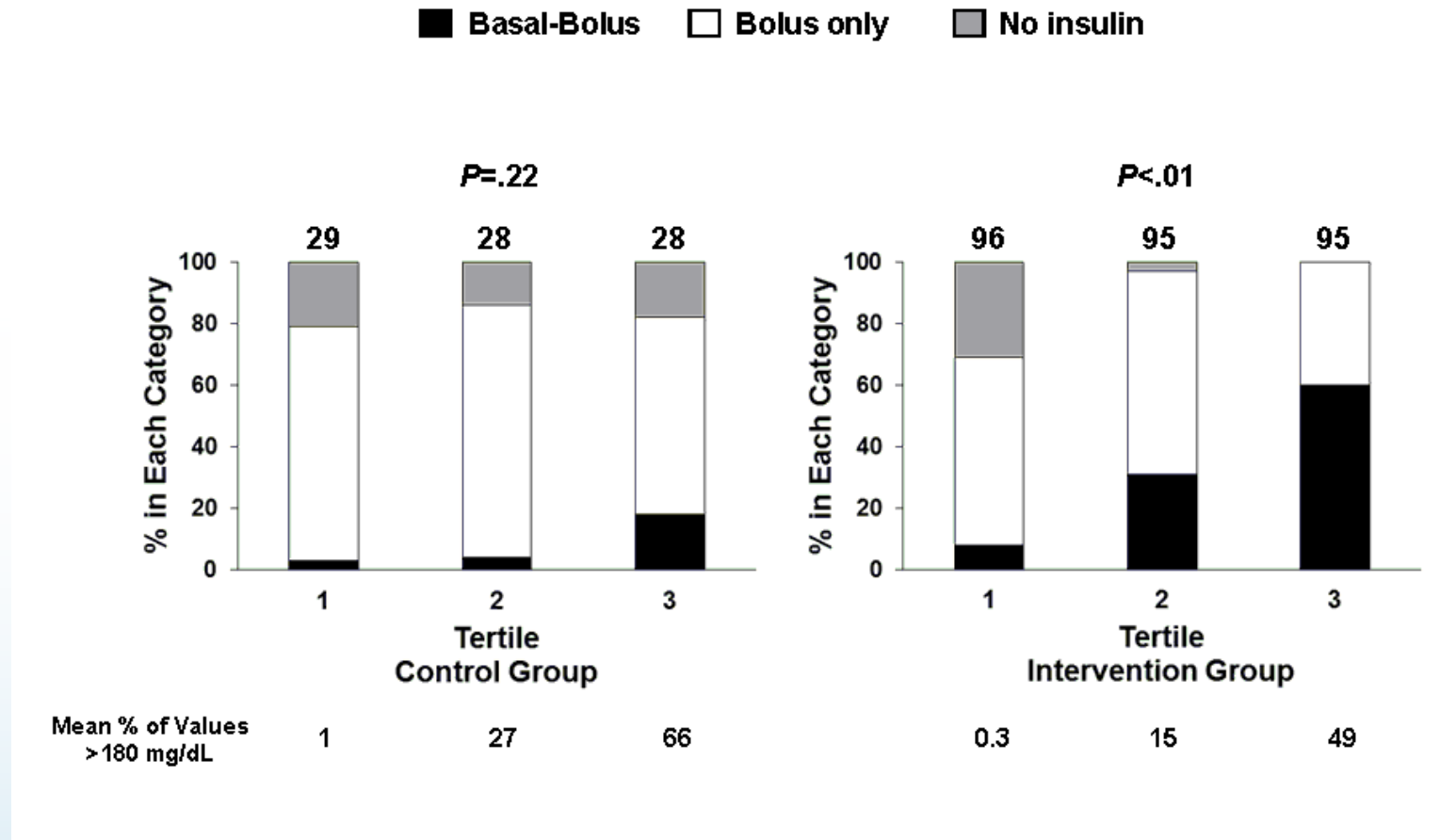
Clinical inertia in the hospital



Cook et. al. J Hosp Med 2007;2:203-211

Applied Glucometrics

Example 2: Overcoming clinical inertia in postoperative inpatients

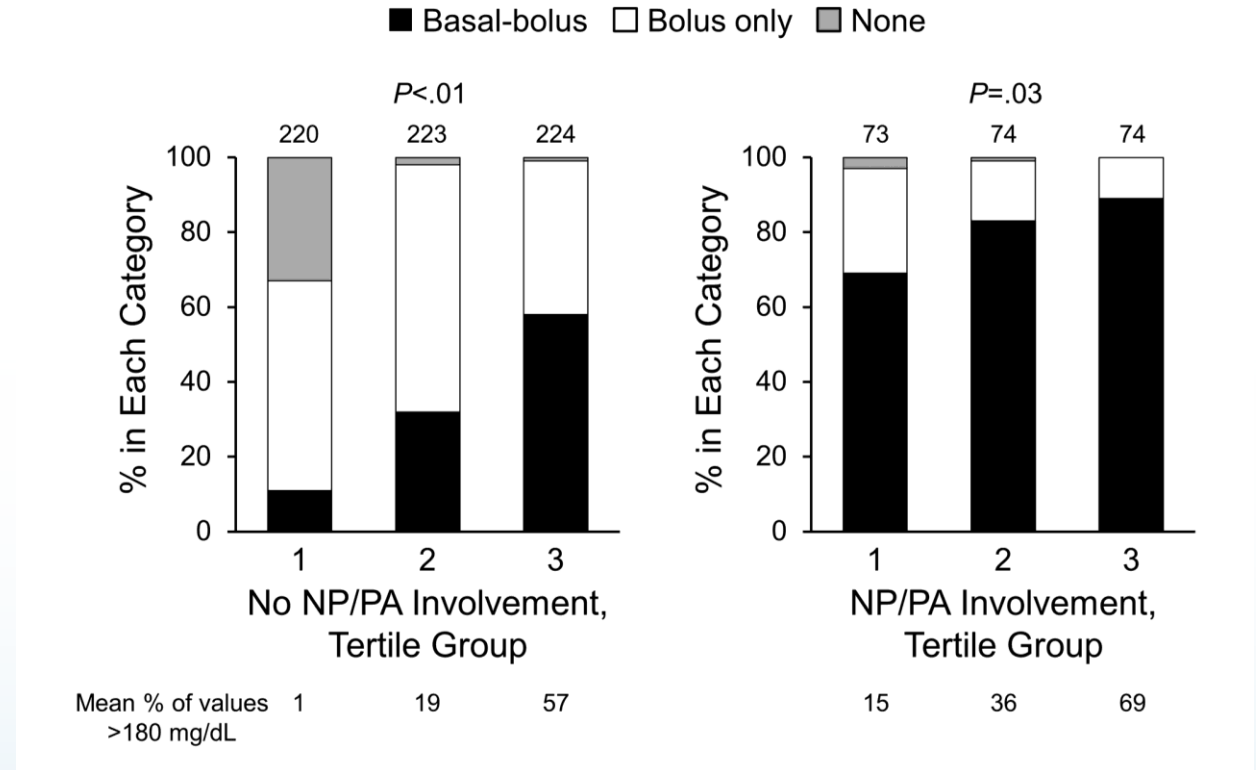


Apsey et. al. Endocr Pract. 2014;20:320-328

Applied Glucometrics

Example 3: Impact of Inpatient APP

Care directed by a specialty-trained nurse practitioner or physician assistant can overcome clinical inertia in management of inpatient diabetes



Mackey PA, et. al.. Endocrine Practice 2014 20:112-119.

Beyond Glucometrics

Forecasting Glycemic Control

- Current methods rely on analysis of retrospective data
 - It may be too late by the time data is analyzed—process may already be out of control
- The ability to forecast inpatient glycemic control could provide an opportunity to anticipate unfavorable changes at an institutional level before they become a problem
- One approach to forecasting inpatient glucose data is to apply mathematical models employed in operational research
 - Models that forecast trends derived from time series data have been well established in commerce and include such applications as:
 - Supply chain management
 - Diffusion of new products
 - Credit risk
 - Accounting and finance
- Damped trend exponential smoothing mathematical model

Beyond Glucometrics

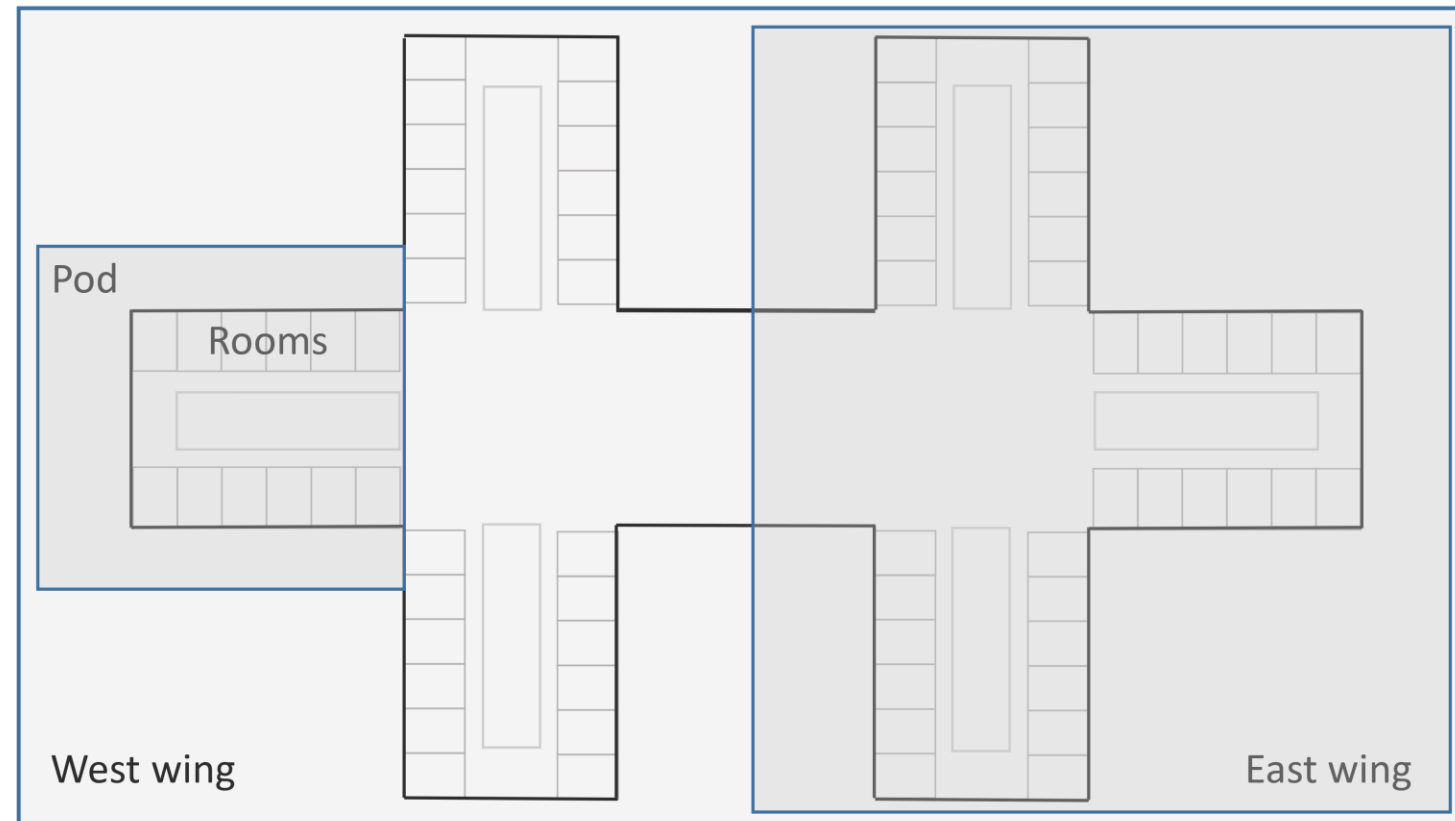
Forecasting Glycemic Control

- Point-of-care glucose data were extracted from the laboratory information system
 - A total of 55,328 patient-day-weighted mean glucose values were calculated
- Between 60 and 63 weekly observations were gathered for each scenario timed to ensure the forecast would begin at the start of a quarter
 - Short and long-range forecast intervals were derived that extended 2, 4, 6, 24, and 48 weeks into the future
- The mean absolute percent error (MAPE) was the metric by which the accuracy of damped trend
 - In demand-based industries, models resulting in MAPE values in the range of 10% to 15% appeared to be reasonable representations of the underlying data

Beyond Glucometrics

Forecasting Glycemic Control

Mayo Clinic Arizona Hospital Floor Plan



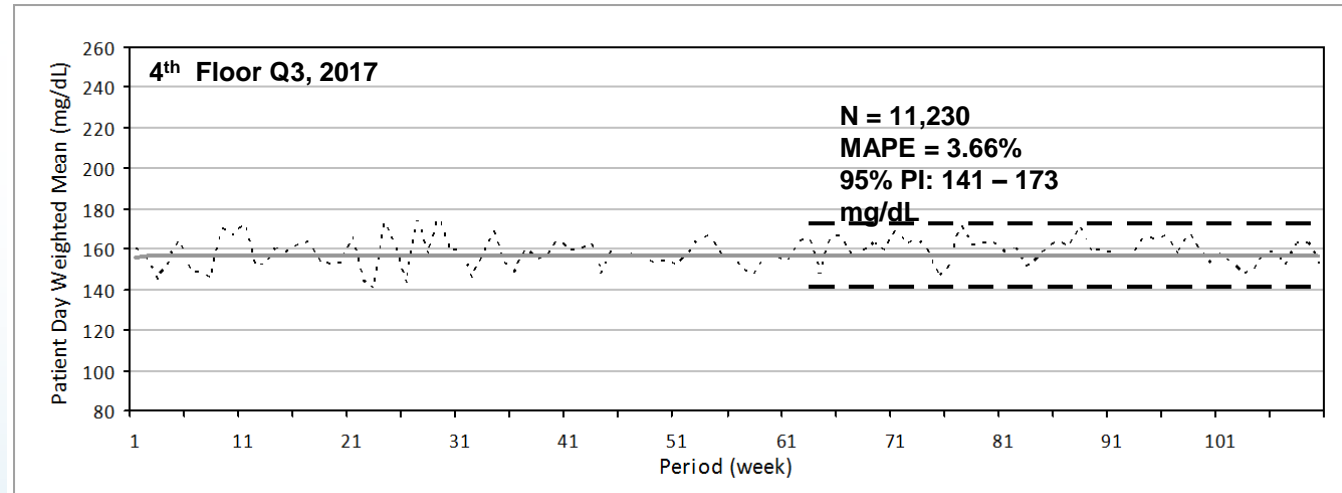
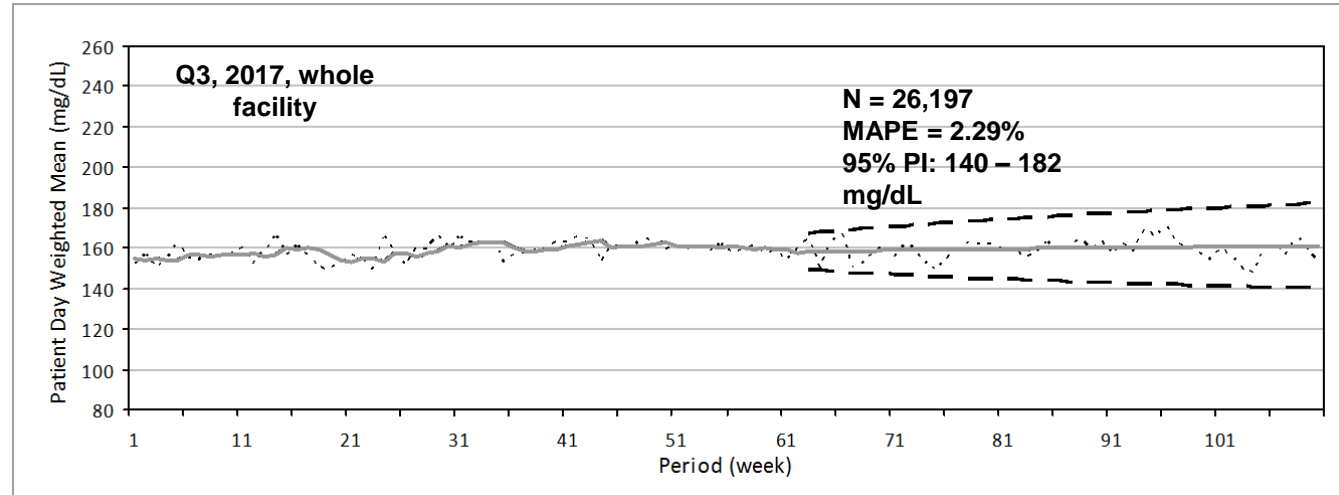
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Forecasting Glycemic Control

Adapted from Saulnier GE, et. al Future Science OA 2017
DOI 10.4155/fsoa-2017-0066

and

Saulnier GE, et. al. Future Sci. OA 2020 6:FSO634 doi:
10.2144/fsoa-2020-0096 PMID: PMC7720372



----- Observed ——— Damped Trend - - - Prediction Interval

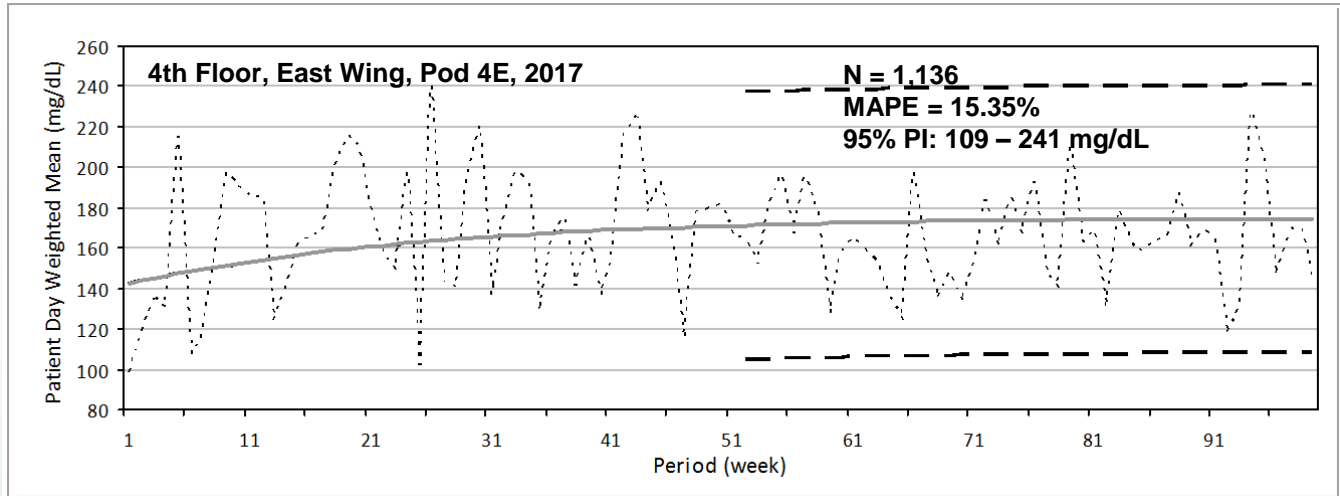
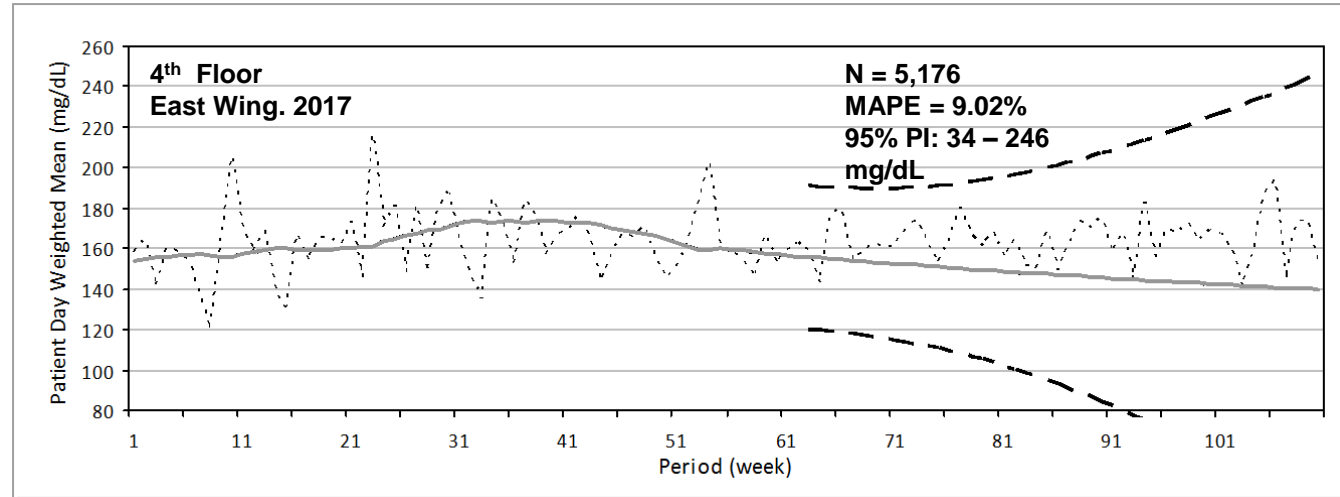
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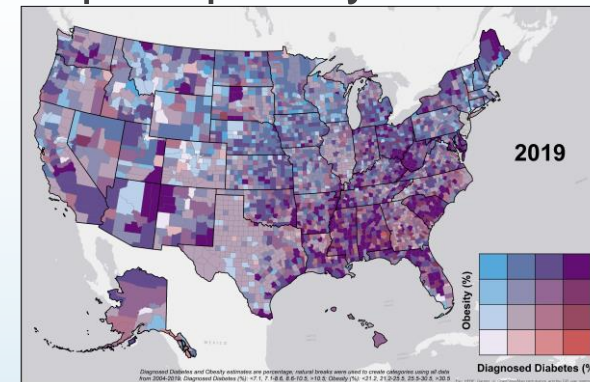


----- Observed ——— Damped Trend - - - Prediction Interval

Beyond Glucometrics

Spatial Analysis

- Spatial reporting of data is widespread in epidemiology, public health, and health care
- One of the earliest examples of geographic analysis in epidemiology was that of the 19th-century physician John Snow
 - Mapped cholera cases in London in 1854 and identified the point source of the outbreak
- Current methods of examining the relationship between health data and the environment use geographic information systems (GISs)
 - Computer systems that collect/edit/integrate/analyze/visually depict spatially referenced data
 - Use geolocators (e.g. Zip Code, latitude/longitude)



Diabetes and Obesity Maps | CDC

Beyond Glucometrics

Spatial Analysis

- Analysis and reporting of inpatient glucose data has been nonspatial
 - 2-dimensional graphic or tabular representation
 - Results reported in aggregate at the institutional level or for specific subpopulations of patients
- The addition of location to the depiction of glycemic control is an alternative approach
- A quick visual scanning of geographic-based glucometric data could yield insights into hot spots of poor glycemic control (either too high or too low)
 - These “heat maps” could provide clues areas of the hospital that should be investigated to learn why glycemic control was not meeting guidelines in some areas but doing better in others
 - Geolocators such as latitude and longitude are not applicable within the hospital, and other locational information needs to be considered

Beyond Glucometrics

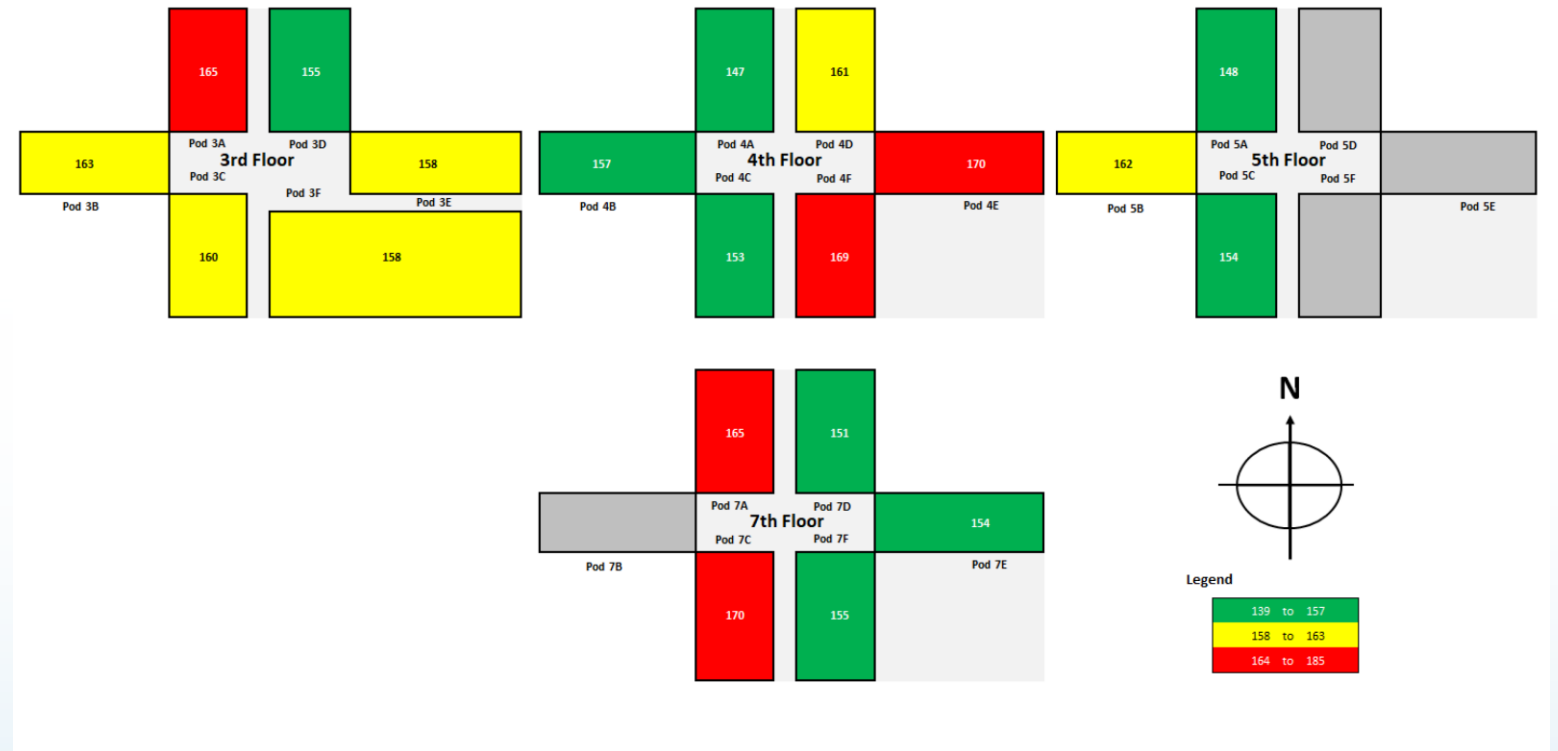
Spatial Analysis: Methods

- Point-of-care blood glucose data from inpatients with diabetes mellitus were extracted
- Calculations included patient-day weighted means and percentage of patient hospital days with hypoglycemia
- Data stratified into tertiles
- Room numbers were used as geolocators to generate cross-sectional views of the data
- Results were overlaid onto hospital floor plans
- Linear mixed and mixed-effects logistic regression models were used to compare the location effect and to assess statistical variation in the data after adjusting for age, sex, and severity of illness.

Beyond Glucometrics

Spatial Analysis: Results

Cross-sectional, 2-Dimensional Mapping of Patient-Day Weighted Mean Point-of-Care Blood Glucose Values



Saulnier GE et. al. Control. J Diabetes Sci Technol. 2021 PMID: 34210201 doi: 10.1177/19322968211027230.

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Spatial Analysis: Results

Cross-sectional, 2-Dimensional Mapping of Percentage of Patient Hospital Days With Hypoglycemia.



Beyond Glucometrics

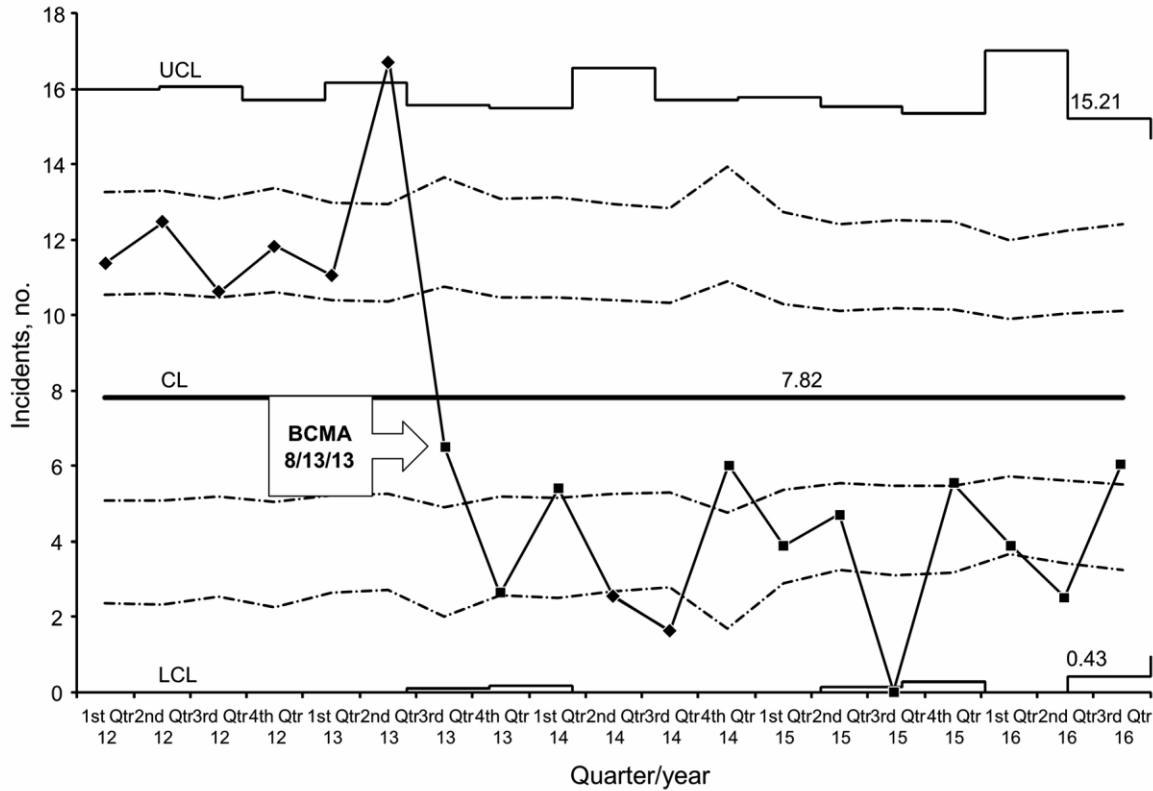
Insulinometrics: Definition, Rationale, and Metrics

- Definition: systematic analysis and reporting of inpatient insulin therapy
- Inpatients with hyperglycemia will typically require insulin
- Need to measure if appropriate insulin regimen is being applied
 - Basal-bolus insulin therapy is the most effective regimen
- Assess for clinical inertia
- Errors in insulin therapy are common in the hospital
 - Remains on ISMP's list of high-risk medications
- Metrics
 - Insulin errors
 - How insulin therapy is being applied and modified according to level of hyperglycemia

Thompson, BM, Cook CB. Current Diabetes Reports 2017 17:121 DOI 10.1007/s11892-017-0964-2.

Beyond Glucometrics

Insulinometrics: Insulin Errors

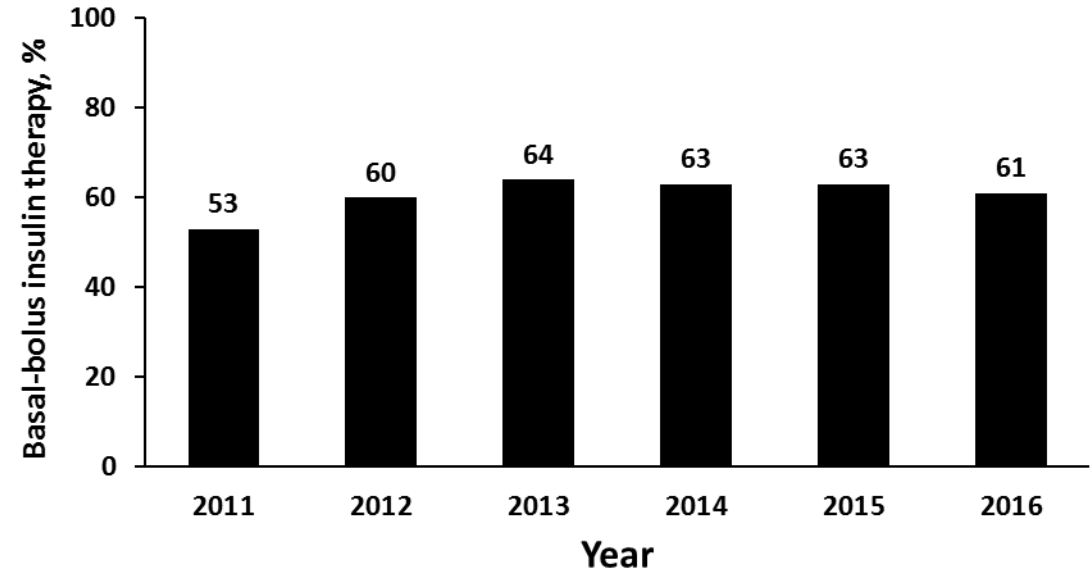


Thompson, BM, Cook CB. Current Diabetes Reports 2017 17:121 DOI 10.1007/s11892-017-0964-2.

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Insulinometrics: Insulin Therapy vs. Hyperglycemia

Basal-bolus insulin therapy according to proportion of patients with patient-day weighted mean point-of-care glucose values >180mg/dL



Thompson, BM, Cook CB. Current Diabetes Reports 2017 17:121 DOI 10.1007/s11892-017-0964-2.

Future Directions

- Glucometric harmonization
 - We still have different organizations advocating for different measures calculated in different ways
- Data type harmonization
 - POC vs. BG
 - Everyone measuring the same thing the same way
 - Same POC instrumentation
 - POC source (capillary vs. drawn from a line)
- Institutional support
 - Informatics
 - Quality

} Likely difficult to achieve with voluntary reporting
- Need to link glucometric data to an outcome
- Processes and policy are important, not just measurement

Thank you

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