Clinical Safety & Effectiveness
Cohort #17

AN EVIDENCE-BASED METHOD ON IMPROVING INPATIENT GLYCEMIC CONTROL IN PATIENTS ADMITTED TO THE INTERNAL MEDICINE WARDS

CENTER FOR PATIENT SAFETY & HEALTH POLICY
UT HEALTH SCIENCE CENTER™ SAN ANTONIO
UNIVERSITY OF TEXAS MD ANDERSON CANCER CENTER
Making Cancer History®

The Team

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- Sponsor Department
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Project Milestones

• Team Created	Aug –Sept 2015
• AIM statement created	Sept 2015
• Weekly Team Meetings	Sept – Nov 2015
• Background Data, Brainstorm Sessions, Workflow and Fishbone Analyses	Sept – Oct 2015
• Interventions Implemented	Oct 2015 (pilot)
• Data Analysis	Ongoing
• CS&E Presentation	Jan 15, 2016

AIM Statement

The aim of this project is to decrease rates of moderate hyperglycemia (blood glucose 181-300) to ≤16% in patients admitted to the internal medicine ward teaching services by June 2016.

Background

- Diabetes Mellitus (DM)
  - 7th leading cause of death
  - 4th leading comorbid condition among hospital discharges
  - Approximately 1 in 4 patients admitted to the hospital has a known diagnosis of DM
  - 1/3 of hospitalized patients will experience significant hyperglycemia while admitted

J Clin Endocrinol Metab, Jan 2012, 97(1): 16-38

Relationship between Acute Illness and Hyperglycemia

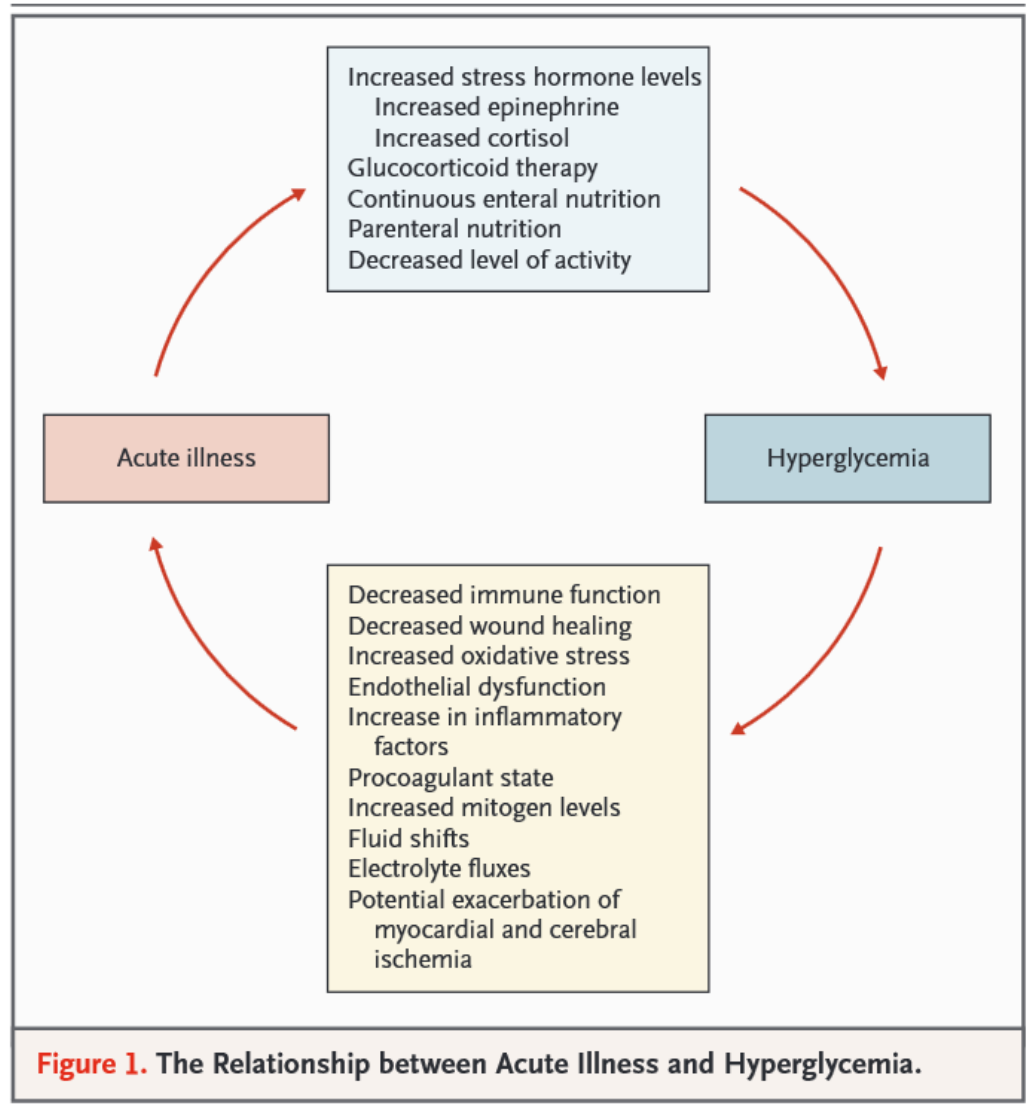


Figure 1. The Relationship between Acute Illness and Hyperglycemia.

N ENGL J MED 355;18 WWW.NEJM.ORG NOVEMBER 2, 2006

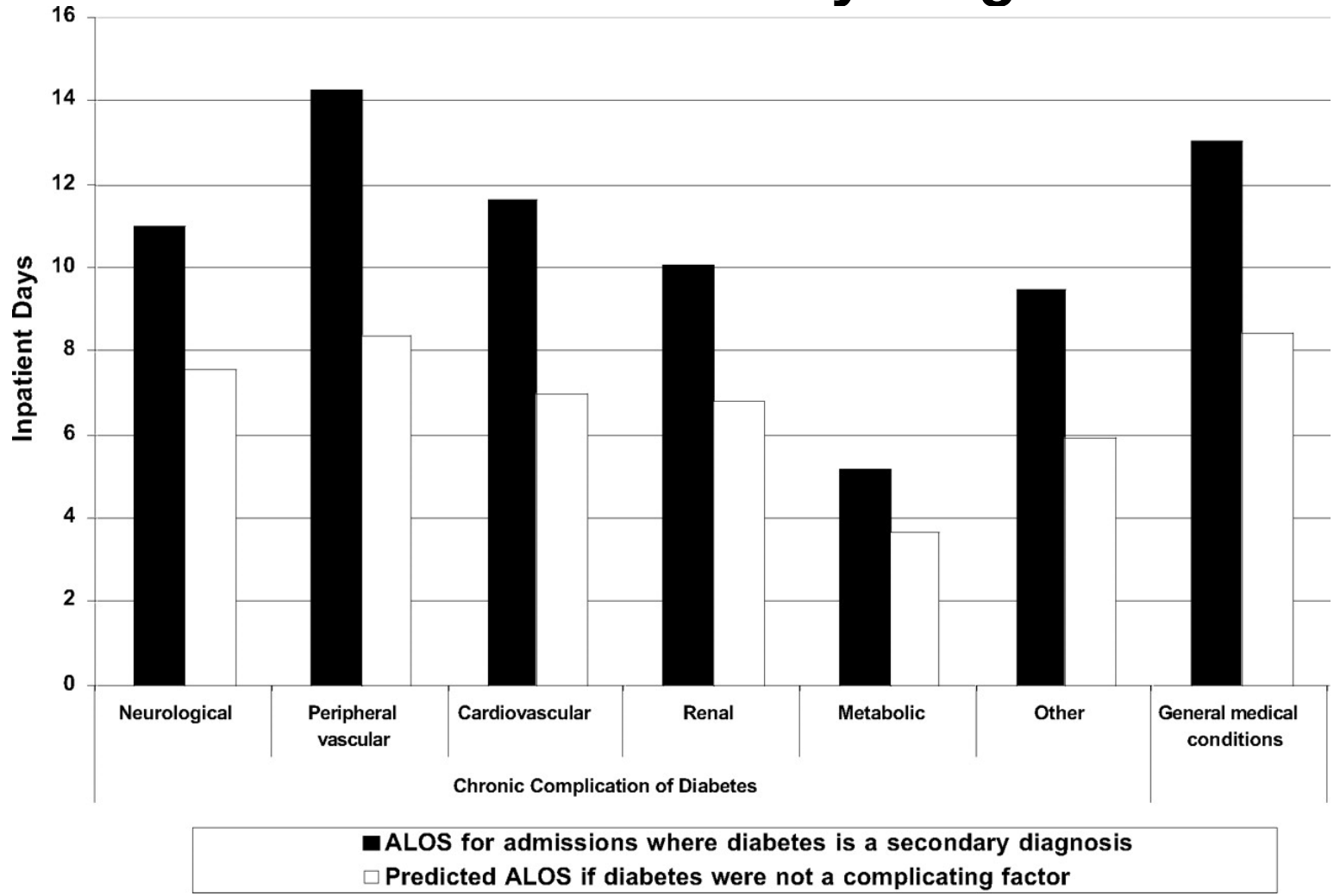
WHY DO WE CARE ABOUT UNCONTROLLED HYPERGLYCEMIA?

ADVERSE OUTCOMES

- Uncontrolled hyperglycemia in hospitalized patients (both ICU and non-critical care) with/without prior diabetes diagnosis is associated with adverse outcomes:
  - Prolonged hospital stay
  - Infections
  - Disability after hospital discharge
  - Death

J Clin Endocrinol Metab, Jan 2012, 97(1): 16-38

Average hospital length of stay (ALOS) when diabetes is a secondary diagnosis.



American Diabetes Association Dia Care 2008;31:596-615

American Diabetes Association.

THE STAGGERING COST OF DIABETES

Today, **4,660** AMERICANS WILL BE DIAGNOSED WITH **DIABETES**

NEARLY **30** MILLION AMERICANS HAVE DIABETES

86 million
Americans have prediabetes

More than the population of the east coast from Connecticut to Georgia

DIABETES AND PREDIABETES COST AMERICA **$322 BILLION** PER YEAR

$ **1 in 5 health care dollars** is spent caring for people with diabetes

$ **1 in 3 Medicare dollars** is spent caring for people with diabetes

$ People with diagnosed diabetes have health care costs **2.3 times higher** than if they didn't have the disease

American Diabetes Association.

Learn how to combat this costly disease at **diabetes.org/congress**

STOP DIABETES.

COST

- The cost associated with hospitalization for patients with diabetes accounts for **half of all health care expenditures for this disease**

- Total estimated cost of diagnosed diabetes in 2012 was $245 billion
  - $174 billion in direct medical costs
    - 43% of total medical cost is related to hospital inpatient care ($76 billion/year)
  - 41% higher than last estimate 5 years prior in 2007 ($176 billion)

Diabetes Care March 2008 vol. 31 no. 3 596-615
National Diabetes Statistic Report, 2014

QUALITY MEASURE - CMS

Center for Medicare and Medicaid Services (CMS) and National Quality Forum (NQF) have recommended that Glycemic Control (both hyperglycemia and hypoglycemia) be endorsed as **Quality Measures** for the inpatient care setting.

- 2017?

RETURN ON INVESTMENT

LOCATION	USERS	ENROLLEES	EXPENDITURES	COST PER USER	COST PER ENROLLEE
NATION	5,958,849	8,965,923	$54,634,070,150	$9,169	$6,094
STX	78,408	118,796	$670,848,400	$8,556	$5,647

COST ASSOCIATED WITH CARE FOR PATIENTS WITH DIABETES AND AT LEAST ONE COMORBID CONDITION

TOTAL # PATIENTS	CHF	CAD	HTN	HLD	MORBID OBESITY	COPD	OSTEOP OROSIS	SCI	DEMENTIA	TOTAL COST ≥ $100K	≥ 1 DISCHARGES	TOTAL ACTUAL COST OF CARE
22,571	9.7%	43%	86.4%	85.5%	42.3%	26.4%	1.9%	2.3%	5.2%	1.4%	10.5%	$239,835,419

- Approximately 29% of the patient population at STX is diabetic with at least one comorbid condition
- Approximately $240 million spent on patient care for diabetic patients
- 36% of expenditures for 2015

RETURN ON INVESTMENT

Cost by Treating Specialty
Summary For Facility(s) (671) - FY 15 through Month - September
(selected TRTs)
(All Patient Population) (All Facility MCG`s)

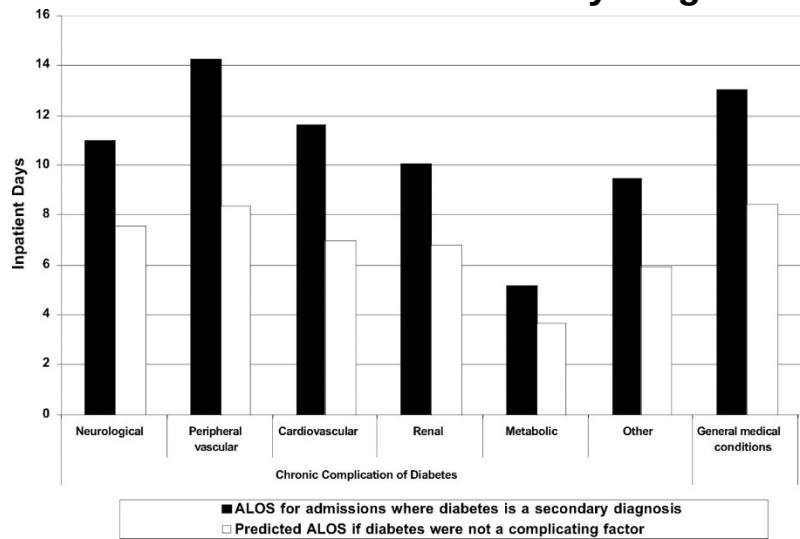
#	VISN	Station	Facility	Facility Name	Through Month	Treating Specialty	Treating Specialty Name	Fixed Direct Cost	Variable Direct Cost	Fixed Indirect Cost	Total Cost	Total Bed Days	Unique Patien per T (Dupli Rem fr TOT	Average Cost per Day	Network Average Cost per Bed Day	National Average Cost per Bed Day	% Varia to Natio
1	17	671	671	San Antonio, TX	Sep	15	GENERAL ACUTE MEDICINE	3,746,286	24,018,710	13,266,026	41,031,022	15,803		2,596	2,659	2,921	
					Sep		**TOTALS**	3,746,286	24,018,710	13,266,026	41,031,022	15,803					

Total Unique Patients 2,605 are All Duplicates Removed.
The Number of Total Unique Patients is Provided While Selecting All TRTs.

Average Cost Per Day: $2,569
Average Cost Per Hour: $107

this is the baseline cost of care which includes room, utilities and nursing care; DOES NOT include cost of physicians, labs, imaging, medications or procedures

Average hospital length of stay (ALOS) when diabetes is a secondary diagnosis



RETURN ON INVESTMENT

Average Cost Per Day: $2,569 Average Cost Per Hour: $107

this this the baseline cost of care which includes room, utilities and nursing care; DOES NOT include cost of physicians, labs, imaging, medications or procedures

Example with one Medicine ward service:

Total # patients over 1 month: 65
Diabetics: 43%
Uncontrolled Hyperglycemia: 20%
AVG Length of Stay (unadjusted): 8 days
MEDIAN Length of Stay (unadjusted): 6 days
Cost per patient: $15K-20K

Prior studies have shown the possibility of reducing LOS by 0.26 days with improved glycemic control.

Possible savings: $668/patient
Total Diabetic Patients: 22,571
Theoretical cost savings: $15,077,428
Improvement with 5% of diabetic population: $753,871 savings

J. Hosp. Med., 3: 76–83. doi: 10.1002/jhm.367

HOW DO WE KNOW THAT THIS IS A PROBLEM AT OUR INSTITUTION (STX VA)?

- **IPEC (Inpatient Evaluation Center)**
  - VA program which uses electronic data to produce validated risk measures
  - Monitors inpatient quality measures including mortality, inpatient infections (CLABSI, CAUTI, etc.)
  - Recently started monitoring inpatient hyperglycemia rates, though they are not currently doing anything with this data

VISN 17 Acute Care Proprotion of Hyperglycemic Patients 2014-2015

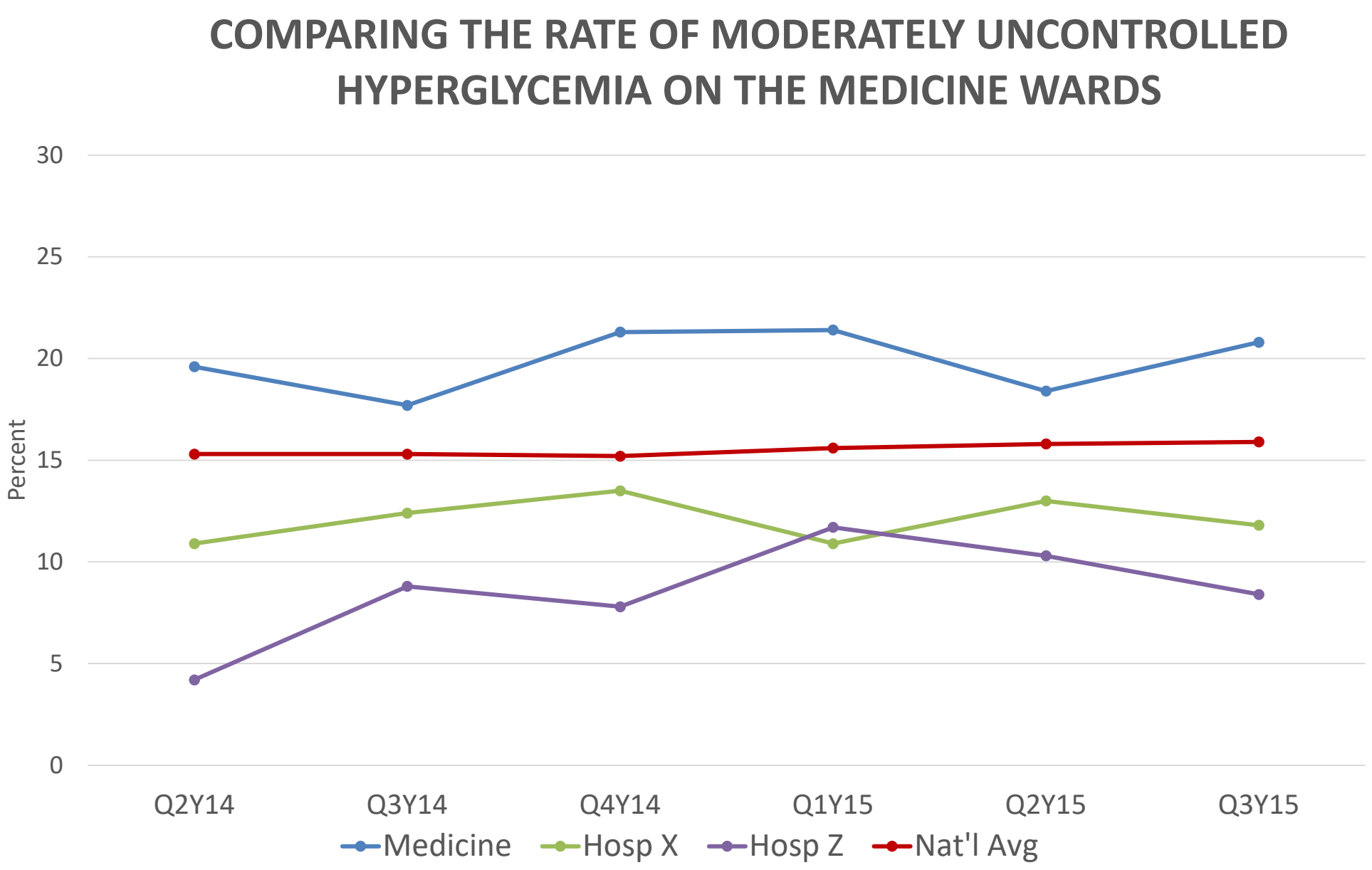
	Rolling 12 Months				FY 2015 YTD				Rolling 6 Months				FY 2015 Q3					National Aggregate FY 2015 YTD	
	181-300		>300		181-300		>300		181-300		>300		181-300		>300			181-300	>300
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	Aggregate Type	%	%
Hosp X	591	12.8	44	1.0	417	12.6	28	0.8	289	13.2	23	1.1	130	12.7	10	1.0	1a	15.9	1.0
Medical Treating Specialty	423	12.3	31	0.9	300	11.9	21	0.8	206	12.4	16	1.0	91	11.8	7	0.9	Medical	16.2	1.3
Surgical Treating Specialty	168	14.2	13	1.1	117	14.7	7	0.9	83	15.6	7	1.3	39	15.5	3	1.2	Surgical	14.4	0.7
San Antonio	1021	19.3	52	1.0	748	18.9	41	1.0	509	18.7	29	1.1	244	18.6	15	1.1	1a	15.9	1.0
Medical Treating Specialty	785	20.4	45	1.2	581	20.1	38	1.3	383	19.6	27	1.4	194	20.8	13	1.4	Medical	16.2	1.3
Surgical Treating Specialty	236	16.3	7	0.5	167	15.5	3	0.3	126	16.6	2	0.3	50	13.1	2	0.5	Surgical	14.4	0.7
Hosp Z	261	9.9	23	0.9	208	10.5	16	0.8	129	9.7	9	0.7	55	8.5	2	0.3	1c	15.2	1.3
Medical Treating Specialty	219	9.6	19	0.8	175	10.2	13	0.8	109	9.4	9	0.8	48	8.4	2	0.4	Medical	16.2	1.3
Surgical Treating Specialty	42	11.7	4	1.1	33	12.5	3	1.1	20	11.2			7	8.6			Surgical	14.4	0.7

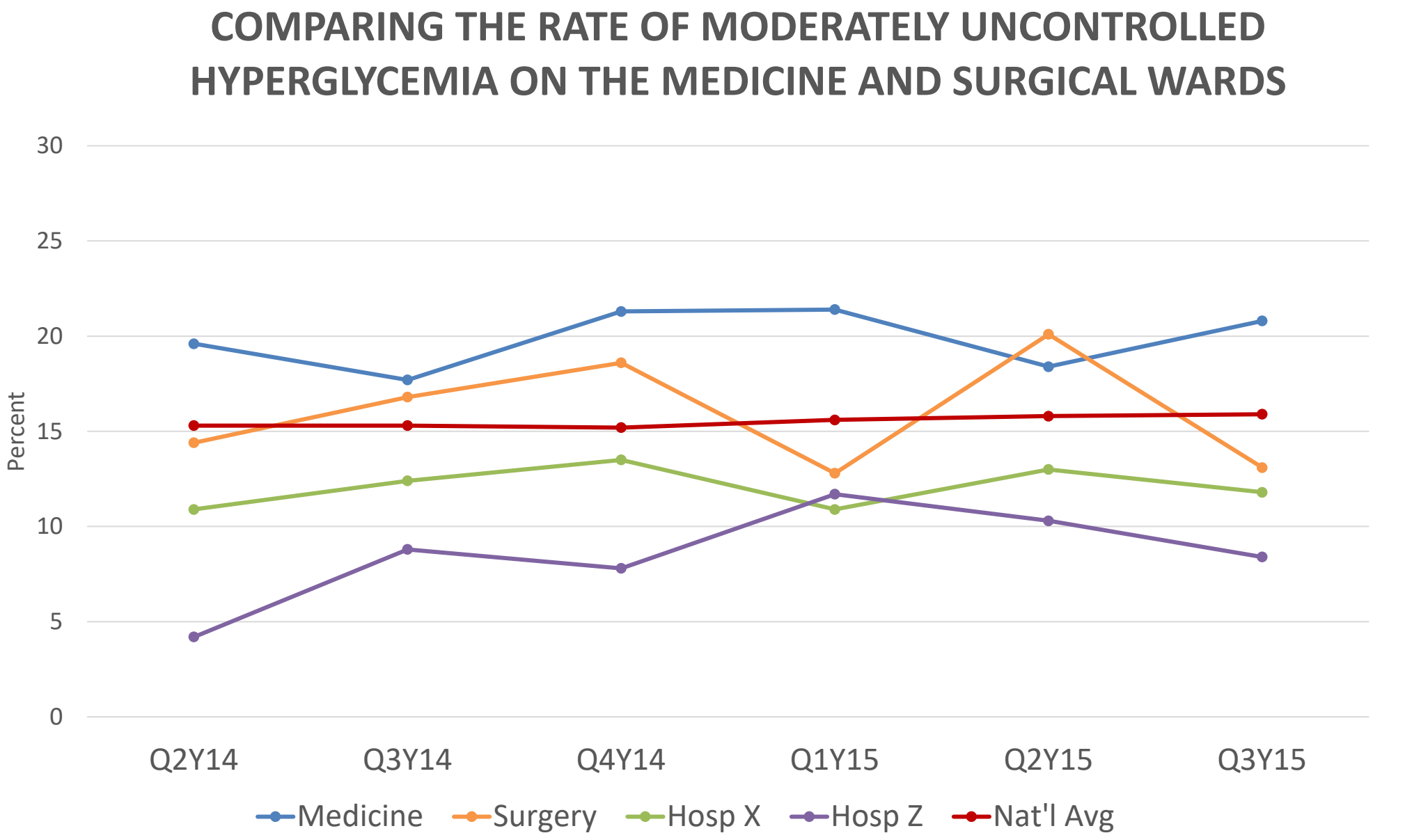
N= Number of Hyperglycemic Cases

% = Percent of hyperglycemic Cases

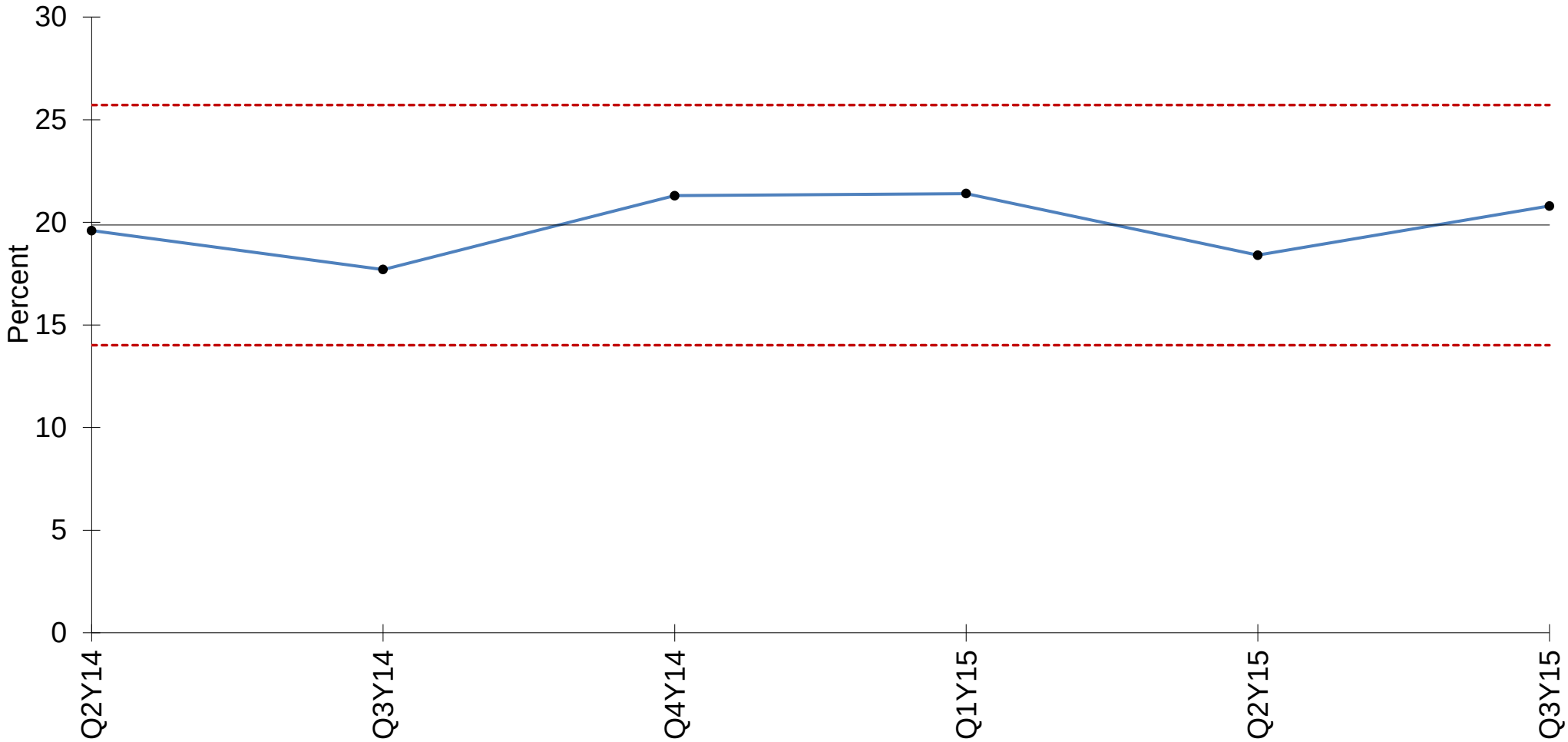
Excludes Diabetes primary admission diagnoses

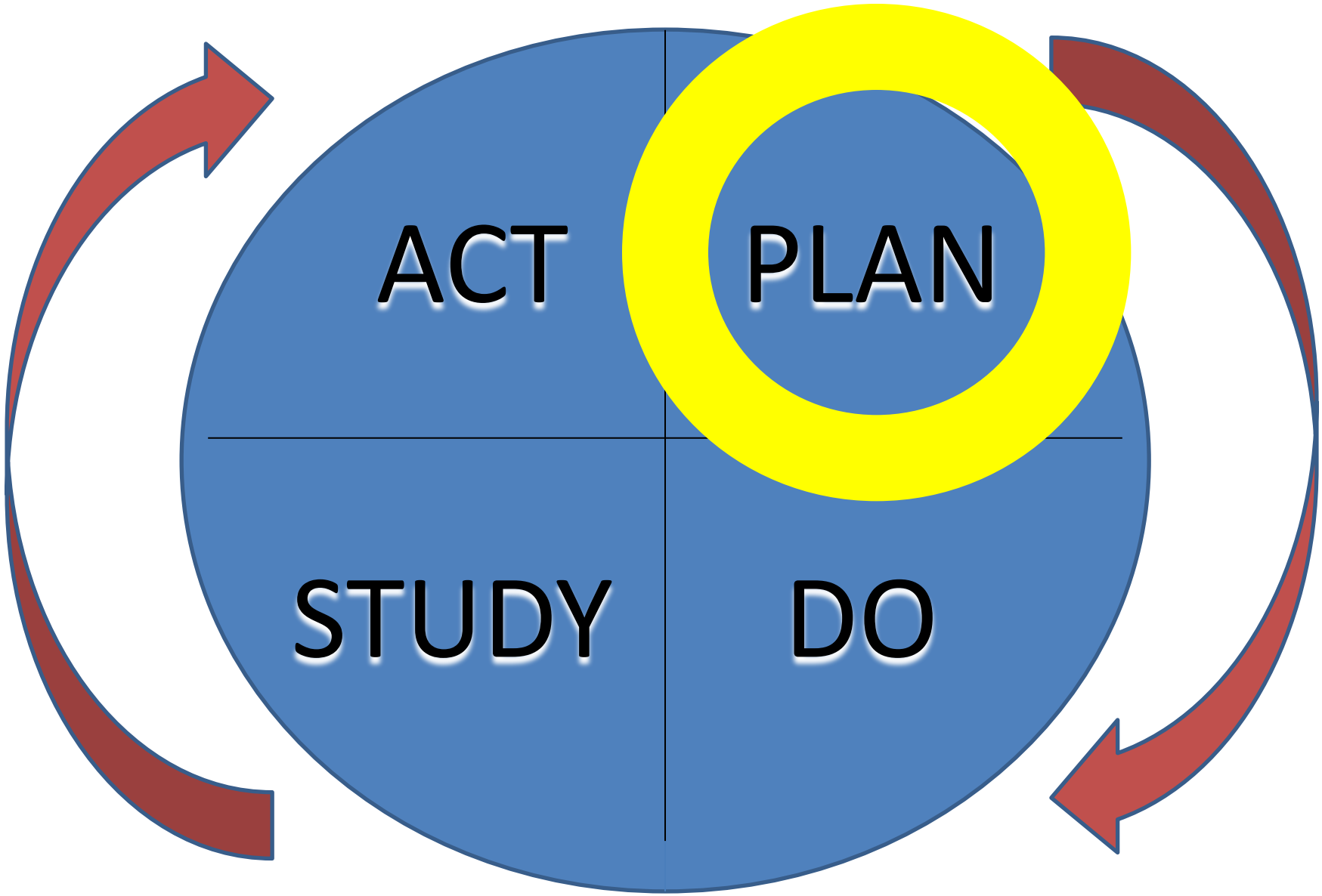
Aggregate Type = Aggregate Type by complexity of hospital and/or unit type


COMPARING THE RATE OF MODERATELY UNCONTROLLED HYPERGLYCEMIA ON THE MEDICINE WARDS
30
25
20
15
10
5
0
Percent
Q2Y14
Q3Y14
Q4Y14
Q1Y15
Q2Y15
Q3Y15
Medicine
Hosp X
Hosp Z
Nat'l Avg


COMPARING THE RATE OF MODERATELY UNCONTROLLED HYPERGLYCEMIA ON THE MEDICINE AND SURGICAL WARDS
30
25
20
15
10
5
0
Percent
Q2Y14
Q3Y14
Q4Y14
Q1Y15
Q2Y15
Q3Y15
Medicine
Surgery
Hosp X
Hosp Z
Nat'l Avg

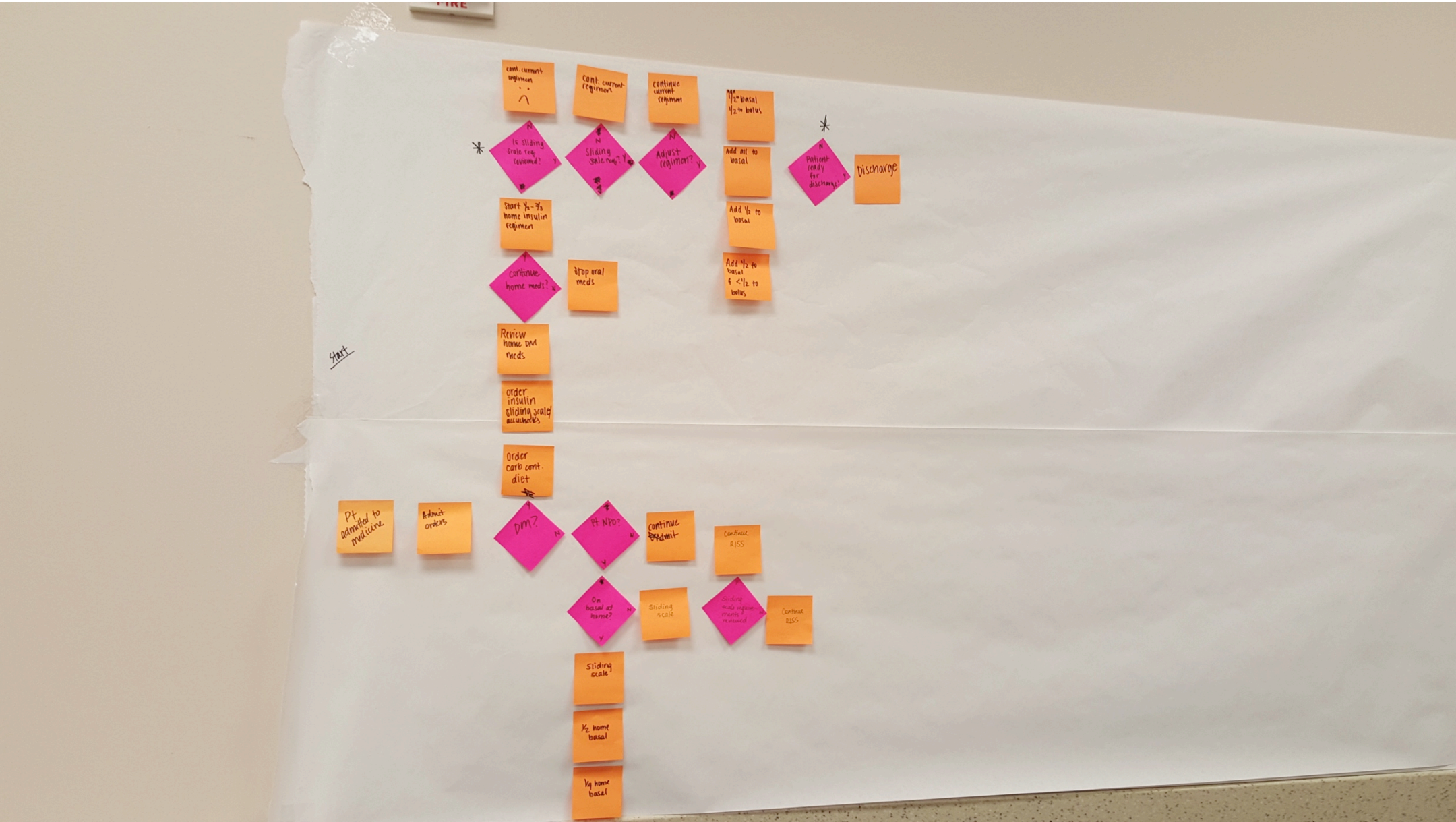
Rates of Moderately Uncontrolled Hyperglycemia on the Inpatient Medicine Wards

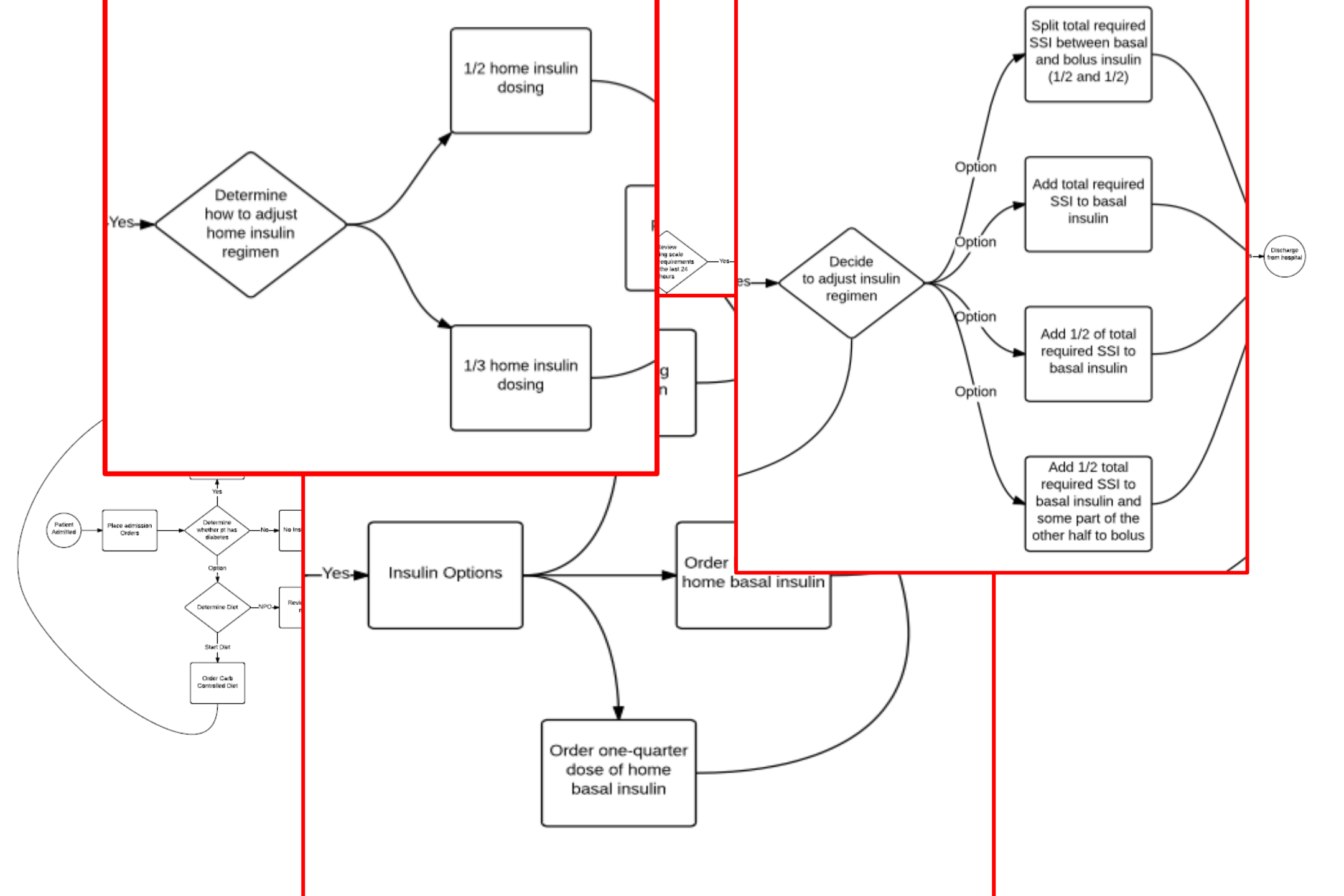



ACT
PLAN
STUDY
DO

WHAT IS OUR CURRENT PROCESS FOR MANAGEMENT OF INPATIENT HYPERGLYCEMIA?

FLOW DIAGRAM WIP

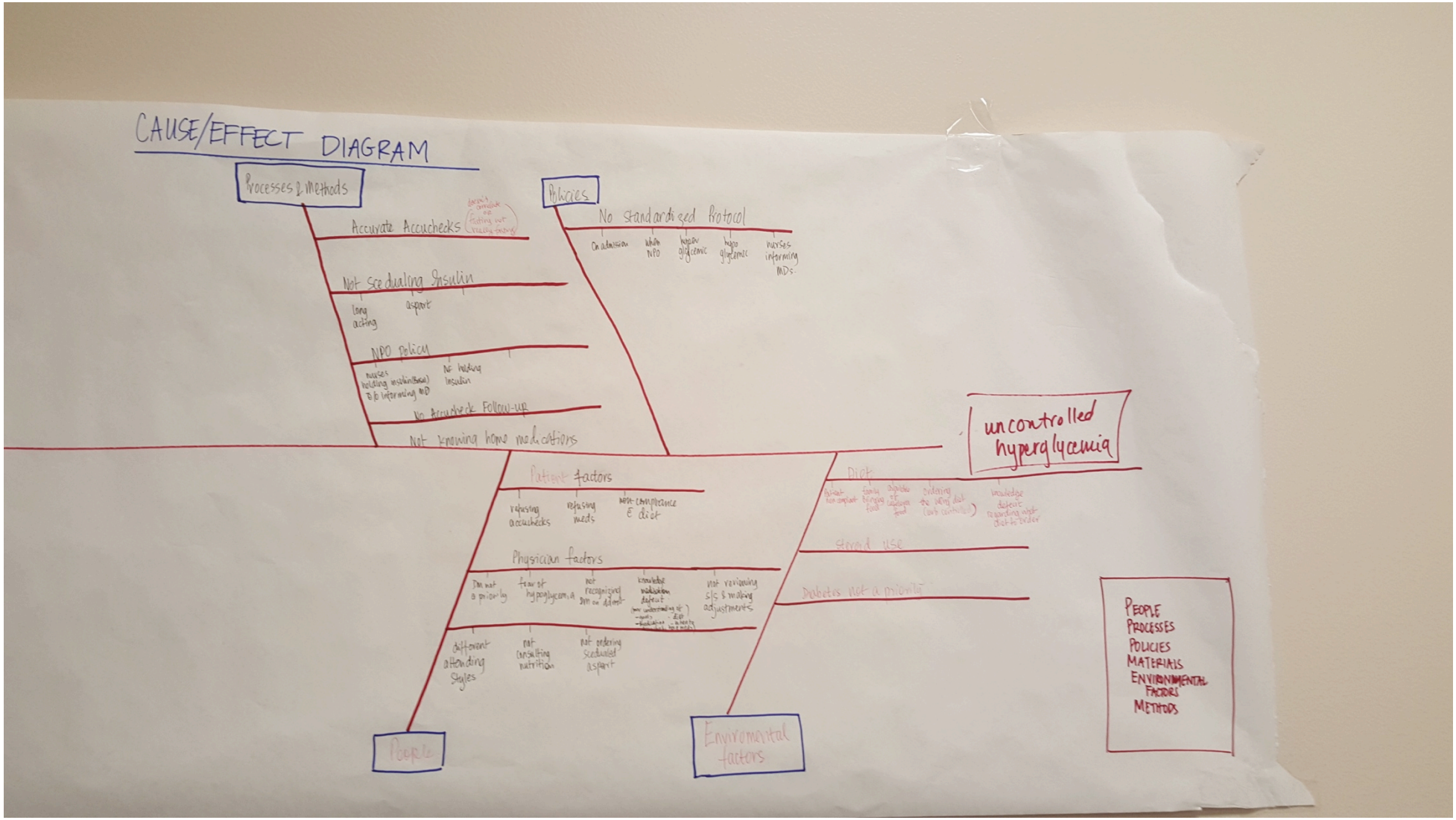


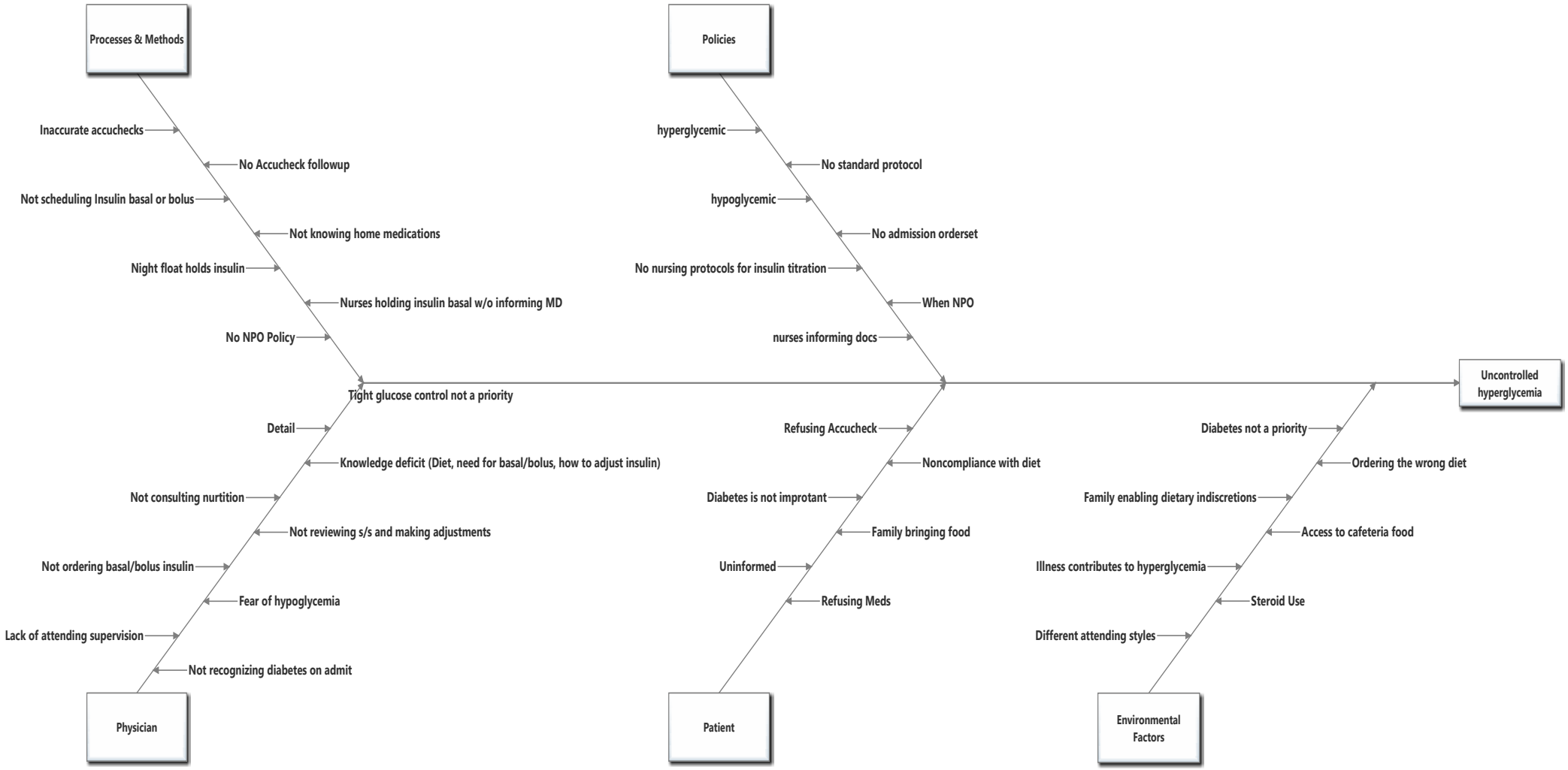

Yes
Determine how to adjust home insulin regimen
1/2 home insulin dosing
1/3 home insulin dosing
Decide to adjust insulin regimen
Option
Split total required SSI between basal and bolus insulin (1/2 and 1/2)
Option
Add total required SSI to basal insulin
Option
Add 1/2 of total required SSI to basal insulin
Option
Add 1/2 total required SSI to basal insulin and some part of the other half to bolus
Discharge from hospital
Patient Admitted
Place admission Orders
Determine whether pt has diabetes
No
Yes
Option
Determine Diet
NPO
Start Diet
Order Carb Controlled Diet
Yes
Insulin Options
Order home basal insulin
Order one-quarter dose of home basal insulin

Structure of a Ward Team:

Up to 10 members overseeing up to 20 patients

FISHBONE WIP




Processes & Methods
Inaccurate accuchecks
No Accucheck followup
Not scheduling Insulin basal or bolus
Not knowing home medications
Night float holds insulin
Nurses holding insulin basal w/o informing MD
No NPO Policy
Tight glucose control not a priority
Detail
Knowledge deficit (Diet, need for basal/bolus, how to adjust insulin)
Not consulting nurtition
Not reviewing s/s and making adjustments
Not ordering basal/bolus insulin
Fear of hypoglycemia
Lack of attending supervision
Not recognizing diabetes on admit
Physician
Policies
hyperglycemic
No standard protocol
hypoglycemic
No admission orderset
No nursing protocols for insulin titration
When NPO
nurses informing docs
Refusing Accucheck
Noncompliance with diet
Diabetes is not improtant
Family bringing food
Uninformed
Refusing Meds
Patient
Uncontrolled hyperglycemia
Diabetes not a priority
Ordering the wrong diet
Family enabling dietary indiscretions
Access to cafeteria food
Illness contributes to hyperglycemia
Steroid Use
Different attending styles
Environmental Factors

HOW DOES OUR PROCESS COMPARE TO WHAT THE LITERATURE RECOMMENDS?

OUR CURRENT PRACTICE

- **Insulin-dependent patients:**
  - Multiple methods of adjusting home insulin dosing for inpatient stay (quarter, third, half-dose)
- **Patients on oral meds**
  - VAST majority are managed with sliding scale insulin alone
- **During inpatient stay**
  - Multiple methods of adjusting current insulin regimen based on sliding scale needs
- **END OF STORY – OUR CURRENT PRACTICE DOES NOT FOLLOW THE CURRENT GUIDELINES/LITERATURE**

AACE GUIDELINES

- **Insulin-dependent patients**
  - If well-controlled continue home regimen but consider slight adjustment (lower dose) while inpatient
  - If uncontrolled, weight-based basal bolus insulin regimen recommended
- **Patients on oral meds**
  - Basal/bolus insulin regimen recommended (weight-based)
- **During inpatient stay**
  - If BG >140, recommend increasing total daily dosing (50/50 basal/bolus if fasting BG elevated; if fasting BG at goal, then add 50% to bolus insulin)

J Clin Endocrinol Metab, Jan 2012, 97(1): 16-38

AIM Statement

The aim of this project is to decrease rates of moderate hyperglycemia (blood glucose 181-300) to ≤16% in patients admitted to the internal medicine ward teaching services by June 2016.

AIM Statement Test

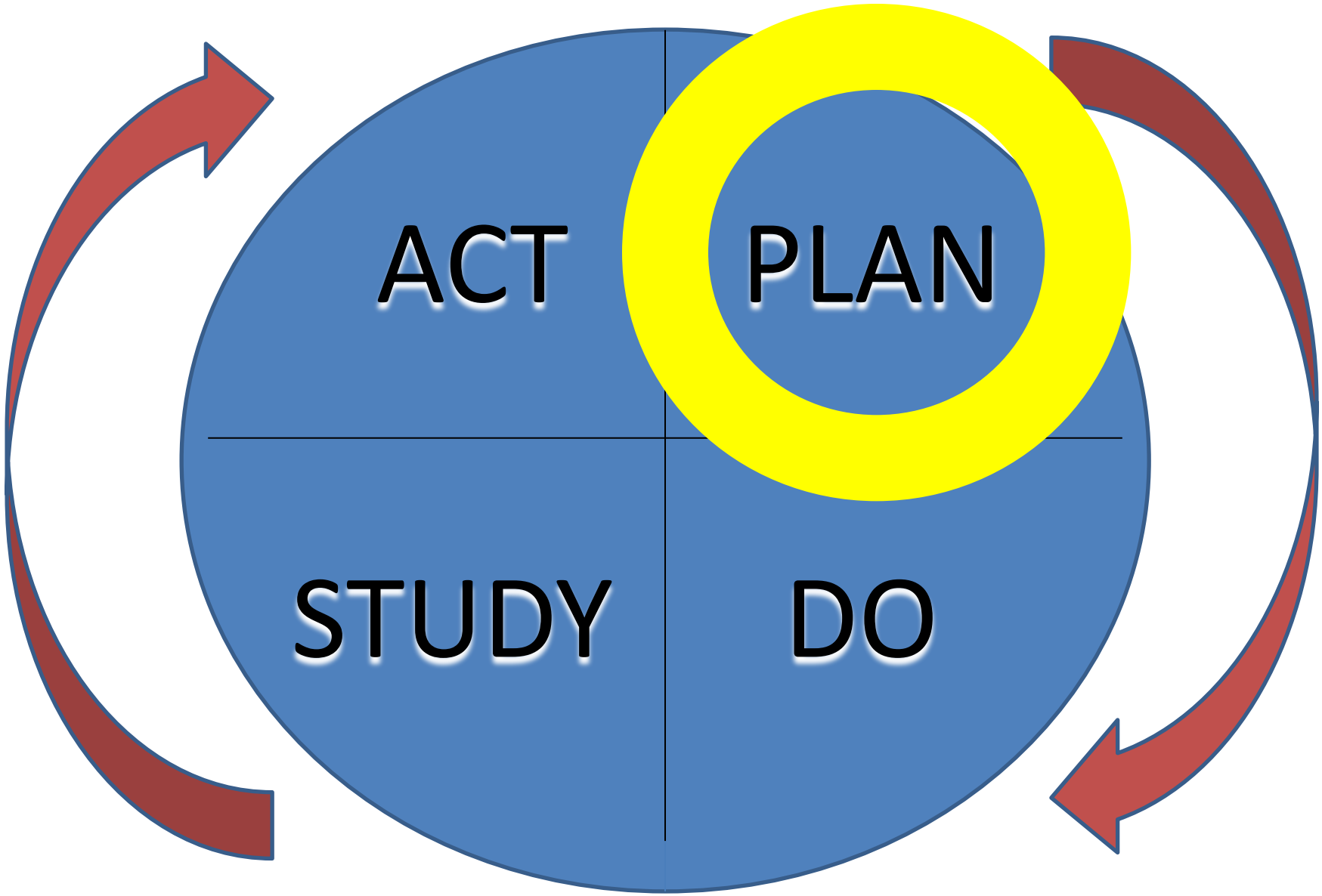
SPECIFIC- All patients admitted to the Medicine Ward service at the VA who are not admitted with a hyperglycemia related condition (DKA or HHS)

MEASURABLE- Data on hyperglycemia rates is already collected at aggregated through IPEC at the VA; patient level data is available by chart review (to be done by the residents in the IM QI Cohort)

ACHIEVABLE- 3 stage intervention plan beginning first with a pilot project with one medicine ward team and then later with all medicine ward teams

REALISTIC- project is supported by Pharmacy and Endocrinology who will assist with implementation of the final EMR changes as part of the intervention

TIMELY- Goal target date is 6/1/2016. In the interim, Stages 1-3 will be implemented prior to target goal date.



PLANNING CONTINUES

PLAN: Intervention

WHAT: **<u>Implement a structured basal/bolus insulin regimen</u>** into the management of diabetic patients admitted to the medicine ward service as recommended by the AACE guidelines .

HOW: 3 STAGE INTERVENTION PLAN

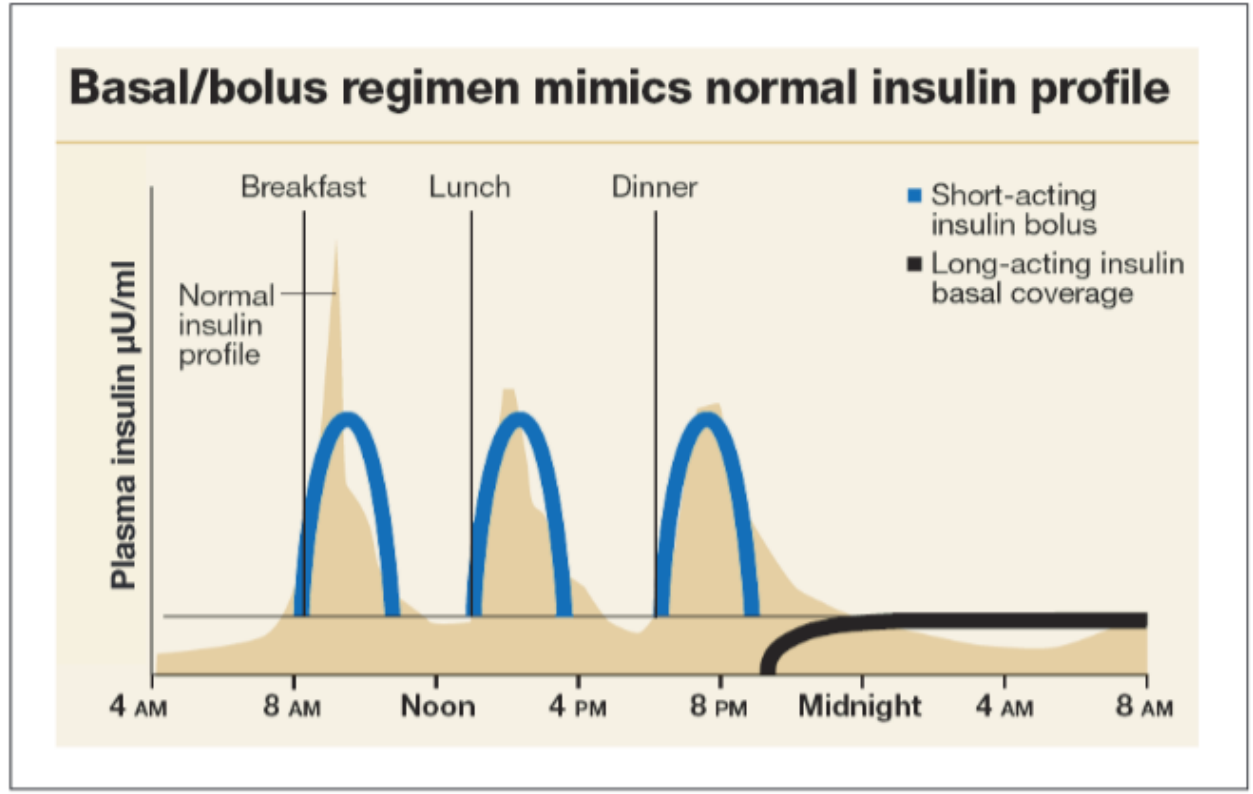


Figure 1. Physiological principles of the basallbolus insulin regimen.[9]

Journal of HOSPITAL MEDICINE

ORIGINAL RESEARCH

Improved Inpatient Use of Basal Insulin, Reduced Hypoglycemia, and Improved Glycemic Control: Effect of Structured Subcutaneous Insulin Orders and an Insulin Management Algorithm

CONCLUSION:
Hypoglycemia and glycemic control can be improved simultaneously with structured insulin orders and management algorithms.

PATIENTS:

- Adult non-critical care inpatients with diabetes or hyperglycemia and point-of-care (POC) glucose testing.

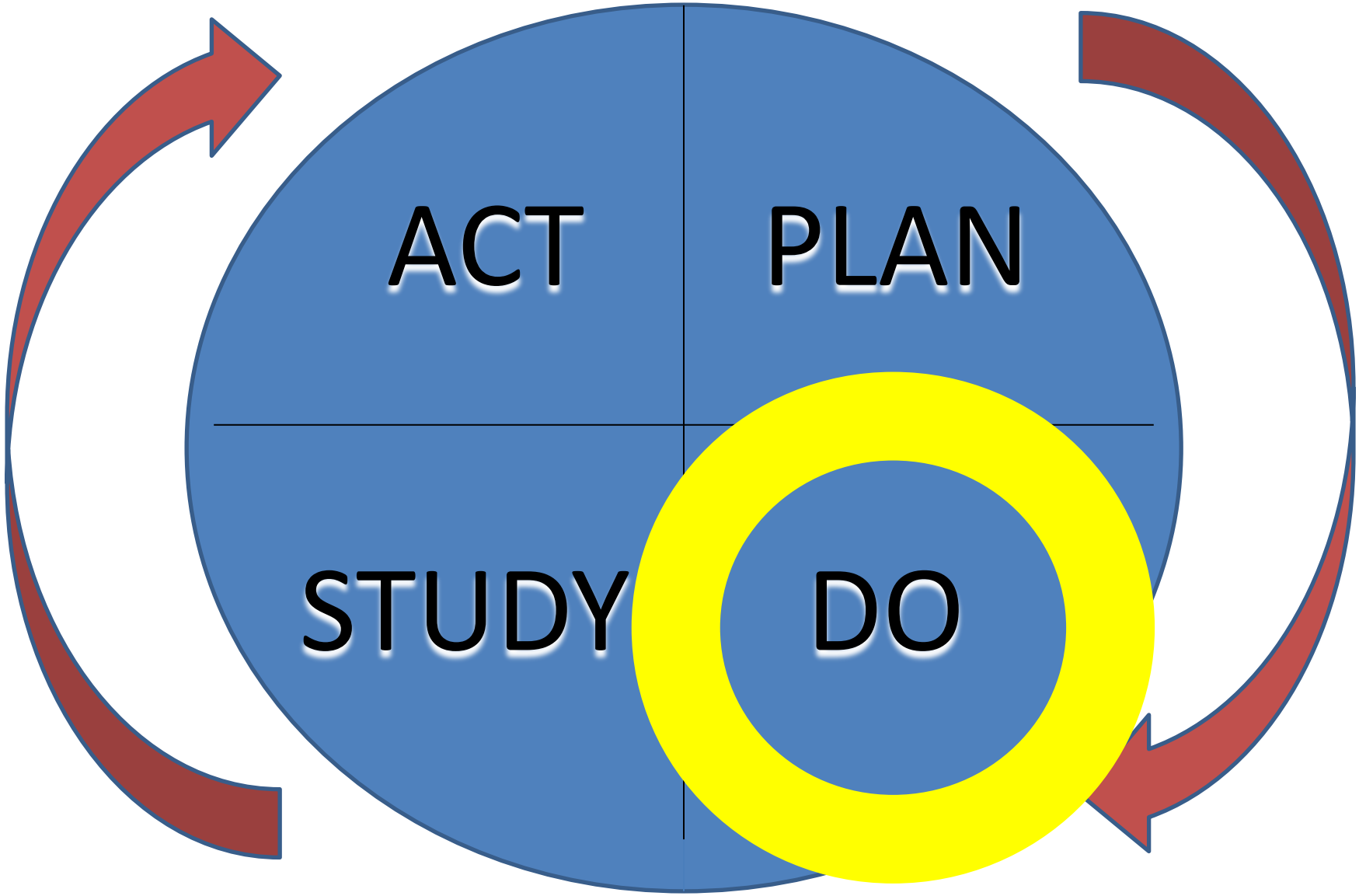
INTERVENTIONS:

- Structured insulin orders, insulin management algorithm.

RESULTS

- Decrease in sliding scale insulin (72%→26%, P<0.0001)
- Improvement in percent of uncontrolled hyperglycemia (37.8% v. 33.9% v. 30.1%, P<0.005; 3 time periods: baseline, structured insulin orders, orders plus algorithm)
- Decreased hypoglycemia (3.8%, 2.9%, 2.6%, CI 0.59-0.78)

Maynard, Greg, et al. "Improved inpatient use of basal insulin, reduced hypoglycemia, and improved glycemic control: effect of structured subcutaneous insulin orders and an insulin management algorithm." Journal of Hospital Medicine 4.1 (2009): 3-15.


ACT
PLAN
STUDY
DO

DO: Implementing the Change

STAGE 1 – PILOT

10/1 – Senior medicine resident (member of QI team) began a basic pilot with his team

-He started by educating those on his team on the basics of the AACE guidelines

-Implemented use of weight-based basal/bolus insulin regimen for patients that would have previously been managed with SSI alone

***all education was verbal; no handouts at this point**

PLAN: Intervention

TABLE 1. Example of a basal bolus insulin regimen for the management of non-critically ill patients with type 2 diabetes

A. Basal insulin orders
- Discontinue oral diabetes drugs and non-insulin injectable diabetes medications upon hospital admission.
- Starting insulin: calculate the total daily dose as follows:
  - 0.2 to 0.3 U/kg of body weight in patients: aged ≥70 yr and/or glomerular filtration rate less than 60 ml/min.
  - 0.4 U/kg of body weight per day for patients not meeting the criteria above who have BG concentrations of 7.8–11.1 mmol/liter (140–200 mg/dl).
  - 0.5 U/kg of body weight per day for patients not meeting the criteria above when BG concentration is 11.2–22.2 mmol/liter (201–400 mg/dl).
- Distribute total calculated dose as approximately 50% basal insulin and 50% nutritional insulin.
- Give basal insulin once (glargine/detemir) or twice (detemir/NPH) daily, at the same time each day.
- Give rapid-acting (prandial) insulin in three equally divided doses before each meal. Hold prandial insulin if patient is not able to eat.
- Adjust insulin dose(s) according to the results of bedside BG measurements.

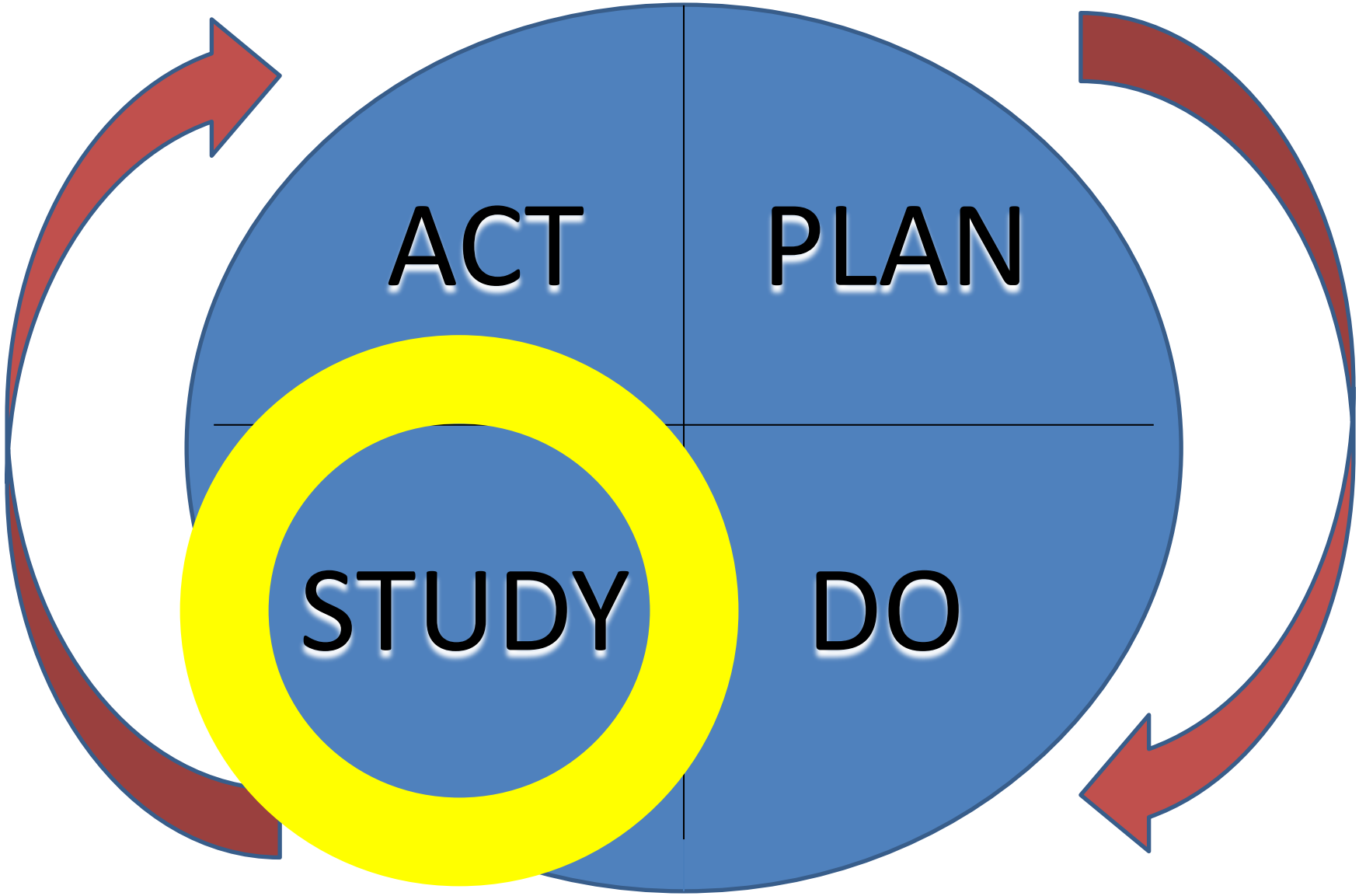
B. Supplemental (correction) rapid-acting insulin analog or

Table 2. Sample Order for Subcutaneous Insulin in a Hospitalized Patient

Sample: Basal/bolus insulin dose calculation for a patient weighing 80 kg with a BMI of 28 kg/m^2 and normal renal function

Step 1	**TDD calculation** TDD = 0.5 units/kg body weight × 80 = 40 units
Step 2	**Basal insulin dose calculation** Basal insulin dose = 50% of TDD = 50% of 40 units = 20 units glargine
Step 3	**Bolus insulin dose calculation** Bolus insulin dose per meal = (50% of TDD)/3= (50% of 40 units)/3 = 20/3 = 6.3 units, or ~ 6 units of rapid-acting insulin before each meal. If the patient or nurse estimates that the patient is only eating 50% of the food on the tray, a reduced dose of 3 units should be ordered instead of the full dose of 6 units
Step 4	**Correctional scale estimation** Assessment of correctional scale insulin is based on TDD. For a patient with a TDD of 40 units, the low correctional scale should be ordered

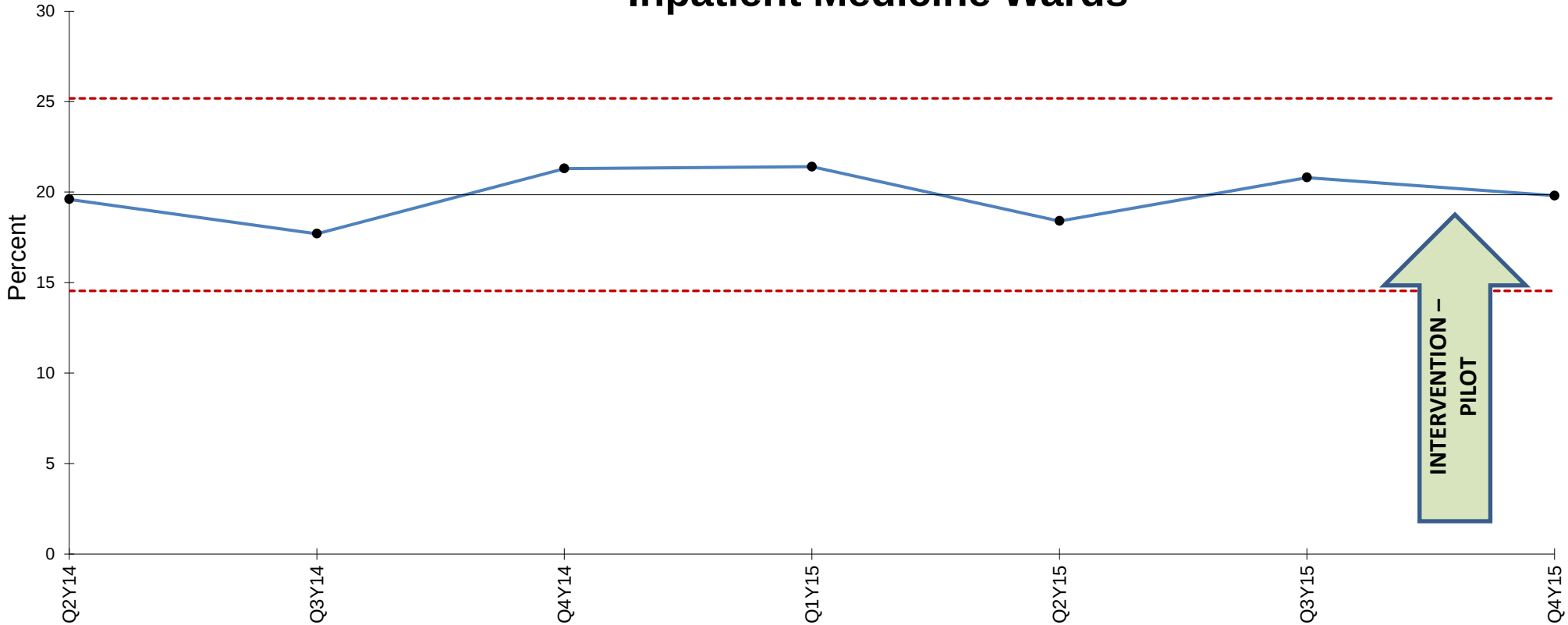
J Clin Endocrinol Metab, Jan 2012, 97(1): 16-38

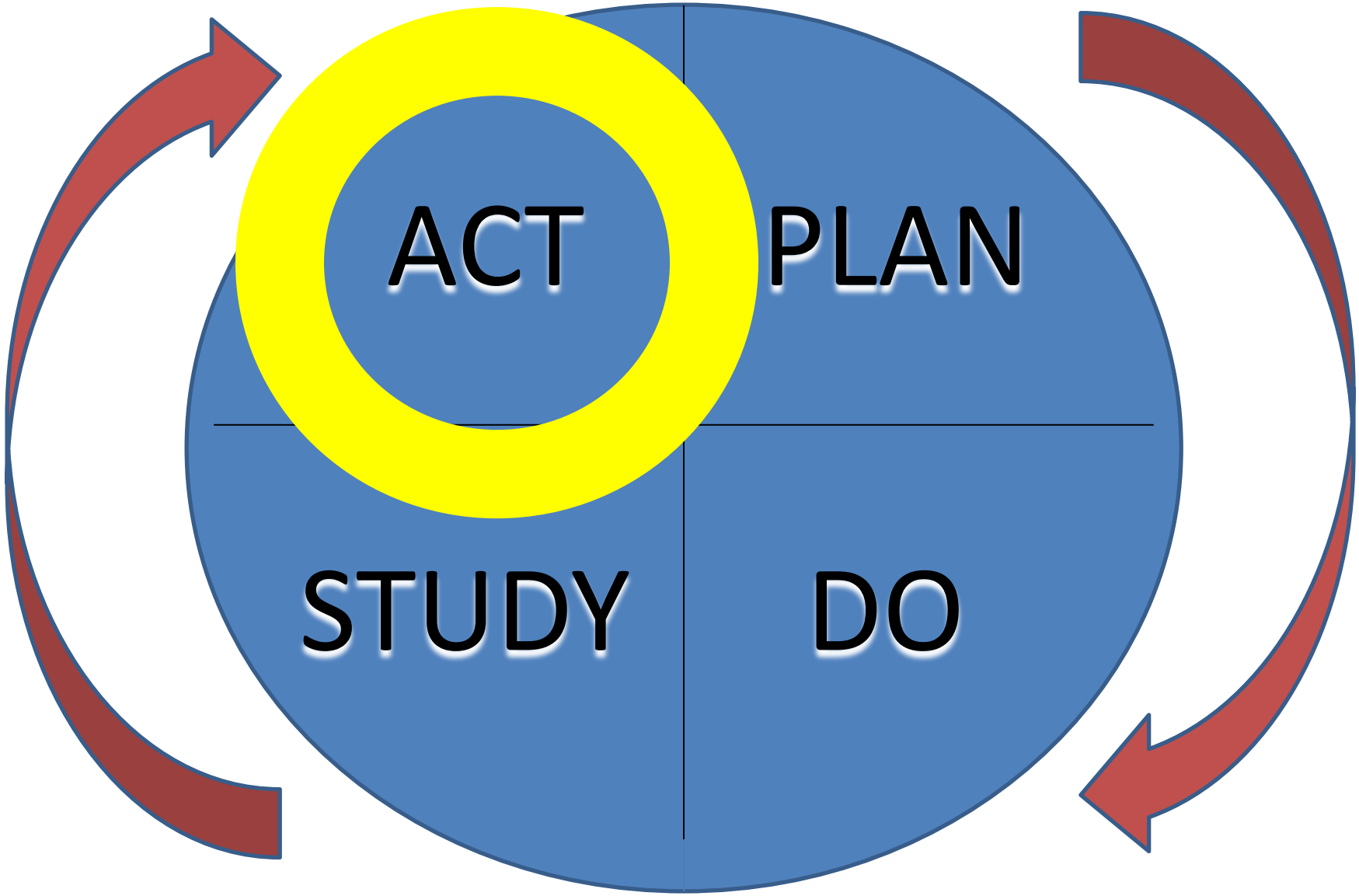

ACT
PLAN
STUDY
DO

PILOT DATA

Total # Patients	64
# Patients with Moderately Uncontrolled Hyperglycemia	13
% with Moderately Uncontrolled Hyperglycemia	20%
Total Glucose Days	373
% with Hypoglycemic days	0.8%

Rates of Moderately Uncontrolled Hyperglycemia on the Inpatient Medicine Wards




ACT
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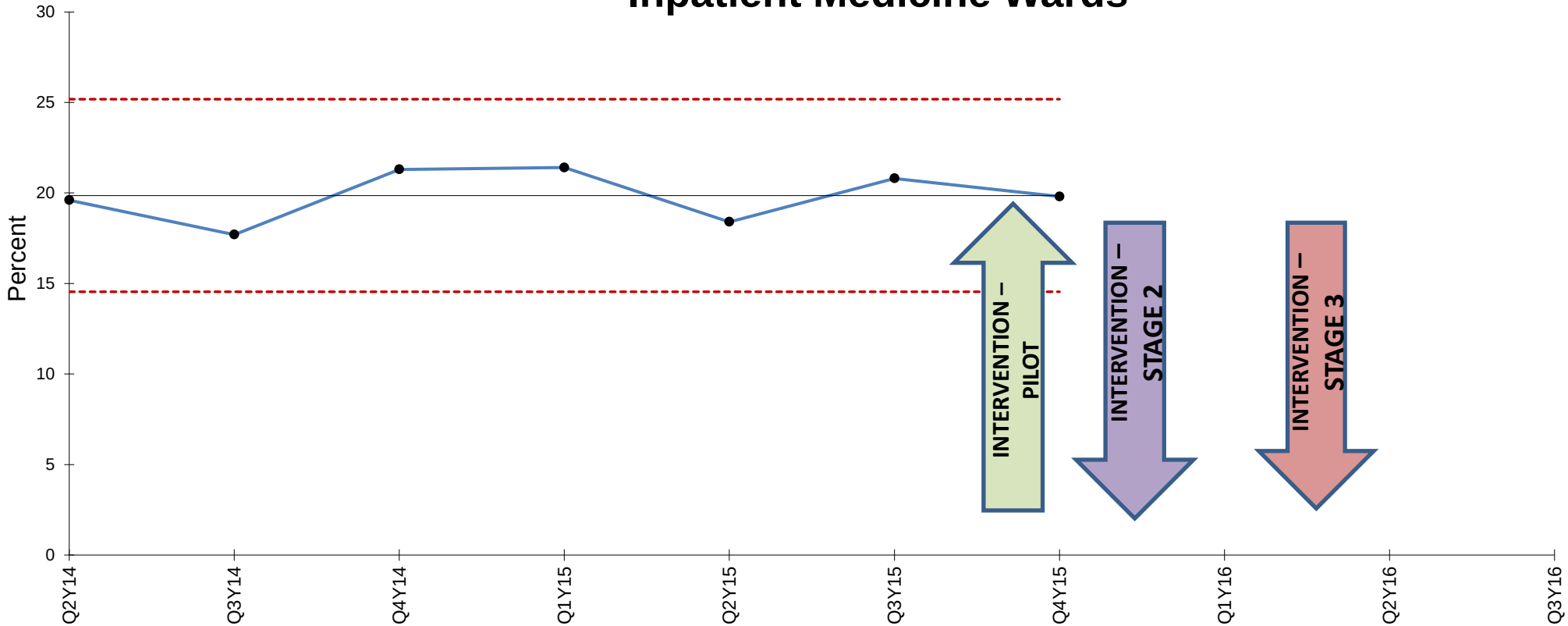
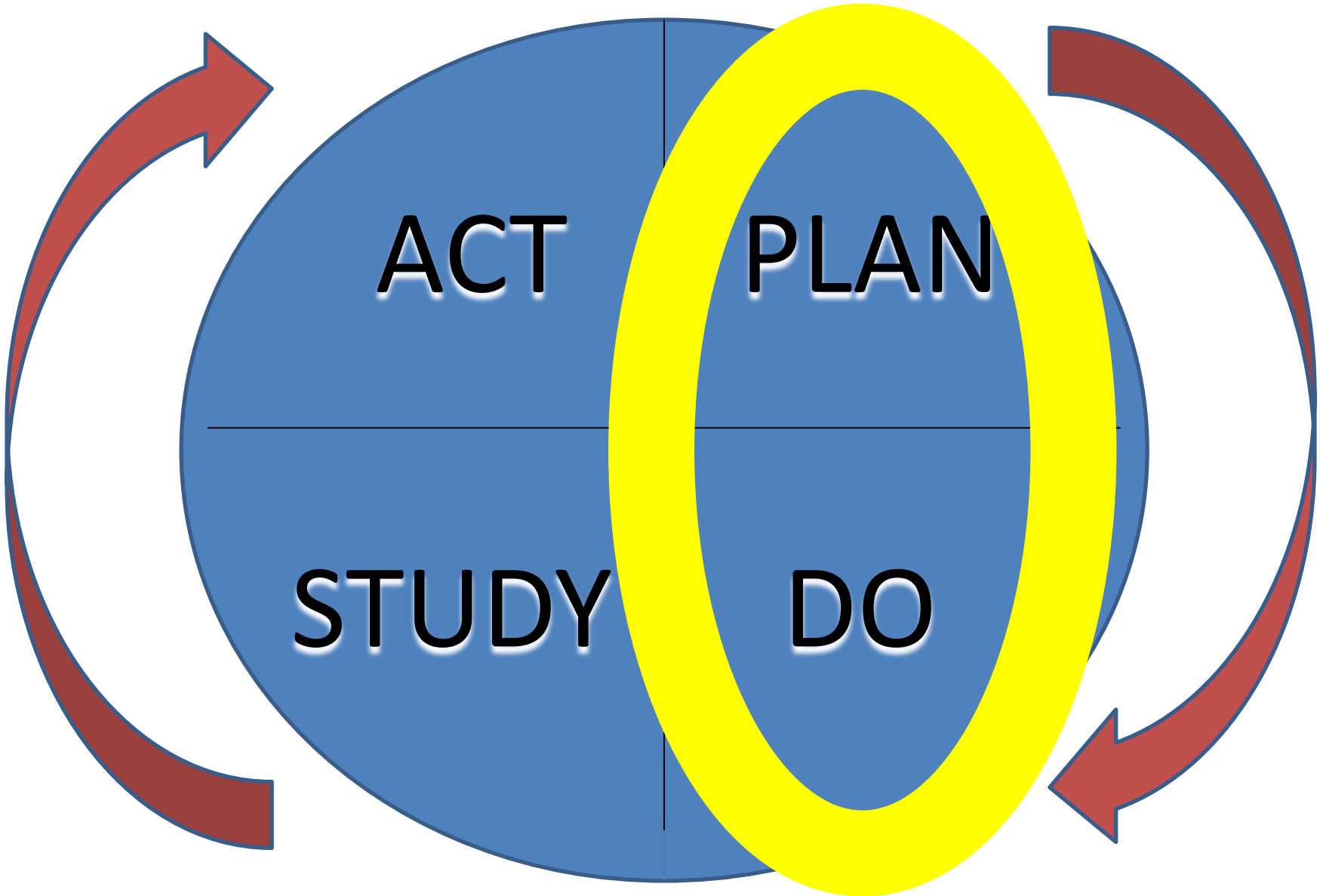
Rates of Moderately Uncontrolled Hyperglycemia on the Inpatient Medicine Wards



LESSONS LEARNED

- As we already knew… education is the weakest form of intervention!
- Residents and interns are VERY BUSY and small changes are forgotten quickly. Verbal education without written instructions or order sets was not sustainable.
- Medicine teams are complex and large… residents and interns can assume that the other person is taking care of diabetes management.
- Improvement is not seen overnight!


ACT
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DO

DO: Implementing the Change

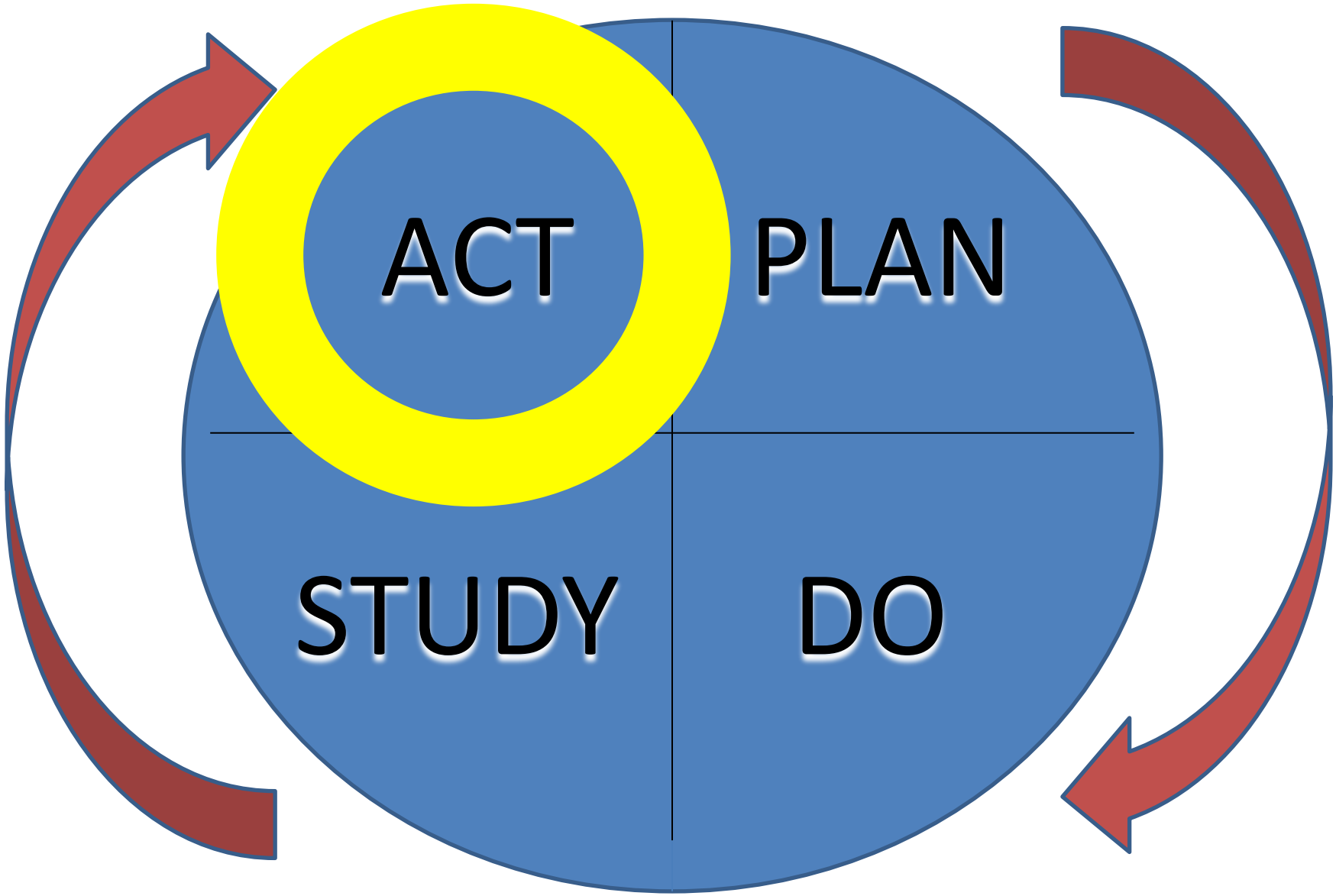
*****STAGE 2 – ALGORITHM*****

-Over Nov/Dec 2015, the team created a written **algorithm** to "walk" residents through a decision tree for insulin dosing based off AACE guidelines

-Allows for continued "fine-tuning" of algorithm before final stage of intervention in the Spring 2016

-Continued education of senior residents and faculty who will then educate/instruct those rotating on/off service

-formal and informal didactics with assistance of Endocrinology fellow


ACT
PLAN
STUDY
DO

ACT: Sustaining the Results

STAGE 3 – ORDER SET IN EMR

- We have been teaming with Pharmacy/Endocrinology to help make our intervention a permanent part of the admission process for each patient

- **HOW? CPRS ORDER SET**
  - This will walk interns/residents through ordering the appropriate basal/bolus insulin regimen for each patient when they are admitted to the hospital

- **WHEN? Spring 2016**

CONCLUSIONS

- Uncontrolled hyperglycemia remains a major problem at the STX VA
- Based on currently available evidence, improvement in glycemic control can be achieved using structured insulin orders and algorithm to guide management
- There is a clear cost benefit and value to be gained in the improvement in glycemic control given association with decreased adverse events and ALOS.

TO BE CONTINUED…

Thank you!