

# Glycemic Control

## Hitting the Sweet Spot During Inpatient Care

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Tim R. Brown, PharmD, BCACP, FASHP

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Director of Clinical Pharmacotherapy,  
Family Medicine

Cleveland Clinic Akron General

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Professor, Northeast Ohio Medical  
University

# Objectives

- Review current initiatives related to adverse drug events secondary to inpatient diabetes management.
- Identify common medication errors seen with hypoglycemic agents and discussed in recent evidence based medicine literature.
- Outline strategies to reduce common adverse drug events associated with hypoglycemic agents, including education of medical staff



**Partnership  
for Patients  
Campaign**

**Your  
Patients  
are Relying  
on You.....**

**Time is  
crucial**

# Call to Action

- Engage all health systems to address 3 high risk drug areas:
  - Anticoagulants
  - Insulin and Oral hypoglycemic agents
  - Opioids
- Make ADEs a priority in your Safety Across the Board (SAB) work
- Reduce ADEs
- Reduce readmissions

# Why DM Medications?

- Endocrine Practice published a paper in 2008
  - Described the characteristics of inpatient medical errors involving hypoglycemia medications
  - Reporting system in place for approximately 5 years
  - 2,598 inpatient errors reported
  - Nursing staff submitted 59% of reports
  - Approximately 66% of errors reached the patient
    - Insulin was the biggest culprit at 82% of reports
    - Oral hypoglycemics represented 18%
    - Sulfonylureas caused 50% of these errors

# Why DM Medications?

- NEJM article from November 2011
  - Two years of data to estimate the frequency and rates of hospitalizations after ED visits for ADEs in older adults
  - Results
    - 265,802 ED visits for ADEs over 2 years resulting in 99,628 emergency hospitalizations over 2 years
    - Nearly ½ of these involved patients > 80 yo
  - Hypoglycemic events resulted in  $\approx$  50% of patients being admitted
  - Insulin was responsible for 19 hospitalizations out of every 10,000 medication visits

# Why DM Medications?

- Diabetic patients are more likely to be hospitalized
  - Have longer LOS
  - Survey showed 22% of all hospital inpatient days were incurred by diabetic patients
  - These admissions accounted for \$87 billion of total US expenditures for DM management
- 2010 US Pharmacopeia reported 4,764 insulin errors over 2 years
  - $\approx$  6.6% caused harm to a patient

# Obstacles to Optimal Care

- Unanticipated changes in nutrition
  - NPO
  - Clears
  - TPN
  - Supplemental enteral nutrition
- Co-morbid events like AKI
- Physiologic response to stress
  - Infections
  - Trauma
- Use of medications that increase BS
- Transition to insulin from other DM oral medications
- System failures – ie TCM/communication failure



# Medications of Concern

# Oral Hypoglycemics

- Sulfonlyureas/Meglitinides
  - Glyburide, Glipizide, Glimepiride
  - Repaglinide, Nateglinide
  - Exert effect on calcium channels in pancreas to release insulin
  - Rudimentary approach to controlling glucose levels
  - Renal function assessment required
- Awareness is Key
  - Glyburide has highest reported incidence of hypoglycemia of the orals
  - Highest risk:  $\geq 65$ yo, CKD 4, concurrent insulin use

# Oral Hypoglycemics

- Metformin
  - First line therapy for the majority of type 2 patients
  - Hypoglycemia is rare if monotherapy
  - Enhances insulin's effect
  - Traditionally hold upon admission
    - Renal – CrCL <30ml/min or a drop below 45ml/min
    - Hypoxia – COPD, CAP, CHF, PE
    - Contrast media – CT scans

# Oral Hypoglycemics

- “New” classes
  - DPP-4 inhibitors
  - SGLT2 inhibitors
- Limited data on use for inpatient management
- Have moved to second line therapy per guidelines
- Moving target with adverse events
  - New HF concerns with DPP-4s
  - New cases of ketoacidosis with SGLT2s

# Concerns with Oral Hypoglycemics

- Most are held upon admission
  - NPO secondary to.....
  - Decreased appetite
  - Acuity/Emergent situations
  - CT scan with contrast
  - Procedures/Surgeries
- Documentation errors with dosing
- Timing errors in relation to meals
- Poor medication reconciliation at admission
- AKI/CKD changes clearance rate

# Injectable Hypoglycemics

- GLP-1 Analogues
  - Exenatide
  - Liraglutide
  - Albiglutide
  - Dulaglutide
- Adjunct therapies
- Will promote hypoglycemia
- Are these usually held during inpatient stay?
- Newest ones are weekly dosing
- No role in ICU setting

# Injectable Hypoglycemics

- Insulin: The Bad Boy of Diabetes
  - Cornerstone of managing glucose both in and outpatient
  - Lifestyle altered during inpatient stay
    - Acutely ill
    - NPO
    - Dietary changes
    - Adherence enforced
    - Caloric intake monitored more closely
  - Transition from oral hypoglycemics to insulin
  - Is this the best management plan?

# Injectable Hypoglycemics

## Insulin

Pharmacokinetics of most commonly used insulin preparations

Insulin type	Onset of action	Peak effect	Duration of action
Lispro, aspart, glulisine	5 to 15 minutes	45 to 75 minutes	Two to four hours
Regular	About 30 minutes	Two to four hours	Five to eight hours
NPH	About two hours	4 to 12 hours	18 to 28 hours
Insulin glargine	About two hours	No peak	20 to >24 hours
Insulin detemir	About two hours	Three to nine hours	6 to 24 hours*

**Rapid (Prandial, Bolus)**

**Short (Prandial, Bolus)**

**Intermediate (Basal)**

**Long (Basal)**



# Insulin Glargine (Toujeo)

- Long-acting insulin analog but higher concentration of 300 u/mL vs 100 u/mL of Lantus
- Indication:
  - Type 1 or Type 2 Diabetes
- Dose:
  - Type 1 insulin naïve start 30-50% of total dose based on 0.2-0.4 u/kg
  - Type 2 insulin naïve start 0.2 u/kg
  - Changing insulin therapy requires a 1:1 conversion if once daily insulin + 10% increase
  - If BID insulin then only use 80% of dose for Toujeo
- Efficacy:
  - Noninferior to Lantus in lowering BS, does have a smaller depot and absorption is slower, allowing for a more consistent lowering
  - Takes up to 5 days to see effect, so dosing adjustments cannot happen daily
- Dosage Form:
  - Solostar pen with 1.5 mL lasting about 28 days
  - Cost \$335
  - Lantus is going generic soon but UHC will be converting all patients to this formulation by 2016

# Insulin Degludec (Tresiba)

- New insulin formulation that is latest attempt to find the most physiologic replacement for absent or insufficient basal insulin secretion
- Indication:
  - Type 1 and Type 2 Diabetes
- Dosing
  - Type 1 insulin naïve start 30-50% of total dose based on 0.2-0.4u/kg
  - Type 2 insulin start 10 units/day
  - Already on insulin it is a 1:1 conversion of daily doses
- Efficacy
  - True once a day insulin that can be given at any time of the day with titration every 3-4 days
  - Non-inferior to other insulins – not any better efficacy but more convenient for dosing
  - Appears to have less hypoglycemia than other “long-acting” insulins
- Dosage forms:
  - 300 u (110u/mL) pens with 5 pens per pack
  - 600 u (200u/mL) pens with 3 pens per pack
  - \$440-530 per pack

# Injectable Hypoglycemics

## Insulin Gets Under Your Skin

	Regimen Tracts			
Dose	Low (DM I, Lean DM II)	Standard (Normal weight DM)	Moderate (Overweight DM)	Aggressive (Obese DM)
Total Daily Dose (TDD)	0.3 units/kg/day	0.4 units/kg/d	0.5unit/kg/d	0.6unit/kg/d
Basal	$\frac{1}{2}$ TDD			
Prandial	$\frac{1}{2}$ TDD divided into 3 meals			
Correction Scale	It should be the same rapid/short acting insulin as used for prandial insulin			

# Injectable Hypoglycemics

## Insulin Correction Dosing

	Regimen Tracts			
Dose	Low (DM I, Lean DM II)	Standard (Normal weight DM)	Moderate (Overweight DM)	Aggressive (Obese DM)
Total Daily Dose (TDD)	0.3 units/kg/d	0.4 units/kg/d	0.5unit/kg/d	0.6unit/kg/d
161-200	1 units	2 units	3 units	4 units
201-250	2 units	4 units	5 units	6 units
251-300	3 units	6 units	7 units	8 units

# Insulin: Unit by Unit

- More aggressive dosing
  - 0.6-0.8 units/kg/day doubled the odds of hypoglycemia
  - 0.2-0.6 units/kg/day is a better range
- Caution in renal impairment
  - CrCl <45ml/min
  - Use 50% of suggested dosing
- Main reason see events
  - Failure to continue preadmission regimen with added SSI

# Insulin: Unit by Unit

- ICU
  - Continuous IV insulin infusions preferred
  - Allows for rapid dosing adjustments
  - Protocol driven
  - Need transitioned to SC insulin as leave unit
- Transition to medical floor
  - Take 75-80% of total daily IV dose
  - Divide into basal and prandial dosing (50/50)
  - May need supplemental doses (SSI)
  - Give first SC dose 1-4 h before D/Cing infusion

# Common Knowledge: Insulin is High Maintenance

- Errors occur with every step of the process
  - Prescribing
  - Data Entry (CPOE)
  - Preparation
  - Dispensing
  - Administration
  - Patient counseling
  - Transitions of care
- Patient's evolve during their inpatient stay

# What Are Our Goals?

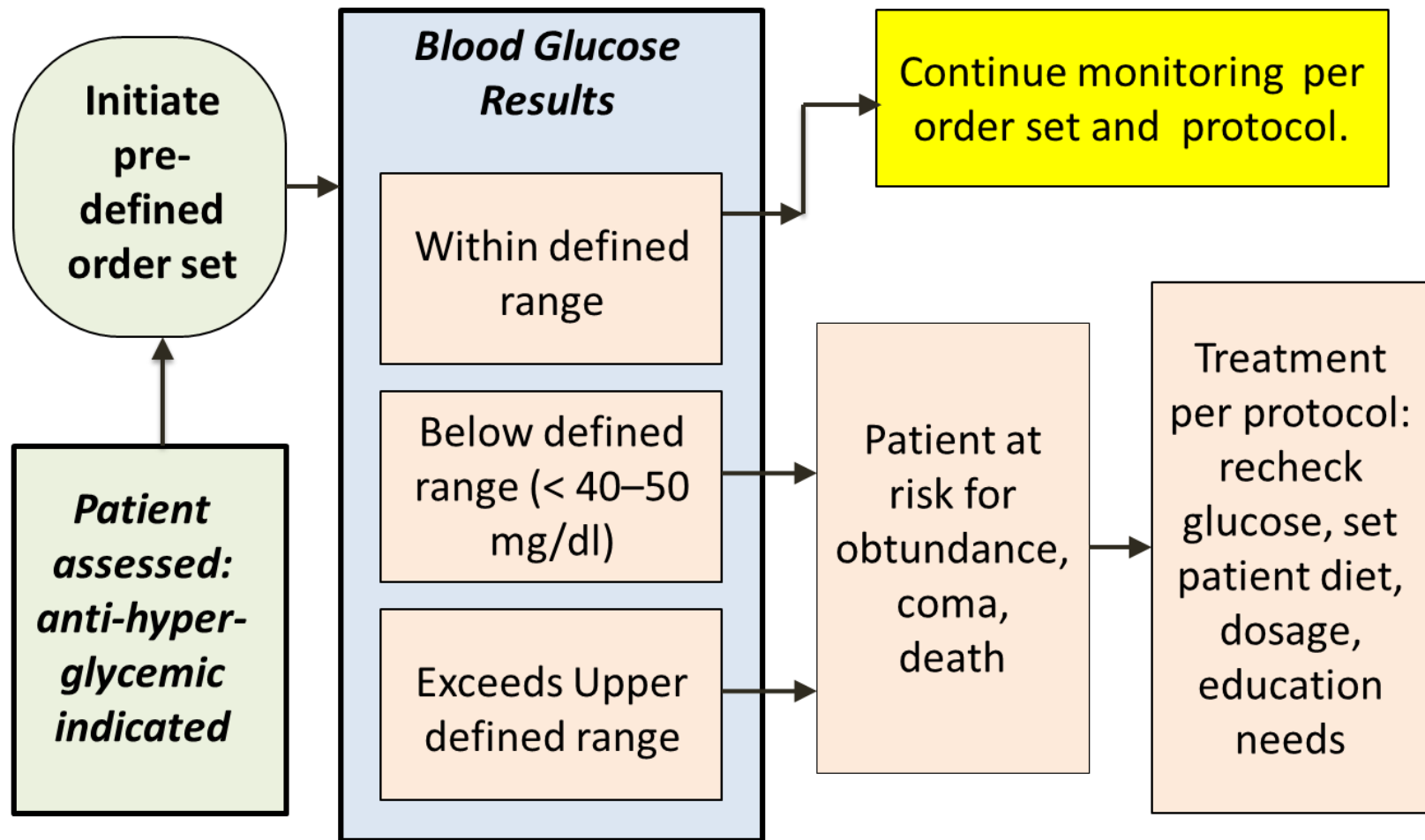
- Initiative is avoiding BG <40-50mg/dl
- Per AACE/ADA Consensus statement 2009
  - ICU
    - BG goal 140-180mg/dl
    - Avoid <100mg/dl
  - Medical Floors
    - Pre-meal <140mg/dl
    - Random <180mg/dl
    - Avoid <100mg/dl



# Euglycemia = Utopia

- Hyperglycemia is linked to poor outcomes as well
- Especially true in the critically ill
  - Sepsis
  - Post-op
  - Post MI
- Prolong hospital stay
  - Slower resolution of infections
  - Disabilities after discharge
  - Mortality

# ADE Target Zone: Hypoglycemic Agents



# STRATEGIC PLANNING

# Finding the Sweet Spot

## Key Components of Glycemic Control Program

Solid administrative support	Multidisciplinary team/committee	Assessment of current processes, care and barriers	Development and implementation of order sets, protocols, policies, and educational efforts	Metrics for evaluation
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# Administrative Support

- Recruit and train qualified personnel
  - Pharmacists on the floors/ICUs
  - Intensive training for nurses and staff
- IT support
  - CPOE capabilities
  - Outcome tracking capabilities
  - TCM templates with Med Rec documentation
- Open minded to new ideas
  - Nontraditional
  - Focus on outpatient care
  - Preventative aspect

# Administrative Support

- Follow the money
  - Readmission rates
  - LOS
  - Reduction in morbidity
- Engaging various departments
  - Hospitalists/Critical Care Units
  - Emergency Department(s)
  - Endocrinologists
  - Nursing
  - Pharmacy
  - Nutrition support/Dietetics

# Multidisciplinary Committee

- Team Players

- Patients

- Nurses

- CDEs

- NP/PAs

- Care managers/Social  
Workers

- Pharmacists

- Administrators

- IT experts

- Physicians

- Dietitians/Nutrition  
experts

# Multidisciplinary Committee

- Chair and reporting structure need defined
- Brainstorm Goals
  1. Define when continuing oral therapy is appropriate
  2. Increase appropriate use of basal and prandial insulin
  3. Decrease SSI use
  4. Avoid hypoglycemic events
  5. Create protocol for meals in relation to medication dosing, testing, procedures, etc
  6. Decrease secondary complications
  7. Decrease LOS and readmission rate
  8. Patient/Caregiver education
  9. Smooth TCM at discharge



# Assessing Your Current System

- Where are current gaps in care?
  - Changes in caloric intake and/or clinical status
  - Addition or D/C of medications
  - Failure to adjust to daily BG patterns
  - Prolonged use of SSI as monotherapy
  - Poor coordination of testing and administration of medications
  - Poor communication for TCM
  - Use of long-acting SU in elderly patients
  - Prescribing Errors – electronic vs. paper
  - Poor medication reconciliation

# Updating the System

- Overhaul protocols
  - Accurate medication history at admission
  - Real time alerts to flag response to Insulin dosing
  - Goal BS based on unit and patient population
  - Nutritional changes should have real time alerts attached to protocols/order sets
  - SSI consistently used with basal insulin
  - Coordination of meals with prandial insulin
  - TCM plan is initiated at admission and documented

# Updating the System

- Overhaul protocol
  - Optimal frequency of BS testing based on nutrition and patient characteristics
  - POC vs. lab monitoring of BS
  - Leveraging IT such as CPOE safeguards/Ease of use
  - Smart Pump technology
  - Automated dispensing cabinet protocols
  - Renal and hepatic status documented
  - Identify inappropriate medication use
  - TCM handoff protocols with follow up plan

# Updating the System

- Impact from Department of Pharmacy
  - Every DM patient should be touched by a pharmacist
  - Add board certified pharmacists to medical floors and ICU
  - Creatinine Clearance on every patient
  - Manage formulary of insulin products
  - Oversee safeguards to avoid confusion with all insulin products
  - All long acting insulin doses prepared in pharmacy
  - Advocating smart pump technology
  - Order verification for ADCs
  - Medication Reconciliation with each step

# Updating the System

- Impact from Department of Pharmacy
  - Oral hypoglycemia protocols
  - System to ID drugs affecting BS
  - Nutrition status sent to pharmacy
  - Focus on elderly patients
    - BEERS list
    - START/STOPP materials
  - When NOT to dispense a drug
  - Concierge Services
  - Discharge counseling/TCM coordination

# Updating the System

- Educational Opportunities
  - Patient engagement is crucial
    - Healthcare literacy level
    - Adherence with treatment plan
    - Self monitoring with goals
    - Understanding of hypo and hyperglycemia
    - Follow up with outpatient provider
    - Nutrition status and eating patterns
    - Administration of DM medications
    - Sick day management
    - Proper use and disposal of needles

# Updating the System

- Educational Opportunities
  - Provider education
    - Current protocol goals
    - SSI is not a maintenance dosing option
    - Types of insulin available
    - NPO status changes insulin dosing
    - Frequency of BS monitoring that is needed
    - Renal function assessment on ALL patients
    - Engage and utilize team members
    - Interprofessional communication

# Updating the System

- Educational Opportunities
  - Provider Education
    - Aware of BEERs list and START/STOPP initiative for elderly patients
    - Oral medications may not need to be held
    - Care does not stop at discharge
    - Assess and address patient's healthcare literacy level
    - Report ADEs
    - Patients come first, not politics – specialist are responsible for BS goals as well



# Updating the System

- Educational Opportunities
  - Nursing Staff Education
    - Included in orientation training
    - Training sessions WITH refresher courses
    - Input into protocols
    - Creation of practice standards
    - Order sets standardized within CPOE
    - CQI process
    - Team leaders to role model

# Updating the System

- Educational Opportunities
  - TCM
    - System in place to relay information
    - Make appointment(s) for patient at discharge
    - Ensure sufficient quantities of all medications and/or provide prescriptions when medication reconciliation is completed
      - Medication reconciliation
      - Concierge discharge team
    - Communication with family concerning plan
    - Anticipate evolution of health and counsel on steps to take to control BS

**FOCUS ON  
IMPROVEMENTS  
NOT DATA  
COLLECTION**

# Creating Metrics

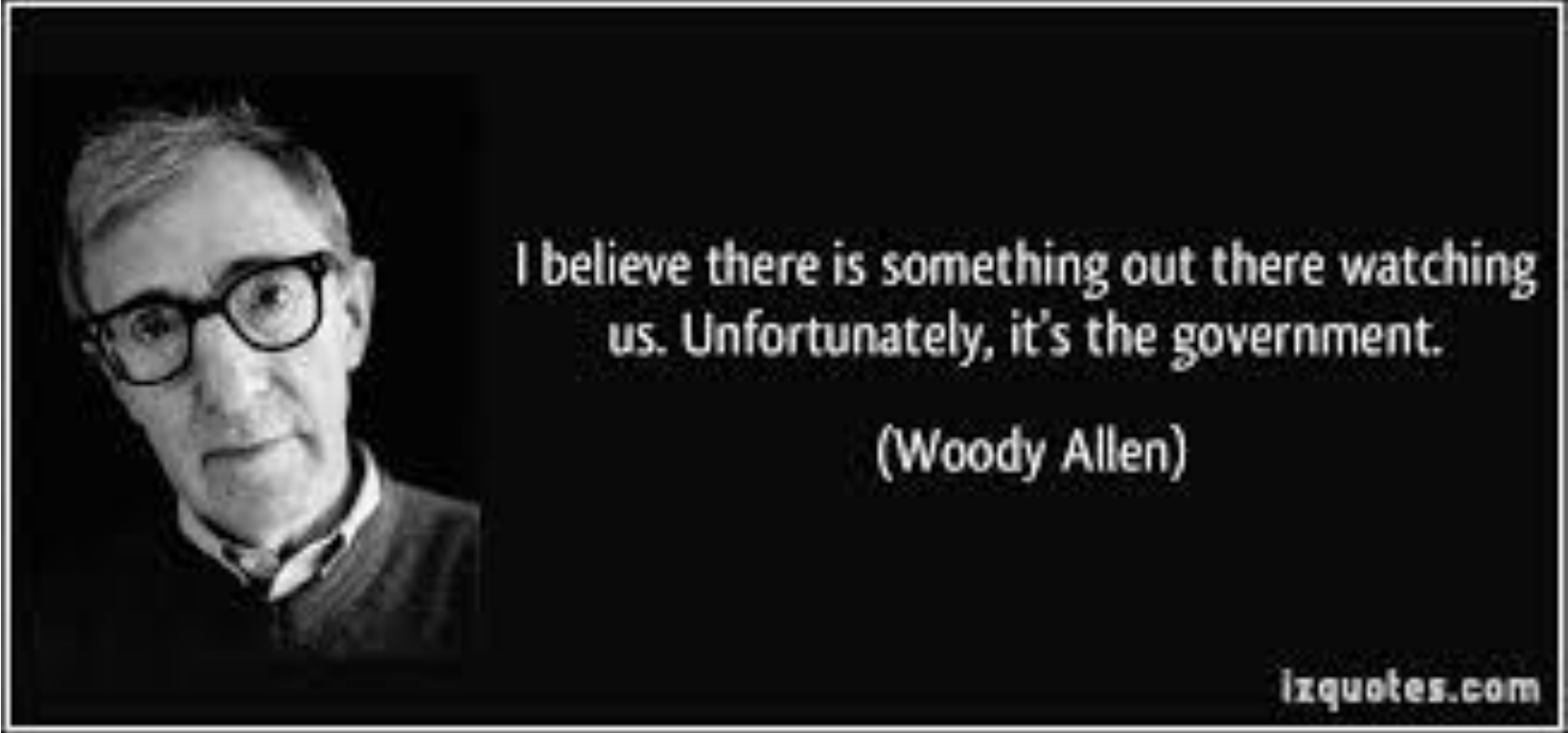
- Setting measurable parameters
  - Utilization of order sets/protocols/clinical decision trees
  - Decrease in SSI orders
  - CKD status for every patient
  - Percent of patients with BS reading <40mg/dl
  - Documentation of “rescue” glucose doses
  - Readmission rates for select patients
  - LOS altered by BG management

# Creative Metrics

- Continuing education for all clinical staff
- Learning modules specific to clinical duties
- Performance assessments of prescribers
- Patient satisfaction scores
- Estimated average glucose during admission
- Number of units of “rescue” medications dispensed
- Readmission rates
- Patient adherence with follow up appointments

# Metrics Being Created

- Action plan was released Summer 2014
- Outlined active collection of standardized data
  - ADE targeting for each class
  - Necessary surveillance and prevention
  - Best Practice example:  
<http://www.mnhospitals.org/patient-safety/current-safety-quality-initiatives/adverse-drug-events>
  - Gap analyses that is comprehensive



I believe there is something out there watching us. Unfortunately, it's the government.

(Woody Allen)

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