# CLINICAL PRACTICE GUIDELINES FOR THE INPATIENT MANAGEMENT OF DIABETES/HYPERGYLCEMIA IN ADULTS

## Goals/Recommendations for Improving Diabetes Care in Delaware Hospitals

1. Improve outcomes by optimizing glycemic/metabolic control
2. Improve methods for glucose monitoring: Intensive insulin therapy should maintain blood glucose at or below 110 mg/dL to reduce morbidity and mortality. (Table 1)
3. Support intravenous insulin infusion for achieving metabolic control during surgery, hemodynamic instability and NPO status and for patients with poorly controlled diabetes or fluctuating blood glucose levels
4. Raise the level of awareness with respect to the unique challenges of diabetes and current standards of care
5. Establish Diabetes Multidisciplinary Team in each hospital consisting of community physicians, hospitalists or resident physician, Registered Dietitians Certified Diabetic Educator, pharmacist, laboratory personnel, staff and anesthesiologist to:
   - Develop protocols for pre-printed orders and insulin infusion algorithms that focus on glycemic control.
   - Develop unit-based protocols for specific guidelines to identify patients at risk for hypoglycemia and actions to be taken to prevent and treat hypoglycemia.
   - Establish policies allowing capable patients to continue self-management of their diabetes in conjunction with the hospital quality assurance program to assure patient safety.
   - Establish policies allowing for adjustments and appropriate provisions of diabetes care including accurate and timely delivery of meal trays, consideration for use of equipment and drugs that already belong to the patient and the administration of diabetes medications.
   - Discourage pre-mixed insulin and sliding scale orders as the only means of management of hyperglycemia; encourage standing dose/scheduled insulin combined with supplemental or correction insulin scale.
   - Incorporate diabetes education, medical nutrition therapy and timely diabetes-specific discharge planning into hospital-based diabetes care [1].
6. Encourage Diabetes Patient Self Management- Allow capable adult patents to continue insulin self-administration and glucose monitoring in hospital as an adjunct to standard nurse delivered diabetes management when appropriate.
7. Focus on discharge planning early and often. Provide opportunities for patients/caregivers to enhance skills during hospitalization allowing patients to return home safely.
8. Refer to outpatient education for follow-up teaching

*Individual hospitals and their medical staffs, should determine the specifics of implementing these guidelines*

**(Table 1) Upper Limits for Glycemic Targets**

***Source: American College of Clinical Endocrinology Position Statement***

| **Intensive care unit** | **Preprandial** Non-critical care units | **Maximal glucose** Non-critical care units |
|---|---|---|
| 110 mg/dL (6.1 mmol/L) | 110 mg/dL (6.1 mmol/L) | 180 mg/dL (10.0 mmol/L) |

**(Table 2) Upper Limits for Glycemic Targets in Pregnancy**

| **Preprandial *Pre-labor*** | **1-hour postprandial *Pre-labor*** | **Labor and delivery** |
|---|---|---|
| 100 mg/dL (5.6 mmol/L) | 120 mg/dL (6.7 mmol/L) | 100 mg/dL (5.6 mmol/L) |

## Achieving Targeted Blood Glucose levels in the hospital

I. **Oral diabetes agents** *(Significant limitations for inpatient use)*
   - **Sulfonylureas-** Should be used cautiously due to concerns of cardiovascular effects, long action and predisposition to hypoglycemia in patients not consuming their normal nutrition
   - **Metformin-**In general, metformin will be contraindicated during acute illness as there are concerns regarding radiologic procedures and other interventions that could impair renal function

This Clinical Practice Guideline was developed by the Medical Society of Delaware's Uniform Guideline Physician Committee for Inpatient Diabetes Care. The guideline is **Not** intended to replace clinical judgment and **Not** intended to establish a protocol for all patients admitted to a hospital with a diagnosis of diabetes/hyperglycemia but should be utilized for the management of routine patients and modified for patient-specific clinical indications.

- **Thiazolidinediones-** Thiazolidinediones are generally not useful in achieving target glucoses during an acute hospitalization and therefore not recommended for acute therapy. They may be quite useful for certain patients in addressing insulin resistance with the benefit to the patient occurring as part of chronic diabetic management.

*Most patients benefit from temporary conversion to subcutaneous or intravenous insulin therapy or by the addition of insulin to oral agents*[2]

## II. Insulin Use

Daily insulin dose requirements must be matched to the specific clinical needs of the acute individual patient vs. the medically stable population

### 1. Subcutaneous (SQ) insulin therapy:

- **Programmed/Scheduled insulin** [1]**:** Orders should include dose(s) required to cover both **basal** and **prandial/nutritional** needs.
  - **Basal** insulin requirement refers to the amount of insulin necessary to prevent unchecked preprandial or fasting gluconeogenesis and ketogenesis.
  - **Prandial** (mealtime)/nutrition insulin requirements for normal meals or the amount of insulin necessary to cover intravenous dextrose, TPN, enteral feedings, nutritional supplements or discrete meals
- **Supplemental/Correction-insulin:** Refers to the insulin used to treat hyperglycemia that occurs before meals, between meals or to correct hyperglycemia in the NPO patient

*(If correction doses are required frequently, scheduled doses should be changed the following day to accommodate the increased insulin needs)*

### 2. Intravenous (IV) Insulin Therapy *using regular insulin* gives the greatest flexiblity to achieve glycemic control and nonglycemic patient outcomes :

***Preferred in the following clinical indications among non-pregnant adults, but are not limited to:***

- Critical illness
- Diabetic ketoacidosis & nonketotic hyperosmolar state
- Postoperative period following heart surgery
- Stroke
- MI or cardiogenic shock
- Following organ transplantation
- Prolonged NPO (nothing by mouth) status in patients who are insulin deficient
- Total parenteral nutrition therapy
- Elevated glucose exacerbated by high-dose glucocorticoid therapy
- Dose-finding strategy prior to conversion to (SQ) insulin therapy in type 1 or type 2 diabetes
- Other illnesses requiring prompt glucose control
- Intra-operative and postoperative care
- Critically ill surgical patients requiring mechanical ventilation

**Additional Protocols for IV insulin include**:

- Insulin infusion is prepared with regular insulin in a solution of one (1) unit per (1) ml IV fluid
- Blood Glucose (BG) monitoring hourly until stability of BG level demonstrated for several hours until stable, then reduced to every 2 hours if BG remains in the desireable range (110-120mg/dl)
- Increase testing to every one hour if BG >120 in severely ill patients
- Call doctor if (2) two consecutive blood sugar readings are <80
- Call doctor if (4) four readings are > 120 (ICU) or 130 (non-ICU)

**Before discontinuing IV insulin infusion:**

- Administer short- or rapid acting subcutaneous insulin 1-2 hours prior to dicontinuing IV infusion allowing enough time to pass for insulin action to begin
- In general, make certain that patient is able to tolerate PO intake before discontinuing IV insulin
- Write orders for alternative glycemic management

## Comprehensive Diabetic Review

***Document the following elements if any impact on the current medical decision:***

- Determine patients with insulin deficiency: Clinical characteristics include [1]
  a) Known type 1 diabetes
  b) History of pancreatectomy or pancreatic dysfunction
  c) History of wide fluctuations in blood glucose levels
  d) History of diabetic ketoacidosis
  e) History of insulin use for > 5 years and/or a history of diabetes > 10 years
- Physical exam with particular attention to diabetes-associated and other related findings including current height/weight and weight history
- History of diabetes management
- Diabetes Type: Type I or Type 2; medication induced and/or stress hyperglycemia
- Current control as good, poor or unknown
- Document symptoms of diabetes-related complications or co-morbidities
- Pre-admission medications: PO and insulin (type & dose)

### Initial Orders

- Initial antihyperglycemic therapy should include:
  -Pre-admission medication plan if appropriate
  -Evaluation of appropriateness of maintaining ambulatory medication plan and/or
  -Temporary conversion to subcutaneous or IV insulin therapy
- Bedside Blood Glucose (BG) monitoring
- Insulin coverage for elevated BG levels
- Diet Order: Carbohydrate controlled and other restrictions as guided by the concurrent illness
- Pneumococcal vaccine if appropriate
- Influenza vaccine if appropriate (Oct-Feb only) at time of discharge

### Lab Testing

- BG level for every patient on admission
- If indicated, baseline A1c, urine albumin, serum creatinine, TSH and lipid panel if not done in the past year

### Medical Nutrition Therapy

**(*Consistent diabetes meal-planning system*)**

- Assessment of actual intake to determine appropriateness of diet
- Carbohydrate controlled meal plan
- Patients who receive clear or full liquid diet should receive approx 200 grams carbohydrate per day. Liquids should not be sugar-free.
- Nutrition consult for patients with decreased intake or need for alternate feeding modality
- Accurate timing of meals

### Self-Management decisions vs. Provider-directed orders

- Physician and patient along with nursing staff should agree that patient self-management is appropriate
- Assess patient's capability to conduct self-management of diabetes
  - Alert, stable level of consciousness and reasonably stable condition; able to make accurate decisions on insulin dose and have adequate oral intake
  - Demonstration of safe insulin administration and glucose monitoring
  - Perform simultaneous laboratory measured capillary or venous blood test and patient performed blood glucose test. Capillary blood glucose test should be ± 15% of the laboratory test
  - Physical skills appropriate to successfully self-monitor blood glucose
  - Consideration should be given to permit self-use of equipment and drugs already in the possession of the patient
- Physician orders for self-management should include selection of food from a general diet, self-monitoring of BG, self-determination of insulin doses and administration of insulin
- Encourage the patient to participate in care when appropriate

Documentation/charting of self-medications including insulin doses and BG monitoring by nursing staff

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***Compiled From*:**

1. Clement. S. et all Management of Diabetes and Hyperglycemia in hospitals. Diabetes Care 2004: 27(2) 553-591
2. Campbell, K.B., Braithwaite, S.S. Hospital Management of Hyperglycemia. 2004. Clinical Diabetes: 22 (2) 81-88.
3. American College of Endocrinology Position Statement on Inpatient Diabetes and Metabolic Control* ENDOCRINE PRACTICE 2004: 10 (1) *By the American College of Endocrinology Task Force on Inpatient Diabetes and Metabolic Control. Presented at The National Press Club, Washington, DC, December 16, 2003*

## Ongoing Hospital Management

### Education/Discharge Planning

- Discharge planning should be initiated well in advance of discharge; identify the patient who needs teaching on admission
- Newly recognized diabetes requires diabetes self-management education
- Explore community resources and arrange for follow-up comprehensive outpatient diabetes self-management training as needed.
- Assessment of home care resources including competence of caregivers
- Assessment of financial constraints to carry out diabetes self-care, including acquiring diabetes supplies and insulin
- Include "call parameters" that would capture a downward or upward trend of blood glucose as well as the need for urgent intervention.
- Patients with no prior history of diabetes who are found to have hyperglycemia during hospitalization should have follow-up testing within one month of hospital discharge

### Preventing Hypoglycemia:

***Hypoglycemia is the leading barrier to normoglycemia.*** Most episodes of hospital hypoglycemia are predictable and therefore should be preventable.

Conditions creating high risk for hypoglycemia include:

- Sudden reduction of corticosteroid dose
- Discontinuing enteral feedings
- Discontinuing TPN or intravenous dextrose
- Altered patient ability to self-report symptoms
- Sudden/new NPO status or reduction in oral intake
- Insulin given at the wrong time relative to meal delivery
- Emesis
- Pre-meal insulin given and meal not ingested
- Use of sulfonylureas in patients with renal impairment
- Unexpected transport from nursing unit after administration of rapid-action insulin

### Protocols and Standing Order Examples (See Appendix)

*Use of diabetic Pre-printed orders and Insulin Algorithms reduces errors*

- Hospital Hypoglycemia Protocol
- Insulin order forms should prompt physicians to address all (3) components of insulin therapy
  - Basal Insulin
  - Prandial and/or nutritional insulin
  - Correctional or supplemental subcutaneous insulin
- Method to monitor effectiveness and improvement

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