Safety Concerns With Insulin Use in the Inpatient Setting: The Pharmacist’s Role
Pharmacist’s Role in the Safe Use of Insulin in the Inpatient Setting

- Minimizing medication errors
- Discouraging the use of sliding scale insulin
- Development of treatment protocols
- Formulary decision-making
- Supporting the education of patients in advance of discharge

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Hospital Pharmacists: Key Areas of Understanding

- Treatment goals
- Treatment options
- Treatment protocols
- Potential medication errors and methods to reduce errors
- Importance of pharmacy’s role on the multidisciplinary team to ensure safe and effective management of hyperglycemia in the hospital setting

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Insulin Use in the Hospital

• Preferred tool to manage inpatient hyperglycemia
  – Most potent agent with which to lower blood glucose
  – Rapidly effective
  – Easily titrated
  – Relatively no contraindications to use

• Limitations
  – Narrow therapeutic range
  – High-alert drug for safety issues
  – Consistently implicated in reports of preventable patient harm in hospitals
    • Main concern: risk of severe hypoglycemia

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Insulin Therapy: Safety Concerns

- The Joint Commission considers insulin 1 of the 5 highest-risk medicines in the inpatient setting\(^1\)
  - The consequences of errors with insulin therapy can be catastrophic
- Insulin is consistently implicated in causing severe adverse events in hospitals through reporting systems maintained by USP and ISMP\(^2\)


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Common Types of Medication Errors Associated With Insulin Therapy

- **Transcription errors**
- **Dispensing errors**
- **Administration errors**

- **Insulin omission**
  - Leads to hyperglycemia
  - Poor outcomes including increased risk of mortality

- **Improper dose or quantity of insulin**
  - Leads to hyperglycemia or hypoglycemia
  - Hyperglycemia $\rightarrow$ ketoacidosis
  - Hypoglycemia $\rightarrow$ range of symptoms from nausea to falls to increased risk of myocardial ischemia


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Types of Medication Errors

• Prescription transcription errors
  – Illegible orders
  – Missing or misplaced zeros and decimal points
  – Use of unsafe abbreviations
  – Unintended drug ordered based on variety of drug formulations

Types of Medication Errors

- Dispensing errors
  - Look alike/sound alike medications
  - Incorrect preparation
  - Accessibility as floor stock
  - Nonstandard compounded IV solutions and infusion rates

Types of Medication Errors

• Administration errors
  – Incorrect drug, dose/infusion rate, or timing
  – Medication given to the wrong patient
  – Incorrect administration technique, route
  – Omission errors or extra doses given
  – Lack of drug monitoring
  – Lack of double-checking

## Potential for Insulin Dosing Errors Using Infusion Protocols

### Potential Errors
- Multiple optional starting points
- Lengthy instructions
- Complex mathematical calculations
- Potential errors from frequent insulin dosage adjustments
  - Misinterpretation of how to use the protocol
  - Ordered for or administered to incorrect patient
  - Failure to recognize a new order
  - Miscalculations
  - Transcription errors
  - Frequent alert alarms, leading to desensitization and delays in testing

### Solution Strategies
- Increase use of user-friendly protocols
- Increase staff education on insulin infusion protocols
- Use computerized provider order entry systems and tools
- Establish multidisciplinary task force to oversee glycemic control in institution
Insulin Storage Practices Recommended to Reduce Risk for Insulin Error

- Remove unusual concentrations (e.g., Humulin® R U-500) from patient care areas
- Store insulin and heparin separately on nursing units and in the pharmacy
- Store insulin syringes apart from tuberculin syringes and remove tuberculin syringes from nursing units, if possible
- Label insulin vial with patient’s name and vial expiration per institutional guidelines
- Conduct unit inspections to ensure proper labeling and disposal per institutional guidelines
- Do not dispense insulin in original carton, or discard carton upon dispensing or delivery to nursing unit
- Provide ongoing education and oversight to assure insulin pens are not shared between patients and that cartridges are not used to prepare insulin doses with a conventional insulin syringe

## Medical Abbreviations to Avoid

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Intended Meaning</th>
<th>Misinterpretation</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT</td>
<td>Bedtime</td>
<td>b.i.d. (twice daily)</td>
<td>Use bedtime</td>
</tr>
<tr>
<td>cc</td>
<td>Cubic centimeters</td>
<td>U (units)</td>
<td>Use mL</td>
</tr>
<tr>
<td>D/C</td>
<td>Discharge or discontinue</td>
<td>Medications discontinued prematurely when term is intended to mean “discharge”</td>
<td>Use discharge or discontinue as intended</td>
</tr>
<tr>
<td>IU</td>
<td>Injection</td>
<td>i.v. or i.j. (intrajugular)</td>
<td>Use injection</td>
</tr>
<tr>
<td>HS</td>
<td>At bedtime</td>
<td>Half-strength</td>
<td>Use at bedtime</td>
</tr>
<tr>
<td>IU&lt;sup&gt;b&lt;/sup&gt;</td>
<td>International unit</td>
<td>i.v. or 10</td>
<td>Use units</td>
</tr>
<tr>
<td>q.d. or QD&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Daily</td>
<td>q.i.d (four times daily)</td>
<td>Use daily</td>
</tr>
<tr>
<td>Qhs</td>
<td>Nightly at bedtime</td>
<td>q hr (every hour)</td>
<td>Use nightly</td>
</tr>
<tr>
<td>qn</td>
<td>Nightly or at bedtime</td>
<td>q h (every hour)</td>
<td>Use nightly or at bedtime</td>
</tr>
<tr>
<td>q6PM etc.</td>
<td>Every evening at 6 p.m. daily</td>
<td>Every 6 hours</td>
<td>Use daily at 6 p.m.</td>
</tr>
<tr>
<td>Sub q</td>
<td>Subcutaneous</td>
<td>q understood as meaning “every” (e.g., “sub q 2 hours before surgery” interpreted as “every 2 hours before surgery”)</td>
<td>Use subcut or subcutaneously</td>
</tr>
<tr>
<td>U or u</td>
<td>Unit</td>
<td>0, 4, or cc (e.g., 4U interpreted as 40, 44, or 4 cc)</td>
<td>Use unit</td>
</tr>
<tr>
<td>Trailing zero after decimal point (e.g., 1.0 mg)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1 mg</td>
<td>10 mg</td>
<td>Do not use trailing zeros for doses</td>
</tr>
<tr>
<td>No leading zero before a decimal point (e.g., .5 mg)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.5 mg</td>
<td>5 mg</td>
<td>Use zero before a decimal point when the dose is less than a whole unit</td>
</tr>
</tbody>
</table>


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U-500 Insulin

• When daily insulin requirements exceed 200 units/day
  – Volume of U-100 injected insulin may be problematic
  – Use of U-500 insulin (5 times more concentrated than U-100 insulin) may be appropriate

• Possible patients
  – Obstetrics patients
  – Patients receiving high-dose glucocorticoid therapy
  – Patients with type 2 diabetes, obesity, or severe insulin resistance

Addressing Safety Concerns About U-500 in a Hospital Setting: One Hospital’s Approach

- Home dose verification by a pharmacist or a CDE is required
- U-500 is not stocked or stored in automatic dispensing machines on the nursing unit
- When ordered, a 2-pharmacist order-entry process is followed
  - Total dose in units is entered
  - Computer converts to volume
- Pharmacist checklist and dispensing kit are stored with product
- Pharmacist hand delivers insulin to charge nurse and bedside nurse
  - Safety time out is taken to review drug, orders, and medication administration record
- Patient and staff education are provided

Current Recommendations for Hospitalized Patients

• All critically ill patients in intensive care unit settings
  – BG level 140-180 mg/dL
  – Premeal: <140 mg/dL
  – Intravenous insulin preferred

• Noncritically ill patients
  – Random: <180 mg/dL
  – Scheduled SC insulin preferred
  – Sliding-scale insulin discouraged

• Hypoglycemia
  – Reassess the regimen if BG level is <100 mg/dL
  – Modify the regimen if BG level is <70 mg/dL

BG, blood glucose.
Treatment Considerations for Management of Inpatient Hyperglycemia

- Non-insulin antihyperglycemic agents have a limited role in acute-care settings
- Practitioners should consider discontinuing them in favor of insulin during acute illness

Selection of an Insulin Infusion Protocol

• Ideal
  – Based not only on current level of glucose but also on rate of change of glucose, insulin sensitivity of patient
  – Easy to implement
  – Clear and specific directions for titration, blood glucose monitoring, and treatment of hypoglycemia
Safe Use of IV Insulin Therapy

- Insulin infusion concentrations and protocols should be standardized within a hospital.
- Staff should receive training on insulin infusion protocol, and competency should be assessed regularly.
- Accurate bedside blood glucose monitoring done hourly (and if stable, every 2 hours).
- Potassium should be monitored and given if necessary.

Essential Part of Any Insulin Use: A Hypoglycemia Protocol

• Clear definition of hypoglycemia
  – BG <70 mg/dL
• Nursing order to treat without delay
  – Stop insulin infusion (if applicable)
  – Oral glucose (if patient is able to take oral)
  – IV dextrose or glucagon (if patient is unable to take oral)
  – Repeat BG monitoring 15 min after treatment for hypoglycemia and repeat treatment if BG not up to target
  – Directions for when and how to restart insulin
• Document the incident
• Look for the cause of hypoglycemia and determine if other treatment changes are needed

BG, blood glucose.
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Standardize Insulin Therapy to Reduce Errors

- Single insulin infusion concentration
- Single insulin infusion protocol
- Guidelines for transitions: IV to SC
- Guidelines for special situations
  - Steroid therapy
  - Enteral nutrition
  - Parenteral nutrition
  - Patient transportation and other handoffs
  - Pre-procedure (NPO)
  - Hypoglycemia: BG <70 mg/dL
Standardize Operations of Pharmacist and Pharmacy Staff

- Prepare all insulin infusions within the pharmacy
- Double-check all insulin preparations against original order
- Use a standard insulin concentration to prepare infusion bags
- Verify diagnosis and indication for insulin
- Store insulin in high-alert bins, away from other drugs
- Alert staff about insulin-containing IV solutions by brightly labeling bag
- Prohibit acceptance of orders containing trailing zeros and “U” in place of “units”
- Use preprinted insulin order sets


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Educate Nursing and Support Staff

- Staff should demonstrate appropriate insulin administration techniques
- Familiarize staff with insulin order sets and protocols
- Educate staff on insulin products and formulary status
- Provide training on blood glucose monitoring
- Enforce backup checks by peers

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Implement Hospital-Wide Initiatives

- Use standardized insulin infusion protocols
- Transition to computerized physician order entry (CPOE) system or standardized medication orders
- Switch to electronic medical records
- Institute a medication error reporting system
  - Participate in multidisciplinary review process of all insulin-related events
  - Lead implementation of practice changes or protocol revisions to minimize insulin-related events
- Reevaluate hospital formulary
  - Include insulin delivery devices that have safety features, perform reliably, and are easy to administer
  - Request that the pharmacy and therapeutics (P&T) committee limits types of insulin on formulary and eliminates duplicate types
Adopt Diabetes Certification Standards

- Specific staff education requirements
- Blood glucose monitoring protocols
- Treatment plans for hyperglycemia and hypoglycemia
- Data reporting of incidences of hypoglycemia
- Patient education on diabetes management
- Identified program champion or team

Joint Commission. Advanced certification in inpatient diabetes.
Adopt Joint Commission Diabetes Certification Standards

- Certificate of merit awarded to hospitals that exemplify superior inpatient diabetes management
- Includes adoption of specific American Diabetes Association (ADA) protocols and initiatives to continually improve patient care and outcomes
Points to Consider

- What practices do you currently utilize in your hospital to promote a safe patient environment?
- Since insulin is a high-alert medication, what actions can your hospital take to address safety concerns surrounding its use?
Summary

- Insulin is the most appropriate agent for the majority of hospitalized patients
- Insulin is a high-alert medication
- For effective and safe use of insulin, institutions need to consider
  - Standardized pharmacy and practice operations
  - Education of nursing and support staff
  - Implementation of hospital-wide initiatives
  - Effective communication and collaboration among caregivers