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

Cohen MR. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S17-S21.

Kelly JL. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S9-S16.

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

Cohen MR. *Am J Health-Syst Pharm*. 2010;67(suppl8):S17-S21.

Kelly JL. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S9-S16.

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

Moghissi ES, et al. *Endocrine Pract.* 2009;15:353-369.

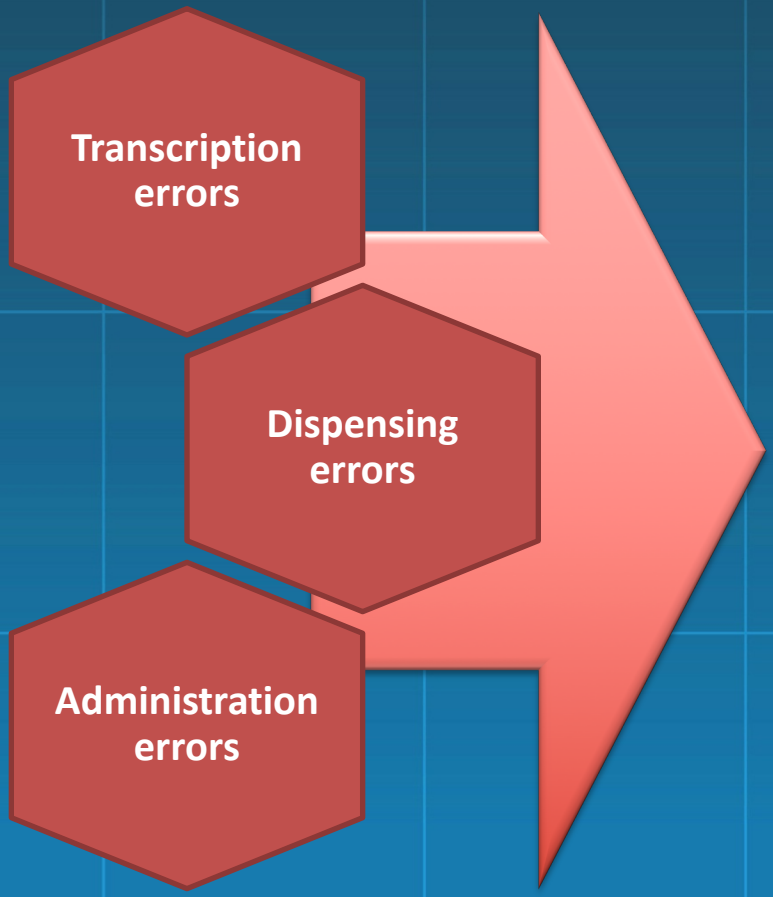
Insulin Therapy: Safety Concerns

- 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]

USP, US Pharmacopeia; ISMP, Institute for Safe Medication Practices.

1. JCAHO. *Int J Qual Health Care*. 2001;13:339-340.
2. ASHP; HAP. Use of insulin. http://www.ashp.org/s_ashp/docs/files/Safe_Use_of_Insulin.pdf.

Common Types of Medication Errors Associated With Insulin Therapy

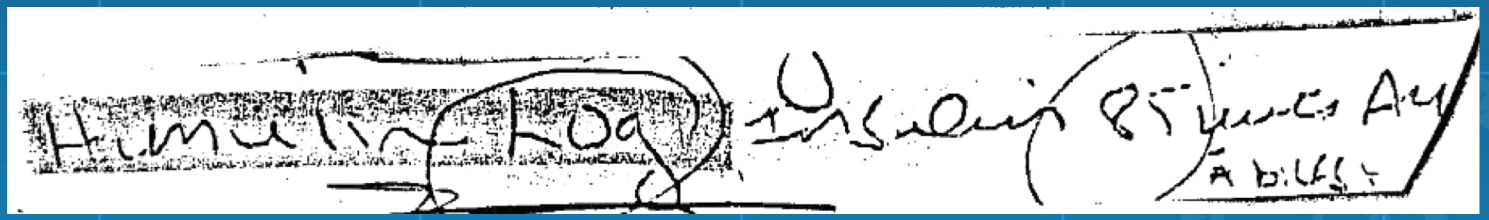


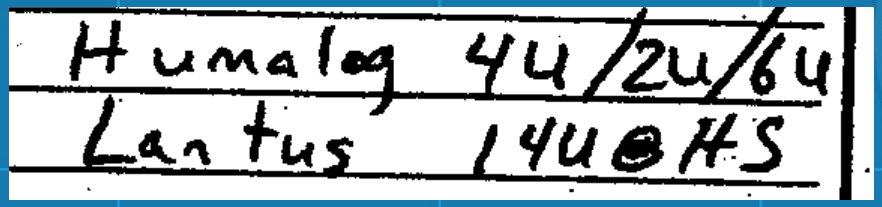
- Insulin omission
  - Leads to hyperglycemia
  - Poor outcomes including increased risk of mortality
- Improper dose or quantity of insulin
  - Leads to hyperglycemia or hypoglycemia
  - Hyperglycemia → ketoacidosis
  - Hypoglycemia → range of symptoms from nausea to falls to increased risk of myocardial ischemia

Cohen MR. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S17-S21.

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

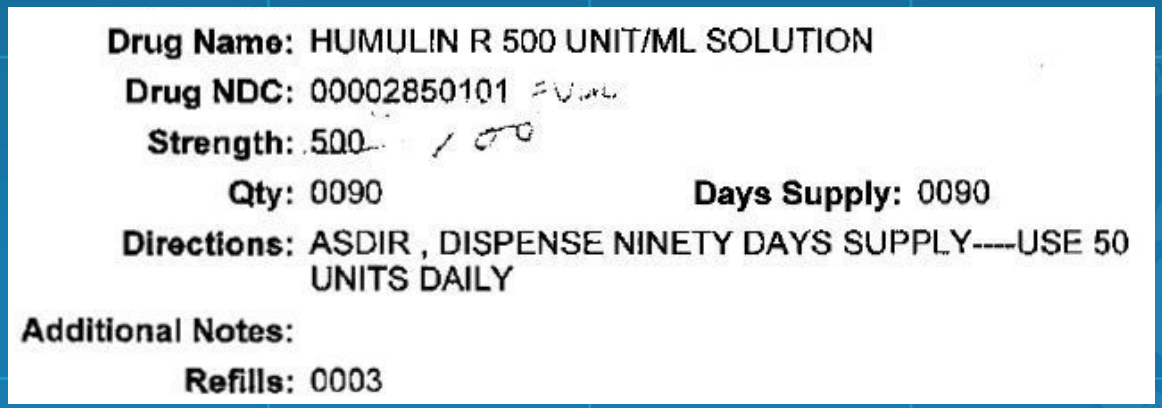




Jackson MA. *US Pharm*. 2003;28:69-79.

Types of Medication Errors

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



Drug Name: HUMULIN R 500 UNIT/ML SOLUTION
Drug NDC: 00002850101
Strength: 500
Qty: 0090 **Days Supply:** 0090
Directions: ASDIR , DISPENSE NINETY DAYS SUPPLY----USE 50 UNITS DAILY
Additional Notes:
Refills: 0003

Jackson MA. *US Pharm*. 2003;28:69-79.

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

Jackson MA. *US Pharm*. 2003;28:69-79.

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

Lee A, et al. *Intensive Crit Care Nurs*. 2010;26:161-168.

Insulin Storage Practices Recommended to Reduce Risk for Insulin Error

- Remove unusual concentrations (eg, 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

Cohen MR. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S17-S21.

Medical Abbreviations to Avoid

Medical Abbreviations to Avoid[a]

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

Cohen MR. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S17-S21.

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

Kelly JL. *Am J Health-Syst Pharm*. 2010;67(suppl 8):S9-S16.

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

Samaan KH, et al. *Am J Health Syst Pharm.* 2011;68:63-68.

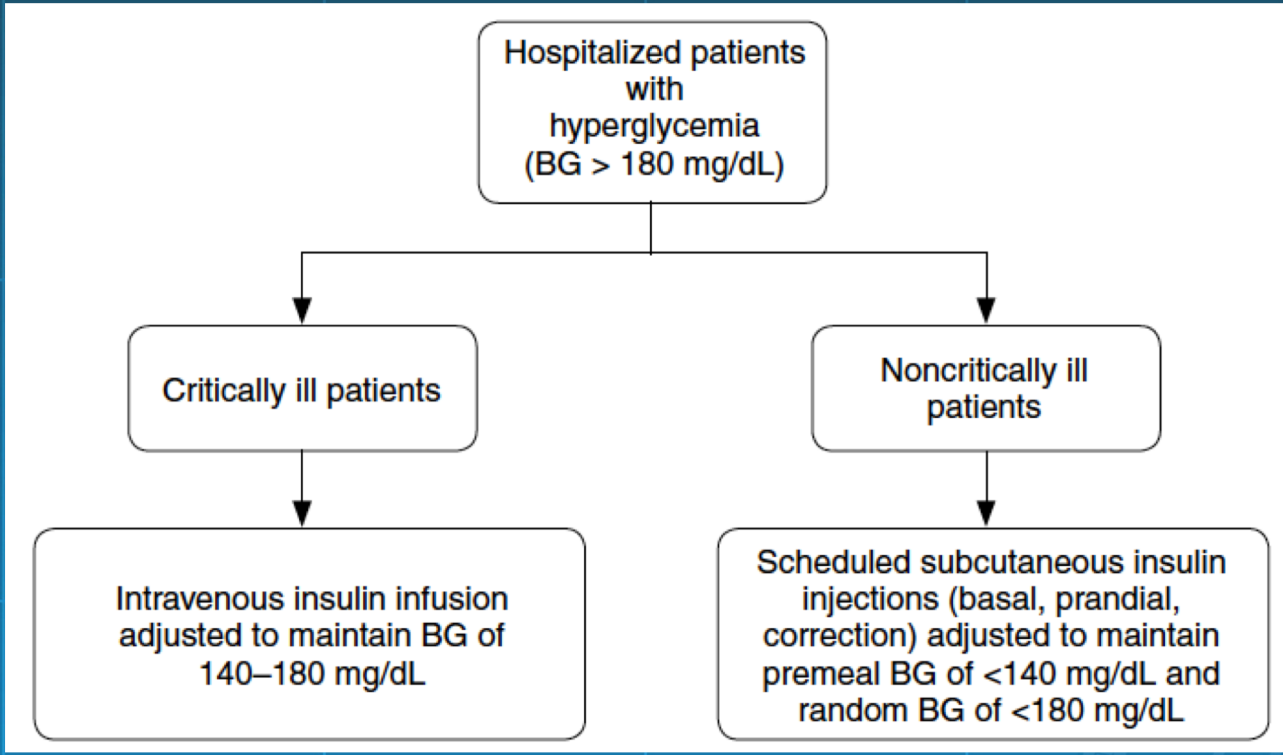
Current Recommendations for Hospitalized Patients

- 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.

Moghissi ES, et al. *Endocrine Pract.* 2009;15:353-369.
Umpierrez GE, et al. *J Clin Endocrinol Metab*. 2012;97:16-38.

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

Moghissi ES, et al. *Endocrine Pract.* 2009;15:353-369.

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

Clement S, et al. *Diabetes Care*. 2004;27:553-591.

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.

Moghissi ES, et al. *Endocrine Pract.* 2009;15:353-369.
Umpierrez GE, et al. *J Clin Endocrinol Metab*. 2012;97:16-38.

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

Moghissi ES, et al. *Endocrine Pract.* 2009;15:353-369.

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

Grissinger M. *P&T*. 2003;28:628.
ASHP; HAP. Use of insulin. http://www.ashp.org/s_ashp/docs/files/Safe_Use_of_Insulin.pdf.
ISMP. High-alert medications. http://www.ismp.org/Tools/highalertmedications.pdf.

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

ASHP; HAP. Use of insulin. http://www.ashp.org/s_ashp/docs/files/Safe_Use_of_Insulin.pdf.
PPSA. *PA-PSRS Patient Safety Advisory*. 2005;2:30-31.
Hellman R. *Endocr Pract*. 2004;10(suppl 2):100-108.

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

Hellman R. *Endocr Pract*. 2004;10(suppl 2):100-108.
ASHP; HAP. Use of insulin. http://www.ashp.org/s_ashp/docs/files/Safe_Use_of_Insulin.pdf.

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. http://www.jointcommission.org/certification/inpatient_diabetes.aspx.

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

Joint Commission. Advanced certification in inpatient diabetes. http://www.jointcommission.org/certification/inpatient_diabetes.aspx.

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