Reducing the risk of patient harm: A focus on insulin

New York State Partnership for Patients (NYSPFP) Initiative
Regional Educational Session
November 2013
Disclosure

Matt Fricker, Matt Grissinger, Christina Michalek, and Darryl Rich declare no conflicts of interest, real or apparent, and no financial interests in any company, product, or service mentioned in this program, including grants, employment, gifts, stock holdings, and honoraria.
Why Insulin?
Diabetes Facts

• Diabetes affects 25.8 million people of all ages
• **8.3% of the U.S. population!**
• Among those 65 years and older, 10.9 million (26.9 %) had diabetes in 2010
• 7 million undiagnosed
• Adults with type 1 or type 2
  – 12% take insulin alone
  – 14% take both insulin and oral medication
  – Hospitalized non-diabetic patients
    • use insulin to treat hyperglycemia in critical care
1975

• Error 1

• An order was written “4 U NPH insulin”

• Because of poor handwriting, the “U” was mistaken for an “0”

• The patient received 40 units of NPH insulin

• Recommendation: the abbreviation “U” should not be used; the word “units” should be spelled out

A Little History

- Fourth error report...
- A physician gave a verbal order for 16 units of regular insulin
- The individual taking the order thought the physician said 60
- Sixty units were administered
## Technical Appendix 12: Products Most Frequently Involved in Harmful Medication Errors (Categories E-I), CY 2006

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin*</td>
<td>428</td>
<td>16.2</td>
</tr>
<tr>
<td>Morphine*</td>
<td>123</td>
<td>4.6</td>
</tr>
<tr>
<td>Heparin*</td>
<td>83</td>
<td>3.1</td>
</tr>
<tr>
<td>Hydromorphone*</td>
<td>71</td>
<td>2.7</td>
</tr>
<tr>
<td>Warfarin*</td>
<td>64</td>
<td>2.3</td>
</tr>
<tr>
<td>Fentanyl*</td>
<td>59</td>
<td>2.2</td>
</tr>
<tr>
<td>Potassium Chloride*</td>
<td>53</td>
<td>2.0</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>45</td>
<td>1.7</td>
</tr>
<tr>
<td>Enoxaparin*</td>
<td>44</td>
<td>1.7</td>
</tr>
<tr>
<td>Dililtazem</td>
<td>37</td>
<td>1.4</td>
</tr>
<tr>
<td>Furosemide</td>
<td>31</td>
<td>1.2</td>
</tr>
<tr>
<td>Total Parenteral Nutrition</td>
<td>28</td>
<td>1.1</td>
</tr>
<tr>
<td>Promethazine</td>
<td>25</td>
<td>0.9</td>
</tr>
<tr>
<td>Levofoxacin</td>
<td>23</td>
<td>0.9</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>22</td>
<td>0.8</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>21</td>
<td>0.8</td>
</tr>
<tr>
<td>Midazolam</td>
<td>21</td>
<td>0.8</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>21</td>
<td>0.8</td>
</tr>
<tr>
<td>Clonidine</td>
<td>20</td>
<td>0.8</td>
</tr>
<tr>
<td>Hydrocodone and Acetaminophen</td>
<td>20</td>
<td>0.8</td>
</tr>
<tr>
<td>Sodium Chloride</td>
<td>20</td>
<td>0.8</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Meperidine</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Metoprolol Tartrate</td>
<td>19</td>
<td>0.7</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>18</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**Note:** Data based on 2,209 records associated with 2,650 selections and 433 unique products

*a A high-alert medication*
PA-PSRS Program

• 25% of all medication errors reported involved high-alert medications
  – 44% involved pain management products
  – 16.3% involved insulin products

PA-PSRS = Pennsylvania Patient Safety Reporting System
Published in 2004
2006: Drugs Most Commonly Implicated in Adverse Events Treated in Emergency Departments

Top 10 classes or agents:

1. **Insulin (8%)**
2. Anticoagulants (6.2%)
3. Amoxicillin(s) (4.3%)
4. Aspirin (2.5%)
5. Trimethoprim-sulfamethoxazole (2.2%)
6. HYDROCodone/APAP (2.2%)
7. Ibuprofen (2.1%)
8. Acetaminophen (1.8%)
9. Cephalexin (1.6%)
10. Penicillin (1.3%)

Budnitz DS et al. *JAMA*. 2006;296:1858–1866
Repeated Confirmation

- Insulin has been associated with medication errors more than any other type or class of drugs
  - Cohen et al found that 11% of harmful medication errors resulted from insulin misadministration
  - MEDMARX
  - PA PSRS

Where do we start?
Let’s Look at the Numbers

2010 Analysis of 2,685 event reports that involved insulin and submitted to the Patient Safety Authority of Pennsylvania from January 2008 to June 2009

• Common care areas cited for insulin errors
  – Medical/Surgical units (22.3%, n = 599)
  – Pharmacy (8.7%, n = 347)
  – Telemetry (7.1 %, n = 191)

• Harm index
  – 78.8% (n = 2,113) of the events reached the patient (C to I)
  – 1.8% (n = 49) of the events resulted in patient harm (E to I)

• Population age
  – 53% (n = 1,434) were older than 65 years
# Let’s Look at the Numbers

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Number</th>
<th>% Of Total Reports (N =2,685)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose omission</td>
<td>662</td>
<td>24.7%</td>
</tr>
<tr>
<td>Wrong drug</td>
<td>374</td>
<td>13.9%</td>
</tr>
<tr>
<td>Wrong dose/overdosage</td>
<td>348</td>
<td>13%</td>
</tr>
<tr>
<td>Other</td>
<td>309</td>
<td>11.5%</td>
</tr>
<tr>
<td>Extra dose</td>
<td>227</td>
<td>8.5%</td>
</tr>
<tr>
<td>Wrong dose/underdosage</td>
<td>137</td>
<td>5.1%</td>
</tr>
<tr>
<td>Wrong rate (IV)</td>
<td>36</td>
<td>1.3%</td>
</tr>
</tbody>
</table>
## Wrong Drug Errors

<table>
<thead>
<tr>
<th>Type of Wrong-Drug Error</th>
<th>Number of Events</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown in retrieving insulin from Automated Dispensing Cabinet (ADC) or stock</td>
<td>75</td>
<td>20%</td>
</tr>
<tr>
<td>- Override from ADC</td>
<td>28</td>
<td>37.3%</td>
</tr>
<tr>
<td>Mix-ups between rapid acting insulin (e.g., Novolog) and regular insulin (e.g., Novolin)</td>
<td>69</td>
<td>18.4%</td>
</tr>
<tr>
<td>Error during prescribing</td>
<td>65</td>
<td>17.4%</td>
</tr>
</tbody>
</table>
Storage
Look-Alike Names

- Novolog
- Novolin
- Novolog Mix 70/30
- Novolin 70/30
- Lantus
- Levemir
- Humalog
- HumuLIN
- Humalog Mix 75/25
- Humalog Mix 50/50
- HumuLIN 70/30
Look-Alike Packaging
How do you store insulin in your patient care areas?
Best Practice Recommendation

• Only the smallest commercially-available insulin vials should be stocked on the clinical units

• Patient-specific doses of long acting insulins are dispensed by the pharmacy
Best Practice Recommendation

Constraints

• Goal- *lessen the chance of harm with insulin use*

• Reduce/limit the variety of insulin products available
  – Plan for conversion from home regimens during medication reconciliation upon entry

• Remove patient-specific vials upon discharge

• Limit U-500 concentration to pharmacy
Best Practice Recommendation
Standardize Storage Locations

• Designated location
• Marked with product name/picture
• Caution when kept on top of carts and when not returned to designated storage location after use
• Remove from sterile compounding areas
Best Practice Recommendation
Differentiation

• Goal- *make products look different*
• Pharmacy preparation of once-daily doses
• Emphasize “mix” or “mixture” on drug entry screens
• Use tall man lettering
  – NovoLOG; NovoLIN
• Bold labeling on atypical insulin concentrations
Administration

• Patient needed replacement of midazolam infusion
• Afternoon blood glucose- 36 mg/dL
• Wrong bag error
Best Practice Recommendation

• Insulin infusions are standardized to one concentration
• Insulin infusions are prepared by pharmacy

How many do not have 24/7 pharmacy services? How are insulin drips handled during hours that the pharmacy is closed?
Best Practice Recommendation

- Insulin infusions are administered using a smart infusion device with hard stops for catastrophic doses

How many are using “smart” infusion devices?

What limits have been set for insulin? Hard maximum limits? Soft limits?

Do you allow bolus doses from the bag?
Best Practice Recommendation

Constraints

• Goal- lessen the chance of harm with insulin use

• Patients receiving insulin infusions are cared for in clinical locations capable of providing the required monitoring (e.g., staffing appropriate in order to provide “q1h” testing if ordered)
Best Practice Recommendation

Redundancies

• Goal- *catch an error before it reaches the patient*

• Independent double check of all IV insulin doses prior to administration and at each dose change and infusion bag change

• Pharmacy prepared pediatric insulin dilutions
Sliding Scale Insulin

7 units to 54 units Q4hs
Novodel 1K units SQ TID NC —
add 1 unit: 50 mg BID > 150
Ex: 151 - 200 = 14 + 2
Ex: 181 - 220 = 6 + 2, etc

Novodel 6 units SQ TID NC
add 1 unit: 40 mg BID > 160 mg/dl
Ex: 141 - 180 = 6 + 1
Ex: 181 - 220 = 6 + 2, etc
Sliding Scale Insulin

- 26% (n = 185) of wrong-dose errors mentioned sliding scale
  - Ambiguously written
    - “ss insulin 10 u TID” written by prescriber
    - Intended to be “sliding scale low TID”
  - Incorrect order entry
    - “Human regular insulin 150 units sq qam prn” entered with reason “patient was on at home”
    - Prescriber inadvertently entered the blood glucose value as the dose
  - Transcription-related
    - 10 units of 70/30 insulin
    - Transcribed as 40 units
Sliding Scale on a MAR

MAR: medication administration record
How many still allow the use of sliding scale insulin?
Sliding Scale Insulin

• Inefficient, ineffective, and potentially harmful
  – Reactive
  – Waits for hyperglycemia to occur
  – Assumes insulin sensitivity is uniform for all

• Scheduled or standing regimens should be the standard of care; basal with nutritional orders
Best Practice Recommendation

• Basal - bolus therapy
• Insulin sensitivity factors for correction doses
• Insulin-to-carbohydrate ratios to match insulin doses to nutritional intake
• Carbohydrate counting replaces “sliding scales”
  – More specific
  – Proactive
Best Practice Recommendation
Standardization

• Goal- *simplify processes around insulin use*

• Use standardized insulin protocols
  – Orders based on insulin sensitivity factor
  – Insulin-to-carbohydrate ratio protocols
  – Hypoglycemia treatment protocols included with insulin orders
  – Patients receiving insulin have orders for blood glucose monitoring at least daily
Communication Errors

• Events that resulted in patients receiving the wrong dose of insulin showed numerous breakdowns
  – Ambiguous orders written by prescribers
  – Transcribing and/or prescriber or pharmacist order-entry errors
  – Displays of insulin products on medication administration records
  – Using an incorrect blood glucose value
Communication - Abbreviations

- Nurse’s medication history:
  
  ![](Humalog_4u_2u_6u.png)
  
  ![](Lantus_14u.png)

- Becomes the Order:
  
  ![](Accuver_Q1D.png)
  
  ![](Humalog_44u_2u_64.png)
  
  ![](Lantus_14u.png)
Communication

Meprobamate 400mg t. po qid
Canthaxant 80mg q. daily c. supper
Ecosin 8mg t. po daily
Does anyone have a standardized process to validate insulin doses?
Best Practice Recommendation

Standardization

• Goal- simplify processes around insulin use
• Use standardized order forms/sets
  – Use (or create) a standard format
  – Require use of form/order set
  – Direct prescribers to specific products
  – Leave prompts to fill in
  – Avoid dangerous abbreviations
Wrong Dose - Communication

• 12.9% (n = 92) of the wrong-dose events involved breakdowns with obtaining and/or communicating patients’ blood glucose values
  – Reporting an incorrect value
  – Verbally communicating the wrong patient’s value
  – Documenting the wrong result
  – Confusing the patient’s weight with their blood glucose level
A System Issue

• Nurses need to know the patient’s most current blood glucose before administering insulin
• This result is obtained by another caregiver
• This result may be written on a board or verbally shared
• The result is not always documented at the time of medication administration
How do you handle communication of blood glucose values?
Best Practice Recommendation
Standardized Communication

• Discourage verbal communication of blood glucose results
• Determine standard process for communication and documentation (location) of blood glucose results
  – MAR
  – Flow sheet
  – EHR location
Appearance on MAR or Transfer Record

- Medication format
- Name followed by patient-specific dose
- Avoid package and strength designations
  - Insulin 100 units/mL 10 mL vial
  - Insulin 100 units/mL
  - “Lantus 100 units/mL 15 units once a day subcutaneously at 8 pm”
Labels

INSULIN REGULAR 100 UNIT/ML 10ML VIAL (SEC (None) (NOVOLIN R INJ)
DOSE: AS DIRECTED IVP AS NEEDED/PRN

HUMULIN N 100 UNITS/ML VIA/LLIL
ELI LILLY & CO.
USE AS DIRECTED

NDC:00002-8315-01 Days Supply: 30 Refills: 0 Qty:20 ML
Are you using U-500 insulin in your hospital?
U-500 Insulin

• Most insulin is supplied as 100 units/mL
• Administered in a U-100 insulin syringe
• More concentrated form comes as 500 units/mL
• Increasing in use due to:
  – obesity epidemic
  – insulin resistance
  – use of insulin pumps
  – use of high doses for tight control
U-500 Complicating Factors

- A patient might be using a U-100 syringe to measure U-500 insulin
- They might state their dose as “40 units”
- However actually receiving 200 units
- Could receive one-fifth of their dose during transitions in care
U-500 Transitions in Care

- Using tuberculin syringes while inpatient
- Patient taught using U-100 syringes for home administration
- Husband prepares home doses
- Guess what happened.....
U-500 Complicating Factors

• Endocrinologist wrote for 25 units of U-500 insulin
• This was calculated to be 0.05 mL (correctly)
• Prescriber asked if order could be changed to U-100 for ease of measurement
• Intended order was for 125 units
How does your organization handle the ordering of U-500 insulin?
U-500 Complicating Factors

• Vials stocked on unit for specific patient
• Patient is discharged
• Vial remains on unit
• Nurse needs regular insulin and recognizes “HumuLIN R” but does not recognize concentration difference
• Patient receives five-fold overdose
How do you dispense U-500 insulin?
Best Practice Recommendation

- U-500 insulin doses are prepared by the pharmacy with a double check
- A dose validation process exists
  - Medication history
  - Order entry
  - Order verification
  - Administration
Best Practice Recommendation
Standardize Order Communications

• Express U-500 doses in actual units of U-500 insulin along with the corresponding markings on the syringe the patient is using

• HumuLIN R U-500 200 units (0.4 mL) subcutaneously before breakfast, lunch, and dinner

• HumuLIN R U-500 200 units (40 units mark on U-100 insulin syringe)
Changing Patient Conditions

• A patient with diabetes on continuous enteral feedings was also receiving subcutaneous insulin twice daily
• The feedings were held for a CT scan
• The insulin was not held and continued to be given
• The next time the patient’s blood glucose was checked it was 26 mg/dL
Best Practice Recommendation

- A standard process is in place for the caregiver to withhold insulin administration when the patient is no longer taking anything orally.
Best Practice Recommendation
Double Checks

• Work best when independent
• No cues from the person who carried out the work
• Caution!
• Use of double checks should be limited
• Too many checkpoints dilute their effectiveness
• Don’t use as the only strategy- both will be influenced by environmental conditions
Best Practice Recommendation
Education and Information

• Ongoing education about insulin products
  – Pen use
  – Dosing protocols
  – Point-of-care devices
  – Use skill days (hands on, observation)

• Create an organization-specific insulin chart
  – Products, pictures, onset, peak, and duration

• Modify MAR and pharmacy labels to facilitate enhanced communication of insulin orders
Pen Devices

BE AWARE
DON’T SHARE

ONE INSULIN PEN,
ONLY ONE PERSON

www.oneandonlycampaign.org
ISMP National Medication Errors Reporting Program

Operated by the Institute for Safe Medication Practices
www.ismp.org

ISMP is a federally certified patient safety organization (PSO)
Questions