Let’s Not Sugarcoat it: Insulin Safety Matters

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Pharmacy Forward: Advancing Practice for a Healthier Tomorrow!

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Disclosure Statement

- Megan Kaun and Michelle Seegert have no relevant financial relationship(s) with ineligible companies to disclose.
  and
- None of the planners for this activity have relevant financial relationships with ineligible companies to disclose.

Learning Objectives

At the completion of this activity, the participant will be able to:

- Identify current **insulin products** across all classes, including basal, bolus, concentrated and premixed options, and describe their roles within contemporary diabetes treatment guidelines
- List **patient-specific factors** that determine the appropriate selection, dosing and transition between various insulin formulations, including circumstances requiring concentrated insulin
- Explain the **pharmacokinetic, pharmacodynamic and adverse-effect profiles** of commonly used insulin products, with emphasis on clinical nuances that increase the risk for severe or preventable medication errors
- Apply the **Pharmacists' Patient Care Process** to assess, initiate, adjust, and monitor insulin therapy safely in diverse practice settings while preventing, detecting and resolving insulin-related medication errors

High Alert Medications

The Institute for Safe Medication Practices (ISMP) defines high alert medications as drugs where even **small errors** (wrong dose, patient, route, or time) can lead to **severe consequences**, such as major injury or death.

- **Examples of high alert medications:** Concentrated Electrolytes, anticoagulants, Opioids, Anesthetics, Chemotherapy, **Insulins**, Adrenergic Agonists/antagonists

Insulin has been demonstrated in multiple studies to be associated with high numbers of serious and harm-associated medication events

2017 ISMP Guidelines for Optimizing Safe Subcutaneous Insulin Use in Adults
Garrouste-Orgeas M, Selected medical errors in the intensive care unit: results of the IATROREF study: parts I and II. Am J Respir Crit Care Med. 2010;181(2):134-42.

Types of Errors Associated with Insulin

Think-Pair-Share Activity

- Think about the most common insulin error you see or have seen
  - Where does this breakdown typically occur: prescribing, dispensing, administration, patient education, monitoring
  - One contributing factor to this error such as workflow, communication, provider education, system design, manufacturing, patient understanding
- Discuss with neighbor

Most Common Errors

- Wrong product
- Improper dosing
  - Too high or too low
  - Pen vs. syringe errors
- Dose omissions or duplications
  - Transitions of care
- Incorrect use of insulin delivery devices
- Wrong route (IV/SQ/IM)
- Improper patient monitoring
- Timing issues (food, procedures etc.)

Indications for Insulin therapy-Type 1

- All patients with Type 1 need insulin
- Basal + bolus + correction

OR

- CSII – Continuous Subcutaneous Insulin Infusion (Insulin Pump)
- Add continuous glucose monitoring when possible

9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2026 | Diabetes Care | American Diabetes Association

Indications for Insulin therapy - Type 2

- Used initially only in patients with severe hyperglycemia or hyperglycemic crisis
- Use as add-on therapy for patients not meeting goals receiving maximum treatment with non-insulin therapy
- Should be used in combination with GLP-1's to maximize effectiveness and minimize weight gain
- May be basal alone or basal plus bolus in more advanced cases

9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes—2026 | Diabetes Care | American Diabetes Association

Patient Factors Impacting Glycemic Control - Inpatient

- Steroid therapy
- Infection
- Critical Illness
- Nutritional Status
  - Enteral/parenteral nutrition
  - NPO status
- Home insulin pump use
- Transitions of care

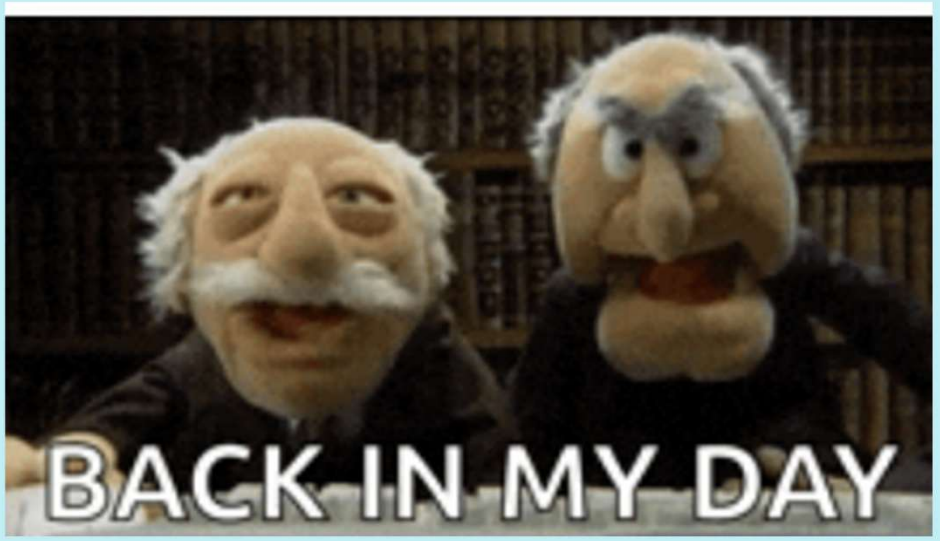
Patient Factors Impacting Glycemic Control - Outpatient

- Medication compliance
  - Forgetfulness
  - Being away from home
  - Complex schedules
  - Cost
  - Other access barriers
- Health Literacy/knowledge of therapy
- Psychological/emotional
  - Fear of hypoglycemia
  - Fear of needles
  - Fear of weight gain
  - Stigma


Novolin® N
NPH, Human Insulin Isophane Suspension (recombinant DNA origin)
U-100
100 units/mL 10 mL


Humulin® R
REGULAR
insulin human injection
U-100
100 units per mL


NDC 0002-8715-01
10mL
100 units per mL
Humulin® 70/30
70% human insulin isophane suspension, 30% human insulin injection (rDNA origin)
U-100


BACK IN MY DAY

100 Years of Insulin

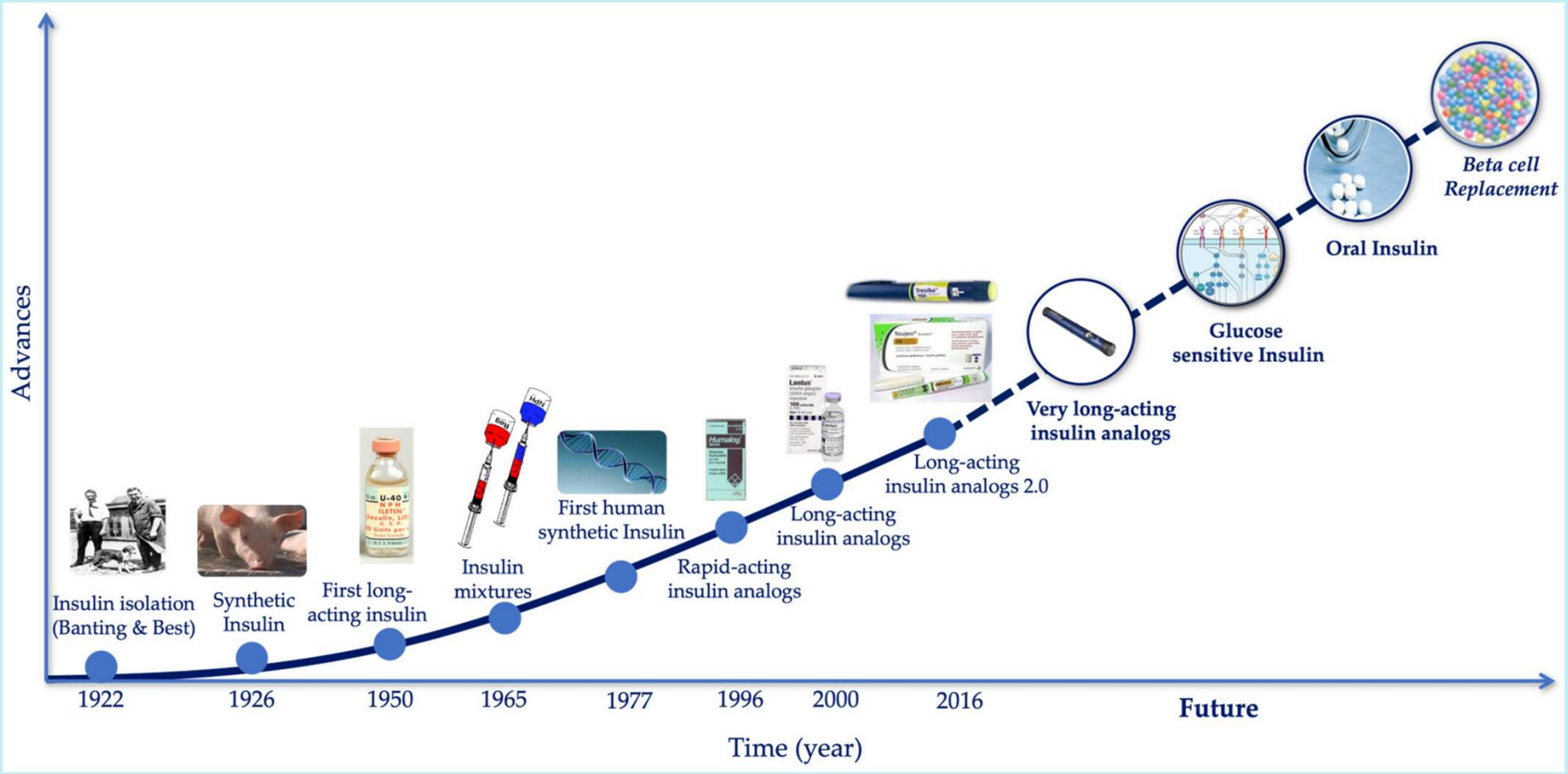


Image accessed from: Lambert C, Delgado E. 100 Years since the Discovery of Insulin, from Its Discovery to the Insulins of the Future. *Biomedicines*. 2024; 12(3):533. https://doi.org/10.3390/biomedicines12030533

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Available Insulin Products

Available Insulin Products Now

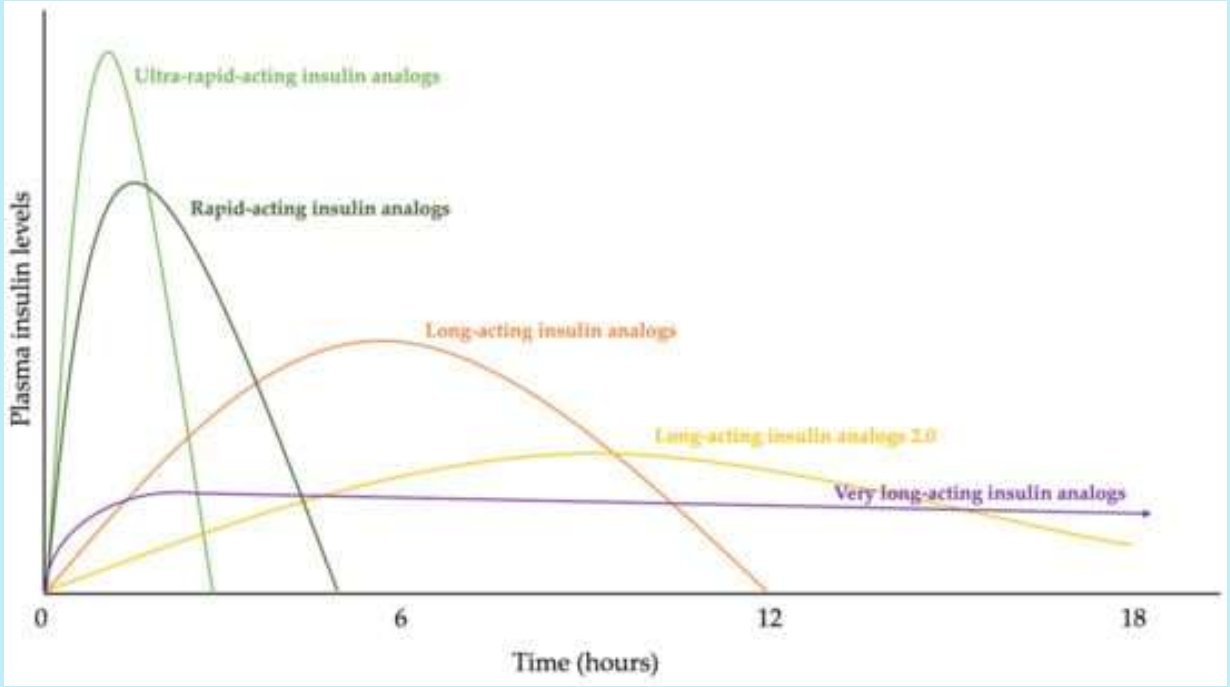
Long acting

- Tresiba (degludec)
- Lantus, Semglee, Toujeo, Rezvoglar (glargine)
- NPH

Short/Rapid Acting

- Novolog, Fiasp, Merilog (aspart)
- Humalog, Lyumjev, Admelog (lispro)
- Apidra (glulisine)
- Regular

Insulin Kinetics



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Other Insulin Products

- Afrezza (Inhaled Insulin, Regular)
- Levemir (detemir)
- Humulin R U-500
- Multiple concentrated insulins (U-200, U-300)
- Awiqli (icodec) – Coming soon?

Comparison of Insulin Regimens

Insulin Plans	Greater Flexibility	Lower risk for Hypoglycemia	Higher Cost
MDI with LAA and RAA	+++	+++	$$$
MDI with NPH and RAA	++	++	$$
MDI with NPH and Regular	++	+	$
2x daily with NPH plus Regular or Mixed Insulin	+	+	$

MDI – Multiple Daily Injections
LAA- Long Acting Analog (ex. Glargine)
RAA – Rapid or Ultra Rapid Acting Analog (ex. aspart, lispro)

Diabetes Care. 2025;49(Supplement_1):S183-S215. doi:10.2337/dc26-S009

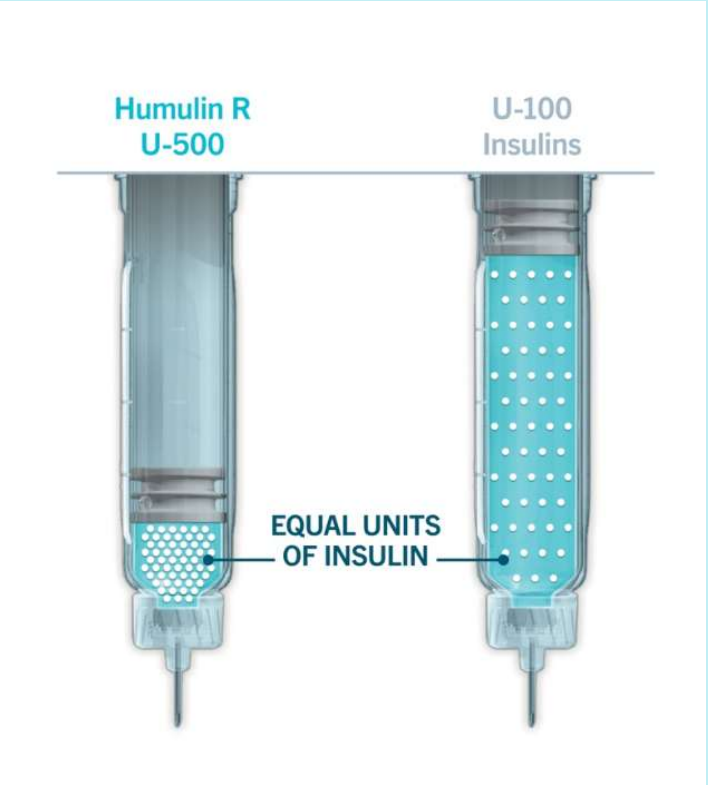
Concentrated Insulin

Concentrated Insulin

Insulin formulations with a higher number of units per mL than standard U-100 insulin (ex. U-200, U-300, U-500)

Purpose:

1. Reduce injection volume for comfort & absorption
2. Improved pharmacokinetics for high doses



Bolus Insulin

Humalog Kwikpen U-200

Lyumjev Kwikpen U-200

Basal Insulin

Tresiba (U-200)

Toujeo U-300 (+Max)

U-500


Lilly
REGULAR
500 units per mL
Rx only
U-500


Humulin R U-500
For Single Patient Use Only
500

U200 degludec (Tresiba U200)

B A S A L

- Duration of action: > 42 hours
- Time to steady state: ~ 2 – 3 days
- If a patient misses a regularly scheduled dose, then 8 hours should be observed between doses
- Taking degludec at variable times does not effect efficacy as long as the 8 hour interval is observed.
- Convert 1:1 with other basal insulins
- 2 unit increments on the pen

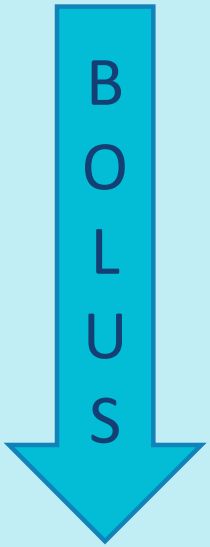
U300 Glargine (Toujeo)

BASAL

- Duration of action: > 24 hours
- Steady state reached after 5 days of therapy
- Concentration dependent kinetics with U-300 (not with U100)
  - 0.4 u/kg/day or less ~24 hour duration
  - >0.6 u/kg/day duration longer than 24 hours
- Max units per injection
  - 80 – Toujeo
  - 160 – Toujeo Max
- Conversion 1:1 with other basal insulins
  - Reduce by 20% if converting from NPH

U200 lispro (Humalog and Lyumjev)

- Similar kinetics and dynamics to U100 Lispro
- Onset: ~ 30 minutes (type 1) and 45 minutes (type 2)
- Time to peak: 2-3 hours
- Duration of action: 4 – 5 hours
- Administer immediately prior to a meal
- Convert from any other U100 bolus insulin in a 1:1



U-500 Insulin

- Basal / Bolus Insulin
- Onset: ~ 15 – 30 minutes
- Time to peak: 4 – 8 hours
- Duration of action: < 24 hours
- Pen allows for 300 units per injection

Indications for U500 and other Concentrated Insulin

Patients who require >200 units/day

>2 units per kg/day

Contraindications to U500

Psychosocial	Biomedical
Irregular meal patterns	Extremes of age
Inability/unwilling to self monitor	High hypoglycemia risk
Poor adherence	Cognitive impairment
Poor self-care	Hypoglycemia unawareness
Psychiatric impairments	Debilitated state

U500 insulin dosing

Does conversion to U-500 based on most recent HbA1c level.

If HbA1c is > 8%,

- then the starting total daily dose (TDD) of U-500 is 100% of the U-100 TDD.

If HbA1c is ≤ 8%,

- then the starting TDD of U-500 is 80% of the final U-100 TDD (20% reduction).

U500 insulin Dosing

- U-500 can be dosed BID (60%/40%) or TID times daily (40%:30%:30%)
  - BID resulted in better patient satisfaction outcomes and similar clinical outcomes
- Dose adjustments (titrations) may range from 5% to 10% depending on subsequent blood glucose readings

https://link.springer.com/article/10.1186/s12955-016-0541-4

Patient Case Example

PG is a 52 yom, 95 kg, A1c=7.8% currently taking Lantus 76 units twice daily and Novolog 25 units three times daily with meals

- Is PG a good candidate for concentrated insulin? Why or why not?
- What concentrated insulin products should we consider?
- How should we convert him from his current regimen to concentrated insulin?

Case Insulin Dosing

If Choose Toujeo or Tresiba:

- Replaces basal only
  - Stop Lantus
- 1:1 ratio
- To simplify regimen, combine doses
  - Must use Toujeo Max
- Additionally, can choose to leave Novolog as is or change to Lyumjev or Humalog-U200

If Select U-500

- Replaces both basal & bolus
- Calculate TDD=227
- 20% reduction
  - Since A1c<8%
- New TDD=182
  - Divide into 2 (60%; 40%) or 3 doses 40%; 30%; 30%
  - BID: Dose 1: 109 units; Dose 2: 73 units
  - TID: Dose 1: 73 units; Dose 2: 55 units; Dose 3: 55 units
    - Timing?

The Role of the Pharmacist

- **Inpatient and outpatient order/prescription review:** Review orders to prevent errors during prescription, transcription, and dispensing, particularly focusing on correct insulin types and concentrations.
- **Patient Education:** Educate patients on correct injection techniques, blood glucose monitoring, insulin storage, and recognizing signs of hypo/hyperglycemia.
- **Inpatient Safety (Hospital):** Manage insulin protocols, prepare infusions, ensure proper storage, and prevent the use of insulin pens on multiple patients.
- **Transition of Care:** Manage the switch from intravenous to subcutaneous insulin and assist in discharge medication reconciliation.
- **Clinical Decision Support:** Offer expertise in selecting appropriate insulin regimens and correcting ambiguous orders.
- **Storage and Handling:** In both community and hospital settings, ensure insulin is stored, handled, and dispensed according to safety guidelines.

Need More Information?

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