GENERAL RECOMMENDATIONS

- Start insulin if A1C and glucose levels are above goal despite optimal use of other diabetes medications. (Consider insulin as initial therapy if A1C very high, such as > 10.0%) \(^{6,7,8}\)
- Start with BASAL INSULIN for most patients \(^{6,7,8}\)
- Consider the following goals \(^{1,6}\)
  - ADA A1C Goals: A1C < 7.0 for most patients
  - A1C > 7.0 (consider 7.0-7.9) for higher risk patients

  1. History of severe hypoglycemia
  2. Multiple co-morbid conditions
  3. Long standing diabetes
  4. Limited life expectancy
  5. Advanced complications or 6. Difficult to control despite use of insulin

ADA Glucose Goals*: Fasting and premeal glucose < 130
Peak post-meal glucose (1-2 hours after meal) < 180
Difference between premeal and post-meal glucose < 50
*for higher risk patients individualize glucose goals in order to avoid hypoglycemia

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BASAL INSULIN

Intermediate-acting:
- NPH Note: NPH insulin has elevated risk of hypoglycemia so use with extra caution \(^{1,6,7,8,17,25,32}\)

Long-acting:
- Glargine (Lantus®)
- Detemir (Levemir®)

* Basal insulin is best starting insulin choice for most patients (if fasting glucose above goal). \(^{6,7,8}\)
* Start one of the intermediate-acting or long-acting insulins listed above. \(^{6,7}\)
* When starting basal insulin: Continue secretagogues. Continue metformin. \(^{7,8,20,29}\)
* Note: if NPH causes nocturnal hypoglycemia, consider switching NPH to long-acting insulin. \(^{17,25,32}\)

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STARTING DOSE:

Start dose: 10 units\(^{6,7,8,11,12,13,14,16,19,20,21,22,25}\)
Consider using a lower starting dose (such as 0.1 units/kg/day)\(^{32}\) especially if patient is thin or has a fasting glucose only minimally above goal. \(^{6,7,8}\)

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TITRATE:

Teach patient to self titrate ↑ by 2 units every 2-3 days until average fasting glucose < 130 \(^{6,7,8,13,14,30,32}\)
("Inform patient to hold titration until further evaluation if develops any hypoglycemia"

Or

Titrte 1-2 times per week such as per table below until average fasting glucose < 130\(^{6,19}\)

- Fasting glucose > 200 ↑ 4 units
- Fasting glucose 131-200 ↑ 2 units
- Fasting glucose 70-130 No change in dose
- Fasting glucose < 70 ↓ 2-4 units or by 10%

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Once fasting glucose at goal, evaluate post-meal glucose pattern \(^{6,7,8}\)

If post-meal glucose levels > 180: ADD PRANDIAL INSULIN\(^{6,7,8}\)

Note: If patient unable to do multiple daily injections, consider switching to MIXED INSULIN instead of adding prandial insulin. (Mixed insulin is more likely to cause hypoglycemia\(^{10}\) and generally requires a fixed meal schedule\(^{3}\))
**PRANDIAL INSULIN**

**Short Acting: Regular**  Note: Regular insulin has longer peak and extra risk of hypoglycemia so use with caution6,8,33  
**Rapid Acting: Lispro (Humalog®)**  
**Aspart (Novolog®)**  
**Gulisine (Apidra®)**  

- Add prandial insulin to basal insulin if post-meal blood glucose levels are above goal6,7,8  
- Start one of the prandials listed above.  
- When adding prandial insulin: Stop secretagogues. Continue metformin. Continue basal insulin (may need to re-adjust dose).6,7,8  
- Rapid acting insulins should be just before meal. Short acting insulin needs to be taken 30 minute before meals.6,7  
- Note: after maximizing prandial and night-time basal insulin dose, may need to consider adding a morning dose of basal insulin if pre-dinner glucose remains above goal (more likely to be necessary if using NPH)18,19,26,28,30

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**STARTING DOSE:**  
4 units qAC4,33,36,37  
- May consider start with largest meal only7,8  
- Instruct patients to eat carb consistent meals when first starting prandial insulin  
Alt. choice: 7-10% of basal insulin dose qAC7,8,36

**Alternate starting choice:**  
1 unit to 15 gm  
1 unit to 12 gm  
1 unit to 10 gm  
1 unit to 7 gm  
1 unit to 5 gm  
1 unit to 4 gm  
1 unit to 3 gm

**Consider adding pre-meal Correction Factor (CF):**  
Add 1 unit for each 50 that pre-meal glucose is >130

**Alternate method to determine pre-meal correction factor:**  
Correction factor (CF) = 1800 / total daily dose of insulin (1800 rule)

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**TITRATE:**  
Titrate 1-2 units every 2-3 days until post-meal glucose < 1806,8,34,35  
(May consider different doses for different meals)

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**ALTERNATE STARTING CHOICE:**  
1 unit to 15 gm carbs qAC34  
Note: may consider calculate insulin to carb (I:C) ratio = 500 / total daily dose (TDD) of insulin (500 rule)

**Consider adding pre-meal Correction Factor (CF):**  
Add 1 unit for each 50 that pre-meal glucose is > 130

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**TITRATE:**  
Adjust insulin to carb ratio as appropriate per below until post-meal glucose < 1806,8,34,35  
1 unit to 15 gm  
1 unit to 12 gm  
1 unit to 10 gm  
1 unit to 7 gm  
1 unit to 5 gm  
1 unit to 4 gm  
1 unit to 3 gm

**TITRATE:**  
Titrate 1-2 units every 2-3 days until average target glucose <13013,51  
**OR**  
Titrate 1-2 times per week such as per table below until average target glucose <13013,51  
- Target glucose >200  
- Target glucose 131-200  
- Target glucose 70-130  
- Target glucose < 70

**Mixed Insulin**  
70/30 NPH/Regular  Note: 70/30 NPH/Regular insulin has elevated risk of hypoglycemia so use with extra caution6,8  
75/25 Lispro Mix (Humalog® Mix) or 50/50 Lispro Mix (Humalog® Mix)  
70/30 Aspart Mix (Novolog® Mix)

- Mixed insulin is an option for patients who are unable to do multiple injections and who have fixed meal schedules.8  
- Mixed insulin is more likely to cause hypoglycemia compared to basal and prandial insulins.6,8,19  
- Start one of the mixed insulins listed above.  
- When adding mixed insulin: Stop secretagogues. Continue metformin. Stop all other insulins.7,8

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**STARTING DOSE:**  
PRE-DINNER dose 6-10 units40,43,45,50  
(may adjust depending on previous basal insulin dose42,51)  
Target glucose for titration is fasting glucose.4,33,43,45,46,53  
(may also consider post-dinner glucose when titrating dose)

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**STARTING DOSE:**  
PRE-BREAKFAST dose: 6-10 units40,43,45,50  
(may adjust depending on previous basal insulin dose42,51)  
Target glucose for titration is pre-dinner glucose.4,33,43,45,46,53  
(may also consider post-breakfast glucose when titrating dose)

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**MIXED INSULIN**

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**TITRATE:**  
Titrated 1-2 units every 2-3 days until average target glucose <13013,51  
**OR**  
Titrated 1-2 times per week such as per table below until average target glucose <13013,51  
- Target glucose >200  
- Target glucose 131-200  
- Target glucose 70-130  
- Target glucose < 70

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**Page 2 of 5. This product may be reproduced with the citation:**  
*Developed by the Diabetes Coalition of California, October 2010*  
See Web site (www.diabetescoalitionofcalifornia.org) for the latest version and disclaimer.
ADDITIONAL INFORMATION:

Alternate self titration for basal insulin:
May consider self titrating basal insulin by increasing dose 1 unit every day until average fasting glucose is < 130, if that is easier for the patient to understand. Self titration of small doses may be easiest for patients using insulin pens.

Other diabetes medication in combination with insulin:
- **Metformin**: Continue if able because helps prevent weight gain when patient on insulin
- **Secretagogues**: (sulfonylureas and meglitinides): Consider continuing when patient is on basal insulin only. Stop when patient is on prandial or mixed insulin.

Other Diabetes Medications: decision to continue or discontinue other diabetes medications should be made with consideration of multiple individual patient characteristics.

Note: once patient’s glucose levels are controlled with insulin, it may occasionally be possible to stop insulin and continue or switch to oral medications depending of the stage of the diabetes and changes in other individual patient characteristics.

Example of correction factor using 1800 Rule:
Patient on 60 units basal insulin. Total Daily Dose (TDD) is 60 units. Correction Factor (CF) = 1800 / 60 = 30. If pre-meal glucose = 250, blood glucose is 150 mg/dl above goal of 100; Correction is 150/30 = 5 units. Give 5 units in addition to prandial insulin dose being used to cover meal.

Example of carbohydrate ratio using 500 Rule:
Patient on 50 units basal insulin daily. Total Daily Dose (TDD) is 50 units. Insulin to Carbohydrate Ratio (I:C Ratio): 500/50 = 1:10 units. For a 60 gm carbohydrate meal = 60/10 = take 6 units.

Example of Insulin with prandial starting dose of 4 units and correction factor of 1:50

<table>
<thead>
<tr>
<th>Pre-meal Glucose Level</th>
<th>Prandial Insulin Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>70-150</td>
<td>4 units</td>
</tr>
<tr>
<td>150-200</td>
<td>5 units</td>
</tr>
<tr>
<td>200-250</td>
<td>6 units</td>
</tr>
<tr>
<td>250-300</td>
<td>7 units</td>
</tr>
<tr>
<td>300-350</td>
<td>8 units</td>
</tr>
<tr>
<td>350-400</td>
<td>9 units</td>
</tr>
<tr>
<td>&gt;400</td>
<td>10 units</td>
</tr>
</tbody>
</table>

Mealtime Advice:
Take rapid acting prandial and mixed insulins just before a meal. At restaurants only take once food actually arrives at table. Take Regular insulin 30 minutes before meals.

Hypoglycemia:
Tell patient to carry rapidly absorbed carbohydrate source at all times and teach friends and family about how to treat low glucose. Treat low glucose (<70) as per Rule of 15’s: Give 15 gm of rapidly absorbed carbohydrate (ie: 1/2 cup juice or 4 glucose tabs). Recheck glucose level in 15 minutes. Give another 15 gm of carbohydrate if glucose still < 70. Repeat until the glucose level is > 70. Once glucose level returns to normal, consider follow with a snack or meal. Inform provider of hypoglycemia episodes at next appointment. If severe (unconscious, seizures) call 911 and give glucagon (1.0 for adult, 0.5 for child < 50 lbs) if available. Prescribe glucagon kit for high risk patient to have at home.

Identification:
Carry personal ID and wear medical ID.

Insulin Device:
Consider insulin pen if able for patients with vision, dexterity or cognition difficulties or for patient convenience. Note insulin pens cost more than insulin vials. However, total cost of insulin pen is potentially lower than vial if patient’s daily insulin dose is low (since less unused insulin needs to be discarded at end of month). Insulin pens may not be covered by insurance.

Storage:
Refrigerate insulin until opened. Discard after expiration date. Once opened can be kept at room temperature. Avoid heat. Replace insulin vial or pen as required per specific insulin package insert.

Syringes and Needles:
For pen consider use pen needles that are 31 or 32 gauge and 5 mm to 8 mm. For vials consider use syringes that are 0.3-1.0 cc with ultrafine 5/16” 31 gauge needles. Instruct patient to leave needle in skin for 5 or more seconds after injection completed.

Exercise:
Low glucose levels may occur during or after exercise. Carry glucose source when exercising. Check glucose before and during exercise. If patient has low glucose levels associated with exercise: consider decreasing preceding prandial insulin dose (if within several hours before exercise) and/or taking extra carbohydrates before or during exercise.

Education:
All patients should receive Diabetes Self Management Training (DSMT) and Medical Nutrition Therapy (MNT) by certified diabetes educator if possible.

Diabetes Coalition of California
The identification and rating of the body of evidence to support the Type 2 Diabetes Insulin Guidelines followed a three-step process:

1. Pertinent articles for review were by identified by a Medline search including the key words: Diabetes Mellitus, Type 2 drug therapy, Hypoglycemic Agents, Insulin Analogs, Dextrose, Glucose, Basal, and Titrare. The search was limited to 2005-2010 and the language English. Older clinical trials evaluating Regular insulin were included, since none were available from 2005-2010. The most recent ADA and AACE consensus statements, position statements and technical reviews on diabetes care topics were also identified. Insulin package insert recommendations were obtained from Lexi-Comp, Online.

2. Experts in diabetes care then examined the list of articles and included only those that were identified as randomized controlled clinical trials examining the initiation and titration of insulin, the most recent general consensus statements, technical reviews, or position statements by ADA and AACE, the most recent insulin review article by the American Academy of Family Practice, and the Lexi-Comp online insulin package insert recommendations.

3. The articles were reviewed and the body of evidence was rated using a system adopted from the ADA grading system for clinical practice recommendations.


The basal insulin (A-level evidence) section is based on the above process and includes the following articles:

**GENERAL INFORMATION: Consensus Statements and Reviews**


**BASEAL INSULIN (A-level evidence)**


TYPE 2 DIABETES ADULT OUTPATIENT INSULIN GUIDELINES

BASAL INSULIN (A-level evidence), continued


27. Robbins DC et al. Mealtime 50/50 basal + prandial insulin analogue mixture with a basal insulin analogue, both plus metformin, in the achievement of target HbA1c and pre- and postprandial blood glucose levels in patients with type 2 diabetes: a multinational, 24-week, randomized, open-label, parallel-group comparison. Clin Ther. 2007 Nov;29(11):2349-64.


PRANDIAL INSULIN (A-level evidence)


MIXED INSULIN (A-level evidence)


