Managing Hyperglycemia in Type 2 Diabetes

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Disclosures

• Off label and investigative use of some medications will be discussed
• Speaker’s Bureau, Novo Nordisk
Objectives

• Describe usual diabetes medications and management of hyperglycemia in Type 2 Diabetes

• Implement proper medication use per guideline management in a patient centered approach

• Improve knowledge of side effects and contraindications of diabetes medications
What We Will Do

• Quick Review of Type 2 Diabetes and Treatment Goals
• Medications Overview
• Discuss Considerations in choosing medications for Type 2 Diabetes
• Strategize practical insulin use in clinic settings
Review Type 2 Diabetes
Natural History of Type 2 Diabetes

*IFG = impaired fasting glucose.

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The Ominous Octet

Islet β-cell

Impaired Insulin Secretion

Decreased Incretin Effect

Increased Lipolysis

Increased Glucose Reabsorption

Increased Glucose Uptake

Increased HGP

Neurotransmitter Dysfunction

Islet α-cell

Increased Glucagon Secretion

DeFronzo Diabetes 2008
Goals of Glucose Management

Targets for glycemic control for many patients:

<table>
<thead>
<tr>
<th></th>
<th>ADA</th>
<th>AACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1c (%)</td>
<td>&lt;7</td>
<td>≤6.5</td>
</tr>
<tr>
<td>Fasting (preprandial) plasma glucose</td>
<td>70-130 mg/dL</td>
<td>&lt;110 mg/dL</td>
</tr>
<tr>
<td>Postprandial (after meal) plasma glucose</td>
<td>&lt;180 mg/dL</td>
<td>&lt;140 mg/dL</td>
</tr>
</tbody>
</table>

• American Diabetes Association. *Diabetes Care*. 2012;35(suppl 1)
# A1C ~ “Average Glucose”

<table>
<thead>
<tr>
<th>A1C %</th>
<th>eAG mg/dL</th>
<th>eAG mmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>126</td>
<td>7.0</td>
</tr>
<tr>
<td>6.5</td>
<td>140</td>
<td>7.8</td>
</tr>
<tr>
<td>7</td>
<td>154</td>
<td>8.6</td>
</tr>
<tr>
<td>7.5</td>
<td>169</td>
<td>9.4</td>
</tr>
<tr>
<td>8</td>
<td>183</td>
<td>10.1</td>
</tr>
<tr>
<td>8.5</td>
<td>197</td>
<td>10.9</td>
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<tr>
<td>9</td>
<td>212</td>
<td>11.8</td>
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<tr>
<td>9.5</td>
<td>226</td>
<td>12.6</td>
</tr>
<tr>
<td>10</td>
<td>240</td>
<td>13.4</td>
</tr>
</tbody>
</table>

*Formula: 28.7 × A1C - 46.7 - eAG*

[Calculator at professional.diabetes.org/eAG](http://professional.diabetes.org/eAG)
Management of Hyperglycemia in Type 2 Diabetes: A Patient-Centered Approach

Position Statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)
Patient-Centered Approach

“providing care that is respectful of and responsive to individual patient preferences, needs, and values - ensuring that patient values guide all clinical decisions.”

- Gauge patient’s preferred level of involvement.
- Explore, where possible, therapeutic choices.
- Utilize decision aids.
- **Shared** decision making – final decisions re: lifestyle choices ultimately lies with the patient.
Approach to management of hyperglycemia:

- **Patient attitude and expected treatment efforts**
  - More stringent: highly motivated, adherent, excellent self-care capacities
  - Less stringent: less motivated, non-adherent, poor self-care capacities

- **Risks potentially associated with hypoglycemia, other adverse events**
  - Low
  - High

- **Disease duration**
  - Newly diagnosed
  - Long-standing

- **Life expectancy**
  - Long
  - Short

- **Important comorbidities**
  - Absent
  - Few / mild
  - Severe

- **Established vascular complications**
  - Absent
  - Few / mild
  - Severe

- **Resources, support system**
  - Readily available
  - Limited
Goals of Glucose Management

- More stringent (<6.5) may be reasonable:
  - No significant CVD
  - Short duration
  - Long life expectancy

American Diabetes Association. *Diabetes Care*. 2012;35(suppl 1)
Goals of Glucose Management

Less stringent (<7.5-8+) may be reasonable:
• History of severe hypoglycemia
• Limited life expectancy
• Advanced complications or comorbid conditions
• Longstanding difficult to control diabetes

American Diabetes Association. *Diabetes Care*. 2012;35(suppl 1)
Goals of Glucose Management

- Hypoglycemia must be considered
- “Many factors, including patient preferences, should be taken into account when developing a patient's individualized goals” (Patient-centered)

American Diabetes Association. *Diabetes Care*. 2012;35(suppl 1)
Lifestyle Management for Type 2 Diabetes

- Optimized, individualized plan
- Weight Management
- Activity/Exercise as appropriate—almost everybody can do something
- Meal Planning
ADA Nutrition Strategies

• Encourage weight loss in overweight/obese
• Modest weight loss-improve insulin resistance
• Reduce calories and fat
• Saturated fat <7%, minimize trans-fat
• Customize plans for patients
Quick Clinic Dietary Interventions

- Cut down/eliminate regular pop
- Can eat some things they like, try eating less of them
- Eat Slow
- Glass of Water before eating
Diabetes Medications
Diabetes Medications

• Many new medications in last decade
• Three main categories
  – Oral agents (pills)- many different kinds old and new
  – Insulin- newer, more modern insulins
  – Newer, non-insulin injectable medications
• Choices allow individualization of treatment plan
• Different medications, different indications, different situations
# Glucose-lowering Potential of Diabetes Therapies*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>FPG ↓</th>
<th>HbA1C ↓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfonylureas</td>
<td>50-60 mg/dl</td>
<td>1-2%</td>
</tr>
<tr>
<td>Metformin</td>
<td>50-60 mg/dl</td>
<td>1-2%</td>
</tr>
<tr>
<td>α-Glucosidase Inhibitors (Precose)</td>
<td>15-30 mg/dl</td>
<td>0.5-1%</td>
</tr>
<tr>
<td>Repaglinade (Prandin)</td>
<td>60 mg/dl</td>
<td>1.7%</td>
</tr>
<tr>
<td>Thiazolidinediones</td>
<td>40-60 mg/dl</td>
<td>1-2%</td>
</tr>
<tr>
<td>Gliptins (Januvia, Onglyza)</td>
<td>targets ppd</td>
<td>0.5 - 0.8%</td>
</tr>
<tr>
<td>SGLT-2 (Invokana)</td>
<td>~ 40 mg/dl</td>
<td>0.5-0.9%</td>
</tr>
</tbody>
</table>

*based on package insert data as monotherapy
# Glucose-lowering Potential of Injection Diabetes Therapies*

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<tr>
<th>Treatment</th>
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<th>HbA1C ↓</th>
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</thead>
<tbody>
<tr>
<td>Exenatide (Byetta, Bydureon)</td>
<td>targets ppd</td>
<td>1-1.5%</td>
</tr>
<tr>
<td>Liraglutide (Victoza)</td>
<td>targets ppd</td>
<td>1-1.5%</td>
</tr>
<tr>
<td>Pramlintide (Symlin)</td>
<td>targets ppd</td>
<td>1-2%</td>
</tr>
<tr>
<td>Insulin</td>
<td>Limited by hypoglycemia</td>
<td>1.5-3.5%</td>
</tr>
</tbody>
</table>

*Based on package insert data as monotherapy
3 Things to Consider With Medications in Type 2 Diabetes

• Where is the patient on their diabetes timeline?
  - betacell decline over time

• What are the patients individual factors and needs at this time? (Patient-centered)
  - age, obesity, hypoglycemia avoidance, cvd, other co-morbid conditions

• Advance therapy every 3 to 6 months if not meeting goals
Oral Diabetes Medications
Sulfonylureas

- Oldest oral medications
- Stimulate pancreas to secrete more insulin
- Effective, inexpensive
- Glyburide, Glipizide, Glimiperide
Caveats with Sulfonylureas

- Hypoglycemia (particularly in elderly)
- Premature B-cell exhaustion?
- Caution in liver disease, renal disease
- Weight gain
- Rash
- Avoid if anaphylactic to sulfa
Metformin

- Improves insulin resistance
- Reduced Hepatic Glucose production
- Effective, inexpensive
- Extremely low incidence of hypoglycemia
- Weight neutral or weight loss
- Positive effects on lipid profiles
- Long term use may result in better CVD outcomes
- Can be combined with virtually all other DM meds
Caveats with Metformin

- Liver Disease
- Renal Disease
- GI upset
- Heavy Alcohol Use
- Intravascular Dye Studies (IVP, Angio, etc)
- CHF
- Not for many persons over 80
- Can result in B12 deficiency
Thiazolidinediones (TZD’s)

• Pioglitazone (Actos)
• Rosiglitazone (Avandia)
• Improves insulin resistance
• Extremely low incidence of hypoglycemia
• Pioglitazone- may have CVD benefit
• The role of TZD’s may be diminishing
Caveats with TZD’s

- CHF (or if hx/risk?)
- Patients already dealing with edema
- Potential weight gain
- Renal disease-fluid overload
- Current TZD’s rare liver disease, not recommended in active liver disease
- Heart disease risk? (Rosiglitazone)
- Bladder cancer? (Pioglitazone)
Gliptins (DPP-IV)

- DPP-IV (Dipeptidyl peptidase) inhibitors
- Increase level of native GLP-1
- Sitagliptin (Januvia)
- Saxagliptin (Onglyza)
- Linagliptin (Tradjenta)
- Oral agents
- Weight neutral or weight loss
- Can use with Metformin, Sulfonylurea, TZD, or insulin
Gliptins Caveats, Benefits

Caveats:
- Hypoglycemia if used with sulfonyurea or insulin
- Nausea, rash

Benefits:
- Few drug interactions; can be renally dosed
SGLT-2 (sodium glucose co-transporters) Inhibitors

- Canagliflozin (Invokana)
- Dapagliflozin (Forxiga)- Europe only
- Several others in development
- Oral agents
- Increase glucosuria at the level of the kidney
- Can be used with other type 2 medications
- Weight neutral or weight loss
- Lower blood pressure
SGLT-2 Inhibitors Caveats

Canagliflozin:

• Increase LDL (4%-8%)
• Genitourinary infections
• Increased urination
• Hypotension (osmotic diuresis)
• Caution in elderly, diuretics, ARB, ACEI
• Not for significant renal impairment (GFR<45), but can be renally dosed (GFR 45-60)
“Niche” Drugs

- Colesevelam (Welchol)
  - adjunct to lower A1c and LDL

- Repaglinide (Prandin), Nateglinide (Starlix)
  - may replace SU if sulfa allergy
  - Prandin may be useful in CKD

- Acarbose (Precose), Miglitol (Glyset)
  - limited efficacy, GI intolerance, cost

- Bromocriptine (Cycloset)
  - limited efficacy? Mechanism uncertain
Non-Insulin Injectable Medications
Glucagon-like Peptide-1 (GLP-1)

- Gut hormone
- Stimulates pancreas to secret insulin
- Suppresses glucagon action
- Many target organs
- Weight regulation
GLP-1 Medications

- Exenatide (Byetta, Bydureon) GLP-1 mimetic
- Liraglutide (Victoza) GLP-1 analog
- Available in pen injectors (easy)
- Modest weight loss
- Combined with other agents except DPP-IV inhibitors
GLP-1 Caveats

• Nausea, vomiting
• Pancreatitis
• Medullary thyroid carcinoma in rodents (liraglutide)
• Hypoglycemia combined with sulfonylurea
• Caution in renal or hepatic impairment
Pramlintide-Synthetic Amylin (Symlin)

- Amylin secreted by normal pancreas along with insulin to regulate blood glucose
- Enhances Postprandial control. Used in Type 1 and Type 2 patients
- Used as adjunct to insulin
- Available in pen injector
- Possible significant hypoglycemia
Combination Drug Therapy

- Consider early if failing monotherapy
- Generally additive or synergistic effects
- Triple or quadruple non-insulin drug therapy
  - benefit-depends on diabetes history
  - safe for many
- Insulin is a good choice for many
- Individual factors need to be considered
Medication “Placement”

• So…….

How do we use these different medications with different mechanisms?

• Position Statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)- April 2012
Healthy eating, weight control, increased physical activity

**Initial drug monotherapy**
- Efficacy (↓ HbA1c)
- Hypoglycemia
- Weight
- Side effects
- Costs

**Two drug combinations**
- Efficacy (↓ HbA1c)
- Hypoglycemia
- Weight
- Major side effect(s)
- Costs

**Three drug combinations**

**More complex insulin strategies**

---

**Metformin**
- high
- low risk
- neutral/loss
- GI/ lactic acidosis
- low

*If needed to reach individualized HbA1c target after ~3 months, proceed to 2-drug combination (order not meant to denote any specific preference):*

- Sulfonylurea
  - high
  - moderate risk
  - gain
  - hypoglycemia
  - low

- Thiazolidinedione
  - high
  - low risk
  - gain
  - edema, HF, fx
  - high

- DPP-4 Inhibitor
  - intermediate
  - low risk
  - neutral
  - rare
  - high

- GLP-1 receptor agonist
  - high
  - low risk
  - loss
  - GI
  - high

- Insulin (usually basal)
  - highest
  - high risk
  - gain
  - hypoglycemia
  - variable

*If needed to reach individualized HbA1c target after ~3 months, proceed to 3-drug combination (order not meant to denote any specific preference):*

- Sulfonylurea +
  - TZD
  - DPP-4-i
  - GLP-1-RA
  - Insulin

- Thiazolidinedione +
  - SU
  - DPP-4-i
  - GLP-1-RA
  - Insulin

- DPP-4 Inhibitor +
  - SU
  - TZD
  - GLP-1-RA
  - Insulin

- GLP-1 receptor agonist +
  - SU
  - TZD
  - GLP-1-RA
  - Insulin

- Insulin (usually basal)
  - TZD
  - DPP-4-i
  - GLP-1-RA

*If combination therapy that includes basal insulin has failed to achieve HbA1c target after 3-6 months, proceed to a more complex insulin strategy, usually in combination with 1-2 non-insulin agents:*

- Insulin (multiple daily doses)

---

Diabetes Care 2012   Diabetologia 2012
<table>
<thead>
<tr>
<th>Initial drug monotherapy</th>
<th>Healthy eating, weight control, increased physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficacy (↓ HbA1c)</strong></td>
<td>Metformin high</td>
</tr>
<tr>
<td><strong>Hypoglycemia</strong></td>
<td>low</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>low risk</td>
</tr>
<tr>
<td><strong>Side effects</strong></td>
<td>neutral/loss</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td>Gl / lactic acidosis</td>
</tr>
<tr>
<td></td>
<td>low</td>
</tr>
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</table>
### Fig 2. T2DM Antihyperglycemic Therapy: General Recommendations

<table>
<thead>
<tr>
<th>Healthy eating, weight control, increased physical activity</th>
<th>Metformin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>high</td>
</tr>
<tr>
<td></td>
<td>low risk</td>
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<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Metformin +</th>
<th>Metformin +</th>
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<tbody>
<tr>
<td>Sulfonylurea†</td>
<td>Thiazolidinedione</td>
<td>DPP-4 Inhibitor</td>
<td>GLP-1 receptor agonist</td>
<td>Insulin (usually basal)</td>
</tr>
<tr>
<td>high</td>
<td>high</td>
<td>intermediate</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>moderate risk</td>
<td>low risk</td>
<td>low risk</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>gain</td>
<td>gain</td>
<td>neutral</td>
<td>risk</td>
<td></td>
</tr>
<tr>
<td>hypoglycemia†</td>
<td>edema, HF, fx’s†</td>
<td>rare†</td>
<td>GI</td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>high</td>
<td>high</td>
<td>high</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>variable</td>
<td></td>
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</table>

**Initial drug monotherapy**
- Efficacy (↓ HbA1c)
- Hypoglycemia
- Weight
- Side effects
- Costs

**Two drug combinations**
- Efficacy (↓ HbA1c)
- Hypoglycemia
- Weight
- Major side effect(s)
- Costs
### Initial drug monotherapy

- **Efficacy (↓ HbA1c)**
- **Hypoglycemia**
- **Weight**
- **Side effects**
- **Costs**

### Two drug combinations*

- **Efficacy (↓ HbA1c)**
- **Hypoglycemia**
- **Weight**
- **Major side effect(s)**
- **Costs**

#### Metformin

- **High**
- **Low risk**
- **Neutral/loss**
- **GI / lactic acidosis**
- **Low**

*If needed to reach individualized HbA1c target after ~3 months, proceed to 2-drug combination (order not meant to denote any specific preference):*

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<tr>
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</tr>
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<tbody>
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<td>+ Sulfonlurea†</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>

*If needed to reach individualized HbA1c target after ~3 months, proceed to 3-drug combination (order not meant to denote any specific preference):*

<table>
<thead>
<tr>
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### Three drug combinations

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</table>

*Abbreviations: TZD, DPP-4-i, GLP-1-RA, SU, Insulin*
Figure 3. Sequential Insulin Strategies in T2DM

- Non-insulin regimens
- Basal insulin only (usually with oral agents)
- Basal insulin + 1 (meal-time) rapid-acting insulin injection
- Basal insulin + ≥2 (meal-time) rapid-acting insulin injections
- Premixed insulin twice daily

Flexibility:
- more flexible
- less flexible

Number of injections:
- 1: low
- 2: mod.
- 3+:

Regimen complexity:
- low
- mod.
- high
Patient Considerations in Choosing Type 2 Diabetes Medications
OTHER CONSIDERATIONS

- **Age: Older adults**
  - Reduced life expectancy
  - Higher CVD burden
  - Reduced GFR
  - At risk for adverse events from polypharmacy
  - More likely to be compromised from hypoglycemia

- **Less ambitious targets**
- **HbA1c <7.5–8.0% if tighter targets not easily achieved**
- **Focus on drug safety**
OTHER CONSIDERATIONS

- **Weight**
  - Majority of T2DM patients overweight / obese
  - Intensive lifestyle program
  - Metformin
  - GLP-1 receptor agonists
  - ? Bariatric surgery
  - Consider LADA (“1.5”) in lean patients

Diabetes Care 2012; Diabetologia 2012:
OTHER CONSIDERATIONS

• Comorbidities
  - Coronary Disease
  - Heart Failure
  - Renal disease
  - Liver dysfunction
  - Hypoglycemia

Diabetes Care 2012; Diabetologia 2012:
T2DM Anti-hyperglycemic Therapy: **General Recommendations**

Healthy eating, weight control, increased physical activity

<table>
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<td></td>
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</tr>
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<td>Metformin + Sulfonylurea</td>
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</tr>
<tr>
<td>Metformin + Sulfonylurea</td>
<td>high</td>
<td>moderate risk</td>
<td>gain</td>
<td>hypoglycemia</td>
<td>low</td>
</tr>
<tr>
<td>Thiazolidinedione</td>
<td>high</td>
<td>low risk</td>
<td>gain</td>
<td>edema, HF, fx's</td>
<td>high</td>
</tr>
<tr>
<td>DPP-4 Inhibitor</td>
<td>intermediate</td>
<td>low risk</td>
<td>neutral</td>
<td>rare</td>
<td>high</td>
</tr>
<tr>
<td>GLP-1 receptor agonist</td>
<td>high</td>
<td>low risk</td>
<td>loss</td>
<td>GI</td>
<td>high</td>
</tr>
<tr>
<td>Insulin (usually basal)</td>
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<td>high risk</td>
<td>gain</td>
<td>hypoglycemia</td>
<td>variable</td>
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<td>If combination therapy that includes basal insulin has failed to achieve HbA1c target after 3-6 months, proceed to a more complex insulin strategy, usually in combination with 1-2 non-insulin agents:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>Insulin (multiple daily doses)</td>
<td>Insulin (usually basal)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Diabetes Care 2012; Diabetologia 2012;
T2DM Anti-hyperglycemic Therapy: Goal = **Avoidance of Weight Gain**

<table>
<thead>
<tr>
<th>Drug Combinations</th>
<th>Efficacy (↓ HbA1c)</th>
<th>Hypoglycemia</th>
<th>Weight</th>
<th>Major Side Effect(s)</th>
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</tr>
</thead>
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<tr>
<td><strong>Initial drug monotherapy</strong></td>
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<td>Hypoglycemia</td>
<td>Weight</td>
<td>Side effects</td>
<td>Costs</td>
</tr>
<tr>
<td>Metformin</td>
<td>high</td>
<td>low risk</td>
<td>neutral/toxic</td>
<td>GI/tachycardia</td>
<td>low</td>
</tr>
</tbody>
</table>

*If needed to reach individualized HbA1c target after ~3 months, proceed to 2-drug combination.*

**Healthy eating, weight control, increased physical activity**

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<th>Drug Combinations</th>
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<tbody>
<tr>
<td><strong>Two drug combinations</strong></td>
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<td>Hypoglycemia</td>
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**Three drug combinations**

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**More complex insulin strategies**

<table>
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Diabetes Care 2012; Diabetologia 2012:
T2DM Anti-hyperglycemic Therapy: Goal = Avoidance of Hypoglycemia
T2DM Anti-hyperglycemic Therapy: Goal = **Minimization of Costs**

### Initial drug monotherapy
- **Efficacy (↓ HbA1c)**
- **Hypoglycemia**
- **Weight**
- **Side effects**
- **Costs**

### Two drug combinations*
- **Efficacy (↓ HbA1c)**
- **Hypoglycemia**
- **Weight**
- **Major side effect(s)**
- **Costs**

### Three drug combinations

### More complex insulin strategies

---

**Metformin**
- high
- low risk
- neutral/loss
- GI / lactic acidosis
- low

### If needed to reach individualized HbA1c target after ~3 months, proceed to 2-drug combination (order not meant to denote any specific preference):

#### Metformin +

<table>
<thead>
<tr>
<th>Medicine</th>
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### If combination therapy that includes basal insulin has failed to achieve HbA1c target after 3-6 months, proceed to a more complex insulin strategy, usually in combination with 1-2 non-insulin agents:

- **Insulin‡ (multiple daily doses)**

---

Diabetes Care 2012; Diabetologia 2012:
AACE/ACE Diabetes Algorithm

Lifestyle Modification

A1C 6.5 – 7.5%
- Monotherapy
  - Metformin
- Dual Therapy
  - GLP-1 or DPP4
  - TZD
  - SGLT2
- Triple Therapy
  - Metformin
  - GLP-1 or DPP4
  - TZD

A1C 7.6 – 9.0%
- Monotherapy
  - Metformin
- Dual Therapy
  - GLP-1 or DPP4
  - TZD
  - SU or Glimepiride
- Triple Therapy
  - Metformin
  - GLP-1 or DPP4
  - TZD

A1C > 9.0%
- Monotherapy
  - Insulin

A1C Goal ≤ 6.5%

Available at www.aace.com/pub
Key Points of Medication Selection in Type 2

- Metformin at diagnosis or soon after diagnosis
- Second line agents- many other meds including injectables
- Advance therapy as disease progresses taking individual factors into account
- Maintain a patient-centered approach
Basal Insulin in Type 2 Diabetes
Role of Basal Insulin in Type 2 Diabetes

Beta-cell function declines as Type 2 diabetes progresses

Insulin in Type 2 Diabetes

- Many type 2 patients will require insulin if they live long enough
  - 7 to 10 years post diagnosis
  - A1C > 9%
- Function of many non-insulin meds based on presence of native insulin
Insulin Today

• Modern insulins safer and more predictable

• Most insulin types come in pen injectors

• Pen injectors easy to use, to teach, less cumbersome than vials/syringes
Long-Acting Insulin

- Detemir (Levemir)
- Glargine (Lantus)
- (Human NPH (N) )
- Taken 1 or 2 times daily
- “Basal” insulin
Rapid Acting Insulin

- Aspart (Novolog)
- Lispro (Humalog)
- Glulisine (Apidra)
- (Human Regular)

- Taken with meals and snacks
- “Bolus” insulin
Insulin Time Action Curves

Rapid (Lispro, Glulisine, Aspart)

Short (Regular)

Intermediate (NPH)

Long (Detemir, Glargine)

adapted from R. Bergenstal, IDC
Basal Insulin in Type 2 Diabetes

- Glargine (Lantus), Detemir (Levemir)
- (NPH)
- Good, potent add-on for improved A1C
- Second line agent for some patients
- Consider when A1C >9, diabetes longer than 5 to 7 years
Basal Insulin in Type 2 Diabetes

- Some oral meds may be continued
  - metformin, maybe TZD, maybe SU, maybe gliptin (DPP-IV), maybe GLP-1
- Glargine (Lantus) or Detemir (Levemir) started at 10 units at HS or weight based
- Increase 3 units every 3 to 5 days until fasting blood sugars <110 (or <140)
- Many type 2 on 50-80+ units/day
Medication Combinations

- Sulfonylureas: Virtually any in type 2
- Metformin: Virtually any in type 2
- TZD: Virtually any in type 2
- Gliptins (DPP-IV): metformin, TZD, insulin, sulfonylureas
- Insulin: metformin, TZD, sulfonylurea, amylin, GLP-1, gliptin (DPP-IV)
- Amylin: only in insulin regimens
- Exenatide/Liraglutide: metformin, sulfonyureas, TZD, insulin
Medication Indications

- Type 1 Diabetes: Insulin, amylin (amylin only in combination with insulin)
- Type 2 Diabetes: All oral agents, exenatide, liraglutide, amylin, insulin (amylin only in combination with insulin)
Review: Typical Type 2 Timeline

• Metformin at or shortly after diagnosis
• Add something else
• Consider insulin if:
  - Duration >5-7 years
  - A1C >9

Take individual factors into account
3 Things to Consider With Medications in Type 2 Diabetes

• Where is the patient on their diabetes timeline?
  - betacell decline over time

• What are their individual factors and needs at this time?
  - age, obesity, hypoglycemia avoidance, cvd, other co-morbid conditions

• Advance therapy every 3 to 6 months if not meeting goals
Summary

• Diabetes is common
• Understand Medications and Indications
• Type 1 diabetes: Insulin regimen (pumps)
• Type 2 diabetes: Lots of choices, but nearly all will need insulin eventually
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- William Zaks, M.D., Ph.D., Altru Diabetes Center
- Altru Diabetes Center Team
- Melissa Gardner, Department of Family and Community Medicine, UNDSMHS
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Slide Decks (Diabetes, Tobacco, other)
http://www.med.und.edu/familymedicine/slidedecks.html

iTunes Podcasts (Diabetes) (Free downloads)
http://www.med.und.edu/podcasts/ or iTunes>> search UND Medcast

WebMD Page: (under construction)
http://www.webmd.com/eric-l-johnson

Diabetes e-columns (archived): http://www.ndhealth.gov/diabetescollection/DrJohnson/DrJohnson.htm