Glycemic Targets and Pattern Management

Janice Lazear, DNP, FNP-C, CDE
Objectives

- Describe principles related to self-monitoring of blood glucose
- List blood glucose targets for various populations
- Discuss the use of algorithms for management of patients with T2DM
- Describe the components of pattern management
Assessment of Glycemic Control

- Methods of assessing glycemic control
  - Self-monitoring of blood glucose (SMBG)
  - A1C
  - Continuous glucose monitoring (CGM)
ADA Recommendations: Assessment of Glycemic Control

- When prescribed as part of a broader educational context, SMBG results may help guide treatment decisions and/or self-management for patients using less frequent insulin injections B or noninsulin therapies. E

- When prescribing SMBG, ensure that patients receive ongoing instruction and regular evaluation of SMBG technique, SMBG results, and their ability to use SMBG data to adjust therapy. E
ADA Recommendations

- Patients on multiple-dose insulin or insulin pump therapy should perform SMBG prior to meals and snacks, occasionally postprandially, at bedtime, prior to exercise, when they suspect low blood glucose, after treating low blood glucose until they are normoglycemic, and prior to critical tasks such as driving. B

- When used properly, CGM in conjunction with intensive insulin regimens is a useful tool to lower A1C in selected adults (aged ≥25 years) with type 1 diabetes. A
ADA Recommendations

- Although the evidence for A1C lowering is less strong in children, teens, and younger adults, CGM may be helpful in these groups. Success correlates with adherence to ongoing use of the device. B

- CGM may be a supplemental tool to SMBG in those with hypoglycemia unawareness and/or frequent hypoglycemic episodes. C
ADA Recommendations

- Given variable adherence to CGM, assess individual readiness for continuing use of CGM prior to prescribing. **E**

- When prescribing CGM, robust diabetes education, training, and support are required for optimal CGM implementation and ongoing use. **E**
SMBG

- Gives patient feedback for self-management
- Guides diabetes team in adjusting regimen
  - Medication decisions
  - MNT
  - Physical activity
- Prevention of hypoglycemia
- Association between frequency of testing and improved A1C
The Application of SMBG

- Patient Education in the use of SMBG Data
  - Adjusting medication
  - Planning exercise
  - Adjusting diet
  - Avoid hypoglycemia
For Patients on Intensive Insulin Regimens

Before meals and snacks
Some postprandial values
At bedtime
Symptoms of low blood sugar
ADA Glycemic Targets
Nonpregnant Adults with Diabetes

<table>
<thead>
<tr>
<th>A1c</th>
<th>&lt;7.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprandial</td>
<td>80 – 130 mg/dl</td>
</tr>
<tr>
<td>Peak postprandial</td>
<td>&lt;180</td>
</tr>
</tbody>
</table>
ACE/AACE Glycemic Targets
Nonpregnant Adults with Diabetes

<table>
<thead>
<tr>
<th>A1c</th>
<th>&lt;6.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprandial</td>
<td>&lt;110 mg/dL</td>
</tr>
<tr>
<td></td>
<td>Individualize on the basis of age, comorbidities, duration of disease, and hypoglycemia risk:</td>
</tr>
<tr>
<td></td>
<td>• In general, ≤6.5 for most*</td>
</tr>
<tr>
<td></td>
<td>• Closer to normal for healthy</td>
</tr>
<tr>
<td></td>
<td>• Less stringent for “less healthy”</td>
</tr>
<tr>
<td>Peak postprandial</td>
<td>&lt;140</td>
</tr>
</tbody>
</table>
Individualize Targets

- Age/life expectancy
- Comorbid conditions
- Diabetes duration
- Hypoglycemia status
- Individual patient issues
- CVD and/or microvascular complications
ACE/AACE
Targets in Recent Onset of T2DM

- Normal or near normal glycemia may be considered
- No clinically significant CVD
- No substantial hypoglycemia
- Delays microvascular complications
ACE/ACCE

A1C goal of 7 to 8 if:
- Limited life expectancy
- History of severe hypoglycemia
- Advanced renal disease or macrovascular complications
- Comorbid conditions
- Difficult to attain A1C goals in patients with a long history of diabetes
<table>
<thead>
<tr>
<th>GDM targets for women without preexisting type 1 or 2 diabetes</th>
<th>Targets for women with preexisting type 1 or 2 who become pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprandial: ≤95 mg/dL (5.3 mmol/L) and either</td>
<td>Premeal, bedtime, overnight glucose: 60-99 mg/dL (3.3-5.4 mmol/L)</td>
</tr>
<tr>
<td>1-hr postmeal: ≤140 mg/dL (7.8 mmol/L)</td>
<td>Peak postprandial glucose: 100-129 mg/dL (5.4-7.1 mmol/L)</td>
</tr>
<tr>
<td>2-hr postmeal: ≤120 mg/dL (6.7 mmol/L)</td>
<td>A1C: &lt;6.0%</td>
</tr>
</tbody>
</table>

GDM = gestational diabetes mellitus

Correlation of A1C With Average Glucose

<table>
<thead>
<tr>
<th>A1C %</th>
<th>Mean plasma glucose mg/dL (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>126 (7.0)</td>
</tr>
<tr>
<td>7</td>
<td>154 (8.6)</td>
</tr>
<tr>
<td>8</td>
<td>183 (10.2)</td>
</tr>
<tr>
<td>9</td>
<td>212 (11.8)</td>
</tr>
<tr>
<td>10</td>
<td>240 (13.4)</td>
</tr>
<tr>
<td>11</td>
<td>269 (14.9)</td>
</tr>
<tr>
<td>12</td>
<td>298 (16.5)</td>
</tr>
</tbody>
</table>

Frequency of A1C Testing

Perform A1C test

- At least 2 times each year in individuals who are meeting treatment targets and have stable glycemic control
- Quarterly in individuals whose therapy has changed or who are not meeting glycemic targets

Point-of-care A1C testing allows for more timely treatment changes

Individualization of Glycemic Targets for Adults With Diabetes

Lowering A1C below or around 7.0% shown to reduce:
- Microvascular complications
- Macrovascular disease*

More or less stringent targets may be appropriate for individual patients if achieved without significant hypoglycemia or adverse events.

More stringent (<6.5%):
- Short diabetes duration
- Long life expectancy
- No significant CVD/vascular complications

Less stringent (<8%):
- Severe hypoglycemia history
- Limited life expectancy
- Advanced microvascular or macrovascular complications
- Extensive comorbidities
- Long-term diabetes in whom general A1C target difficult to attain

*If implemented soon after diagnosis
CVD=cardiovascular disease

Depicted are patient and disease factors used to determine optimal A1C targets.

American Diabetes Association Dia Care 2015;38:S33-S40
Glycemic Targets for Children and Adolescents With Type 1 Diabetes

Consider risk-benefit assessment, including hypoglycemia risk, when individualizing targets.

- All children & adolescents:
  - A1C < 7.5%†
  - Plasma glucose before meals: 90-130 mg/dL (5.0-7.2 mmol/L)
  - Plasma glucose at bedtime & overnight: 90-150 mg/dL (5.0-8.3 mmol/L)

Lower goal (<7.0%) reasonable if can be achieved without excessive hypoglycemia.

Goals should be individualized; Glucose goals should be modified in children with frequent hypoglycemia or hypoglycemia unawareness; If on basal-bolus: measure postprandial PG to monitor glycemic values and if discrepancy between preprandial PG and A1C.

# Management of High Blood Pressure

<table>
<thead>
<tr>
<th>Screening</th>
<th>Measure BP at every visit; confirm elevated BP at separate visit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment targets</strong></td>
<td>Diabetes and hypertension: SBP &lt; 140 mm Hg</td>
</tr>
<tr>
<td></td>
<td>• Lower SBP targets (eg, &lt;130 mm Hg) may be appropriate*</td>
</tr>
<tr>
<td></td>
<td>Diabetes: DBP &lt; 90 mm Hg</td>
</tr>
<tr>
<td></td>
<td>• Lower DBP target (eg, 80 mm Hg) may be appropriate*</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>BP &gt; 120/80 mm Hg: lifestyle changes</td>
</tr>
<tr>
<td></td>
<td>• Weight loss (if overweight) • DASH-style diet incl sodium restriction, potassium increase • Moderate alcohol intake • Increased physical activity</td>
</tr>
<tr>
<td></td>
<td>BP &gt; 140/90 mm Hg: lifestyle changes + pharmacologic therapy</td>
</tr>
<tr>
<td></td>
<td>• Diabetes and hypertension: ACEI or ARB†</td>
</tr>
<tr>
<td></td>
<td>• ≥2 agents, incl thiazide-type diuretic, ACEI, or ARB, at max doses usually required to achieve targets</td>
</tr>
<tr>
<td></td>
<td>• Administer ≥1 agent at bedtime</td>
</tr>
<tr>
<td></td>
<td>• ACEI, ARB, diuretic: monitor serum creatinine/eGFR and serum potassium</td>
</tr>
<tr>
<td><strong>Treatment and targets for pregnant women</strong></td>
<td>Diabetes and hypertension: 110-129/65-79 mm Hg target</td>
</tr>
<tr>
<td></td>
<td>ACEI, ARB contraindicated</td>
</tr>
</tbody>
</table>

*In certain individuals (eg, younger), if achieved without treatment burden; †if one class not tolerated, substitute another class
ACEI=angiotensin-converting enzyme inhibitor; ARB=angiotensin receptor blocker; DASH=Dietary Approaches to Stop Hypertension; DBP=diastolic blood pressure; eGFR=estimated glomerular filtration rate; SBP=systolic blood pressure

Management of Dyslipidemia: Lifestyle + Statin Based on Risk

Treatment initiation and initial dose driven by risk status—not LDL-C level

<table>
<thead>
<tr>
<th>Age</th>
<th>Risk factors</th>
<th>Statin intensity</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;40</td>
<td>0 CVD risk factors</td>
<td>N/A</td>
<td>Annually or as needed to check adherence</td>
</tr>
<tr>
<td></td>
<td>Overt CVD</td>
<td>Moderate or high</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>40-75</td>
<td>0 CVD risk factors</td>
<td>Moderate</td>
<td>As needed to check adherence</td>
</tr>
<tr>
<td></td>
<td>Overt CVD</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>&gt;75</td>
<td>0 CVD risk factors</td>
<td>Moderate</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

Screening at diabetes diagnosis, initial medical evaluation, and/or at age 40
Periodically (every 1-2 yrs) thereafter

At time of publication, combination therapy (statin + add-on nonstatin) was not shown to provide incremental CVD benefit. Results from IMPROVE-IT\(^1\) have since shown a 2% CV risk reduction with ezetimibe/statin vs statin alone.

CVD risk factors: LDL-C \(\geq 100\) mg/dL (2.6 mmol/L), high blood pressure, smoking, overweight/obesity
Overt CVD: Individuals with prior cardiovascular events or acute coronary syndrome

Glycemic Control Algorithm

**Lifestyle Modification**
( Including Medically Assisted Weight Loss)

**Entry A1c < 7.5%**
- **Monotherapy**
  - Metformin
  - GLP-1 RA
  - SGLT-2i
  - DPP-4i
  - AGi
  - TZD
  - SU/GLN
  - If not at goal in 3 months proceed to Double Therapy

**Entry A1c ≥ 7.5%**
- **Dual Therapy**
  - GLP-1 RA
  - SGLT-2i
  - DPP-4i
  - TZD
  - Basal Insulin
  - Colesevelam
  - Bromocriptine QR
  - AGi
  - SU/GLN
  - If not at goal in 3 months proceed to Triple Therapy

**Entry A1c > 9.0%**
- **Triple Therapy**
  - GLP-1 RA
  - SGLT-2i
  - TZD
  - Basal Insulin
  - DPP-4i
  - Colesevelam
  - Bromocriptine QR
  - AGi
  - SU/GLN
  - If not at goal in 3 months proceed to intensify insulin therapy

**Symptoms**
- **NO**
  - Dual Therapy
- **YES**
  - TRIPLE Therapy

**Add or Intensify Insulin**
- Refer to Insulin Algorithm

**Legend**
- Check: Free adverse events or possible benefits
- Exclamation: Use with caution

*Order of medications listed represents a suggested hierarchy of usage*

**Progression of Disease**

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**Algorithm for Adding/Intensifying Insulin**

### Start Basal (long-acting insulin)

**A1c < 8%**
- TDD: 0.1–0.2 U/kg

**A1c > 8%**
- TDD: 0.2–0.3 U/kg

**Insulin titration every 2–3 days to reach glycemic goal:**
- Fixed regimen: Increase TDD by 2 U
- Adjustable regimen:
  - FBG > 180 mg/dL: add 20% of TDD
  - FBG 140–180 mg/dL: add 10% of TDD
  - FBG 110–139 mg/dL: add 1 Unit
  - If hypoglycemia, reduce TDD by:
    - BG < 70 mg/dL: 10% – 20%
    - BG < 40 mg/dL: 20% – 40%

**Consider discontinuing or reducing sulfonylurea after basal insulin started (basal analogs preferred to NPH)**

**Glycemic Goal:**
- <7% for most patients with T2DM; fasting and premeal BG < 110 mg/dL; absence of hypoglycemia
- A1c and FBG targets may be adjusted based on patient’s age, duration of diabetes, presence of comorbidities, diabetic complications, and hypoglycemia risk

### Intensify (prandial control)

**Add GLP-1 RA or SGLT-2i or DPP-4i**

**Add Prandial Insulin**
- TDD: 0.3–0.5 U/kg
  - 50% Basal Analog
  - 50% Prandial Analog
  - Less desirable: NPH and regular insulin or premixed insulin

**Insulin titration every 2–3 days to reach glycemic goal:**
- Increase prandial dose by 10% for any meal if the 2-hr postprandial or next premeal glucose is > 180 mg/dL
- Premixed: Increase TDD by 10% if fasting/premeal BG > 180 mg/dL
- If fasting AM hypoglycemia, reduce basal insulin
- If nighttime hypoglycemia, reduce basal and/or pre-supper or pre-evening snack short/rapid-acting insulin
- If between-meal daytime hypoglycemia, reduce previous premeal short/rapid-acting insulin

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Pattern Management

- Comprehensive approach to blood glucose control
  - Patterns are trends not single values
  - Pattern
    - Series of out-of-range glucose values obtained at the same time each day
    - Examples of patterns
      - Frequent high blood glucose
      - Frequent low blood glucose
      - High preprandial blood glucose
      - Low preprandial blood glucose
      - Postprandial blood glucose spikes
      - Poor control with little or no pattern
Strategies

- Review several days of glucose records
- Make adjustments based on trends
- Balance food intake, activity and insulin/oral medications
- Pattern management includes all variables
  - Stress
  - Illness
Pattern Management

- Based on SMBG logs and other data
  - Changes to insulin does
  - Oral medications
  - Carbohydrate intake
  - Activity level
- Examine patterns that are consistent trends in blood glucose over several consecutive days
Gathering Data

- Blood glucose logs
- Food diaries
Pattern Management Versus Sliding Scale

- Sliding scale (supplemental insulin)
  - Adjusting insulin to correct BG based on a single BG value
  - Does not solve problems – quick fix OR
  - Closing the barn door when the cow is already out of the barn
Adjusting Based on Pattern Management

- Changes are based on the root cause of recurring problems

- Prevents the repetition of problems

- Adjustments are made to prevent out of target BG values
Goals of Pattern Management

- Patient safety
  - Hypoglycemia
  - Hyperglycemia
- Increases the patient’s awareness of cause and effect
- Enhances patient’s problem solving skills
- Empower patients - promotes independence in achieving glycemic control
Pattern Management is NOT:

- Providers or diabetes educators adjusting does on BG data alone
- Effective without the patient’s buy-in and active participation
Patient Centered Approach

Patient

Educator

Providers and Team Members

Preferences

Family

Values

Needs
Avoid simply providing information

Empower the patient to make informed self-management choices
Required Knowledge and Skills

- SMBG
- Interpretation of blood glucose results
- Correct medication administration
- Ability to identify the effect of diet and activity of blood glucose
- Keep records – blood glucose, diet and exercise
  - Written
  - Electronic
Pattern: Hypoglycemia

- Excess medication
- Overcorrection with insulin
- Carbohydrate too low for medication dose
- Increase in physical activity without
  - Increase in food intake
  - Decrease in insulin
- Alcohol intake without increase in carbohydrate intake
Pattern: Hyperglycemia

- Not enough medication
- Skipped/forgotten dose of medication
- Expired insulin
- Insulin not stored properly
- Carbohydrate intake too much for medication dose
- Decreased physical activity
- Stress or illness
Barriers to Effective Pattern Management

- Low numeric literacy
- Lack of or poor initial diabetes education
- Inadequate problem solving skills
- Burn out
  - Record keeping
  - Time consuming
  - Discomfort
Role of CDE in Pattern Management

- Validate knowledge and skills
- Ascertain the patients goals and priorities
- Verify targets
- Individualize approach and identify preferred tools
  - Technology
  - Communication
Questions?