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IMPROVING GLYCEMIC CONTROL IN TYPE 2 DIABETES

A Practical Guide for Performance Improvement

NEWSLETTER FACULTY

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COMPLIMENTARY CME/CE

This implementation guide is one of the many certified continuing medical education activities available in the series, Performance Improvement Strategies: Diabetes Care. Now in its second year, this series offers a comprehensive collection of activities designed to cover a broad range of topics on diabetes care, with the ultimate goal of helping primary healthcare professionals improve the care of patients with diabetes. For additional information on this certified CME/CE initiative or to view the other available activities, visit www.pi-iq.com/diabetes.

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Series Overview/Statement of Need
Diabetes mellitus is a worldwide epidemic that has created a crisis for the healthcare system and society. Recent findings from large randomized controlled trials provide clear and compelling evidence that intensive treatment of diabetes mellitus and its known risk factors can significantly decrease the development and/or progression of diabetes-related complications. Achieving glycemic control, treating hypertension, and controlling blood lipid levels are the cornerstones of preventing diabetes-related complications and early death. Furthermore, patient participation in the management of this progressive disease is essential for success.

Primary care physicians play a central role in the management of patients with diabetes, providing care for approximately 90% to 95% of adult patients with type 2 diabetes. The challenges of keeping abreast of recent advances in glycemic control and the prevention and detection of diabetes-related complications are major barriers to the implementation of optimal management strategies.

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LEARNING OBJECTIVES

Upon completion, participants should be able to:

1. Identify glycemic targets and implement screening recommendations for glycemia in patients with type 2 diabetes
2. Implement guideline- and algorithm-based approaches to achieve glycemic control in patients with type 2 diabetes
3. Discuss the roles that self-monitoring of blood glucose and specialist referral play in the management of type 2 diabetes

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PROGRAM DESCRIPTION

This implementation guide is one of the many certified continuing medical education activities available in the series, Performance Improvement Strategies: Diabetes Care. Now in its second year, this series offers a comprehensive collection of activities designed to cover a broad range of topics on diabetes care, with the ultimate goal of helping primary healthcare professionals improve the care of patients with diabetes.

The performance improvement track of this program guides physicians through a three-step process of self-assessing current practice, implementing change to current practice, and evaluating the effects of the changes implemented. As part of the self-assessment process, healthcare professionals collect data retrospectively from 20 diabetes care visits and choose at least one of three benchmark areas to improve:

- General diabetes care
- Preventing and managing diabetes-related complications
- Improving glycemic control

Each of the three general benchmarks has several specific areas of care that can be the focus of performance improvements. For example, the general care benchmark encompasses areas such as diet, physical activity, and medication adherence. The suggestions offered for specific areas of care align with guideline and consensus statement recommendations to encourage the delivery of evidence-based care.

THE PURPOSE OF THIS GUIDE

Although this guide can benefit all healthcare professionals who manage patients with diabetes, it has primarily been designed to serve as a practical guide for those who are participating in the performance improvement track of this program and who have chosen the improving glycemic control benchmark as the focus of their improvement plan. With this focus in mind, it will offer targeted recommendations and practical suggestions, tips, tools, and forms that are specifically related to the measurable areas of care collected on the patient data forms: HbA1C (levels, frequency of testing, actions taken to reduce levels), hypoglycemia, and self-monitoring of blood glucose. This guide is not meant to be a comprehensive review of the entire spectrum of pharmacologic options available to improve glycemic control (participants seeking this information should refer to the ADA and AACE guidelines, in addition to the prescribing information for individual agents). It focuses solely on key strategies outlined in guidelines and consensus statements, providing healthcare professionals with practical information and tools that can immediately be applied to their own practice for the benefit of their diabetes patients.

Improving Glycemic Control in Type 2 Diabetes:

A Practical Guide for Performance Improvement

INTRODUCTION

Type 2 diabetes mellitus is now recognized as a progressive disease that, in most patients, will require escalating pharmacologic interventions over time.[1,2] Research has conclusively shown that achieving and maintaining glycemic control can delay or prevent diabetes-related complications, but many patients with type 2 diabetes fail to achieve adequate control.[3,4] Therefore, managing glycemia and improving control are at the core of successful diabetes care.

Although lifestyle modifications can have profound benefits, most patients with type 2 diabetes fail to achieve glycemic control with physical exercise and diet alone.[3] In addition, because of the chronic nature of the disease, even those who successfully implement lifestyle modifications typically require pharmacologic therapy to reach target HbA1C levels as their disease progresses.[3]

Fortunately, the recent developments of additional noninsulin agents and new types of insulins have increased the number of available therapeutic choices.[1] With the plethora of available agents and wide variety of individual patient characteristics, however, it can be difficult to choose the most appropriate interventions for patients with type 2 diabetes and modify treatment regimens when necessary.[2]

WHAT'S INSIDE

This guide will focus on guideline-based strategies for improving glycemic control in patients with type 2 diabetes. As part of this discussion, we will review HbA1C goals and screening recommendations from both the American Diabetes Association (ADA) and the American Association of Clinical Endocrinologists (AACE), as well as two recently published algorithms that offer simplified, step-wise approaches to initiating and advancing pharmacologic therapy to improve glycemic control. We will also discuss treatment strategies that have been shown to effectively control hyperglycemia, ways to address patient reluctance to insulin use, protocols for self-monitoring of blood glucose (SMBG), strategies for managing hypoglycemia, and specialist referrals.

CONTROLLING HBA1C LEVELS

Goals[1,3,5]:

- ADA: Maintain an average HbA1C value of < 7.0% in most patients
- AACE: Maintain an average HbA1C values of < 6.5%

Clinical trials have helped establish the glycemic goals suggested by the ADA and AACE. Results from the UKPDS (United Kingdom Prospective Diabetes Study) suggested that treatment to below or around 7% is associated with a reduction in the risk of microvascular disease.[6] In addition, both the UKPDS and Kumamoto studies demonstrated significant reductions in microvascular and neuropathic complications with intensive therapy.[6,7] A more recent analysis of the UKPDS data found that relative risk reductions were sustained 10 years after the cessation of interventions, suggesting that early and intensive intervention has a lasting effect on reducing rates of microvascular complications, myocardial infarction, and death from any cause.[8]

STANDARD, INTENSIVE, AND RELAXED CONTROL

Several trials have attempted to determine whether more intensive glycemic control (< 6% to 6.5%) is superior to standard therapy (< 7%). The ACCORD study (Action to Control Cardiovascular Risk in Diabetes) showed an increase in cardiovascular disease (CVD) mortality in the intensive treatment group (HbA1C < 6%), which led to the early discontinuation of this arm, but a subgroup analysis showed some evidence of CVD benefit with intensive control in patients without prior CVD events or whose HbA1C levels were 8% or less at baseline.[9,10] In contrast, the ADVANCE study (Action in Diabetes and Vascular disease: Preterax and Diamicron MR Controlled Evaluation) did not find that the intensive regimens (HbA1C levels < 6.5%) increased total or CVD mortality.[11] In addition, the ADVANCE trial demonstrated reductions in the combined incidence of micro- and macrovascular events, primarily due to reductions in the incidence of nephropathy.[11] Collectively, these studies support a role for intensive therapy for type 2 diabetes in some, but not all, patients.

Therefore, when setting HbA1C goals, recommendations from AACE and the ADA note that individual patient needs and circumstances should be taken into account. For example, less stringent goals (> 7%) may be preferred in patients with a history of cardiovascular problems, severe hypoglycemia, limited life expectancy, comorbid conditions, and longstanding diabetes, as well as in special populations such as children and the elderly.[3,5] In contrast, more stringent goals (lower than the standard goal of < 7%) may be appropriate in patients with a short duration of diabetes, with long life expectancies, or without significant CVD.[5]

HbA1C ALTERNATIVE

Although HbA1C values are indicative of long-term glycemic levels, they do not reflect glycemic variability.[3] In particular, patients with type 2 diabetes who

have severe insulin deficiency may be prone to significant glucose excursions. In these patients, fasting, preprandial, and postprandial levels of plasma or capillary glucose in combination with HbA1C measurements more accurately reflect glycemic control.[2,3] The ADA recommends targets of[2,3]:

- Fasting/preprandial: 70-130 mg/dL
- Postprandial (1.5 to 2 hours after a meal): < 180 mg/dL

These recommendations, however, are somewhat controversial, with some experts recommending lower goals. The AACE, for example, recommends fasting levels of less than 110 mg/dL and postprandial levels of less than 140 mg/dL.[1]

FREQUENCY OF TESTING

Guidelines offer the following recommendations for HbA1C testing[3,12]:

- Test at initial assessment
- Test every 6 months in patients who have achieved and maintained treatment goals
- Test every 2 to 3 months if patients are not meeting goals or if therapy is modified

Point-of-care testing is ideal because it allows healthcare professionals to make immediate therapy decisions.[3] Most offices, however, are not set up for this type of testing. In such cases, an equally effective alternative is to have patients visit the lab 1 week before the scheduled visit so up-to-date results can be reviewed at the patient visit.

Keep in mind that the frequency of HbA1C monitoring depends on individual patient factors and clinician judgment.[3] Tool 1 provides key HbA1C goals and information in a pocket-card format for easy reference.

PRACTICAL STRATEGIES TO MEET GLYCEMIC GOALS

Numerous treatment strategies have been published to help clinicians initiate and manage antihyperglycemic therapies in patients with type 2 diabetes. This section of the publication provides an overview of two recently published algorithms—one released by AACE in conjunction with the American College of Endocrinology (ACE), and another that appears in a revised consensus statement authored by Nathan et al and published jointly by the ADA and the European Association for the Study of Diabetes (EASD).[2,12]

Although the algorithms differ from one another in their approaches in several notable ways (Table 1), both underscore the importance of lifestyle modifications and diabetes education in diabetes therapy. Recommended interventions should include weight management, physical activity, medical nutrition therapy, and patient education.[2,12] (Additional information on these interventions can be found in MedIQ's implementation guide on general diabetes care available at www.pi-iq.com/diabetes) However, the AACE/ACE and Nathan approaches concur that diet and exercise alone are usually insufficient to attain and maintain glycemic control, and, therefore, support the early initiation of pharmacologic agents as a preferred approach.[2,12]

These algorithms strive to use medications that will minimize side effects, such as hypoglycemia and

TABLE 1. Key Differences Between the AACE/ACE and Nathan et al Algorithms

	AACE/ACE	Nathan et al.
General Approach	Offers three different therapeutic pathways based on current HbA1C levels	Offers a step-wise approach to intervention based on response to therapy (ie, does not take starting HbA1C value into consideration)
Initiating Therapy	Recommends different initial approaches for different starting HbA1C values: • 6.5%-7.5%: a single oral agent • 7.6%-9.0%: two agents (ie, dual therapy) • > 9%: insulin or up to three oral agents	Follows the same treatment sequence of adding one agent or insulin at a time for all patients
Novel Agents	Allows the first-line use of newer antihyperglycemic agents such as GLP-1 agonists or DPP-4 inhibitors	Does not consider newer antihyperglycemic agents to be appropriate first-choice therapies due to a lack of long-term evidence
Triple Noninsulin Therapy	Offers this approach as an option before initiating insulin	Recommends choosing insulin after failure of dual-agent strategies because of cost and efficacy

DPP-4 = dipeptidyl peptidase-4 inhibitors; GLP-1 = glucagon-like peptide-1 agonists.

The Importance of Charting

Accurate charting is an important aspect of medical practice that can help provide high-quality care and improve patient adherence and outcomes.[a,b] In addition, it also has the added benefit of offering an enhanced level of legal protection to healthcare professionals.[b] One 2005 report from a primary care practice highlighted the positive effects that improved charting can have on the delivery of guidelines-based care to diabetes patients.[a] This practice served more than 500 patients with diabetes and examined how charting improvements on national benchmarks for HbA1C levels, LDL cholesterol (LDL-C), and foot exams could bring physicians closer to Diabetes Physician Recognition Program standards of care.

Interestingly, initial reports showed that although physicians were reporting that they were doing foot exams, few were documenting this action in the chart. By focusing on properly documenting HbA1C testing, LDL-C testing, and foot exams in the electronic medical record (EMR), the percentage of patients receiving these assessments improved; LDL-C monitoring rose from 32% in 2001 to 91% in 2005, and physician adherence to documenting foot exams rose from 1% in 2001 to 80% in 2005.[a] Statistical feedback offered by the EMR system played a large role in improving physician behavior, but the improvements in charting formed the foundation for improving the quality of care provided to diabetes patients.

[a]Helm R, Slawson J, Damitz B, et al. Beyond charting: using your EHR's data to improve quality. *Fam Pract Manag*. 2005;12(5):90-92. www.aafp.org/fpm/20050500/90beyo.html. Accessed October 12, 2010.
[b]Stimpfel N. Quality medical charts: the importance of proper medical record documentation. *TransforMed*, 2007. www.transformed.com/workingPapers/QualityMedicalCharts.pdf. Accessed October 12, 2010.

weight gain.[2,12] In addition, a basic principle behind combination therapy in both publications is the use of medications with complementary mechanisms of action to maximize glycemic control.[2,12] To facilitate the selection and use of noninsulin antihyperglycemic agents mentioned in this guide, a medication chart with mechanisms of action, initial doses, maximum doses, and contraindications is presented in Tool 2.

THE AACE/ACE ALGORITHM

Perhaps the most notable difference between the AACE/ACE and Nathan algorithms is that the AACE/ACE algorithm stratifies therapy according to the patient's starting HbA1C level, recommending initial therapies specific to the patient's HbA1C range (Figure 1).[12] Recommendations for preferred agents or combinations of therapies are based on efficacy and the risk of side effects, but the algorithm also recognizes that many choices for therapy exist. Basic strategies for each of the three HbA1C groups are outlined below.

Patients With HbA1C Levels of 6.5% to 7.5%. For patients with HbA1C levels in this range, monotherapy may be sufficient.[12] Unless contraindicated, metformin is usually the most appropriate choice, given its safety and efficacy. Gastrointestinal (GI) disturbances are the most common adverse effects of metformin and can be minimized by slowly titrating the dose over time or using an extended-release formulation.[12,13]

Other acceptable choices for monotherapy include a thiazolidinedione (TZD), a GLP-1 receptor agonist, a DPP-4 inhibitor, or an alpha-glucosidase inhibitor. TZDs may be preferred in patients with insulin resistance or metabolic syndrome or in patients with nonalcoholic fatty liver disease. All TZDs, however, carry a number of serious risks and are contraindicated in patients with congestive heart failure and liver disease.[14] Of note, sulfonylureas are not recommended as monotherapy in this HbA1C range because of relatively short-lived effectiveness and their substantial risk of hypoglycemia and weight gain.[12,15]

If monotherapy with maximally effective doses is unsuccessful after 2 to 3 months, dual therapy is indicated.[12] This algorithm recommends the addition of one of the following agents, in order of preference based on safety, tolerability, and ability to reduce postprandial glucose)[12]:

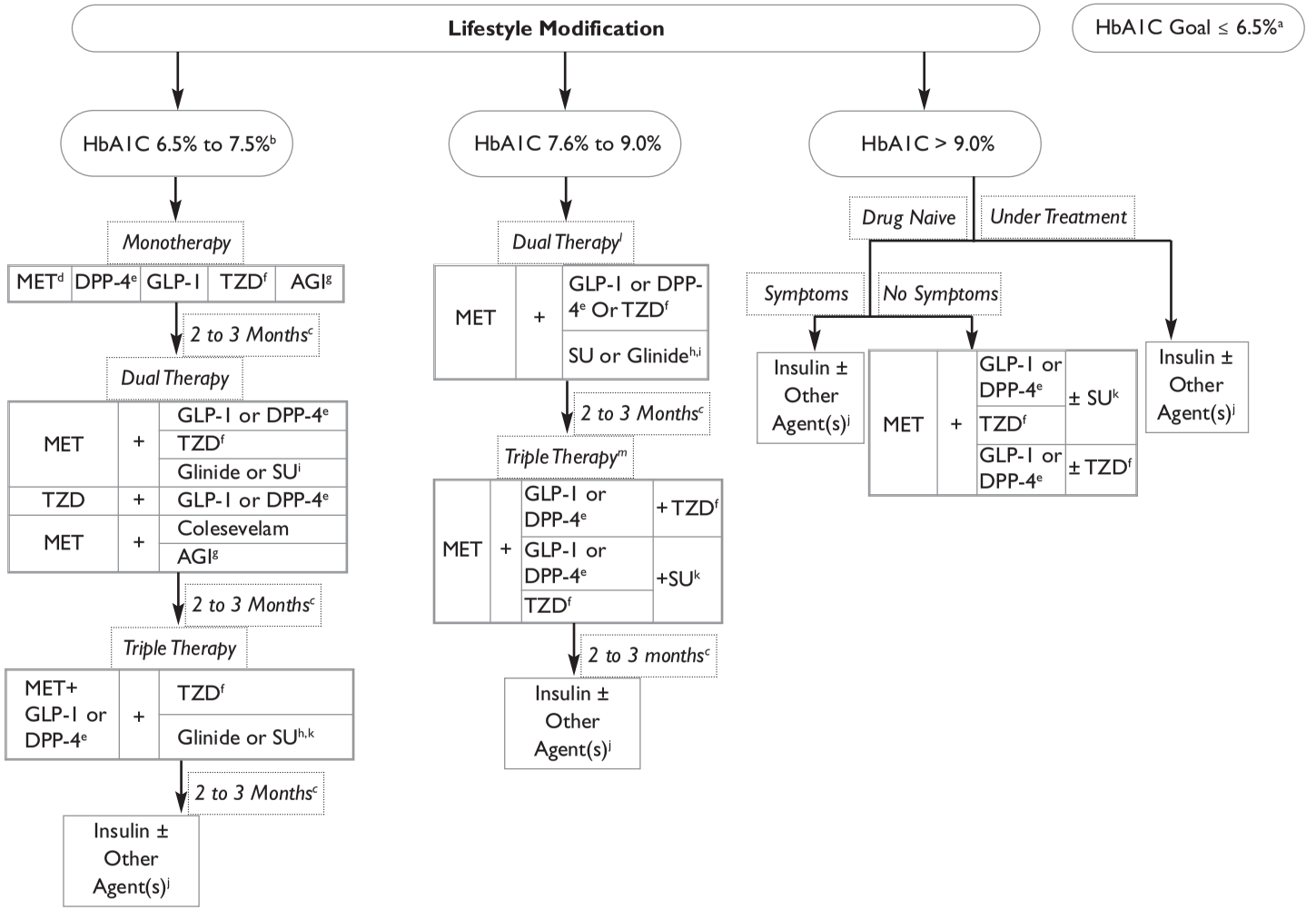
- GLP-1 receptor agonist
- DPP-4 inhibitor
- Insulin secretagogue (eg, glinide, sulfonylurea)

Metformin with either the bile acid sequestrant colesevelam or an alpha-glucosidase inhibitor are combinations also mentioned as choices for dual therapy because of their safety. Colesevelam also has the potential to reduce LDL cholesterol.[12,16] Colesevelam, however, can increase triglycerides, particularly when used with insulin or sulfonylureas; therefore, it is contraindicated in patients with serum triglycerides above 500 mg/dL.[17]

If maximally effective doses of each component of dual therapy fail to achieve HbA1C goals after 2 to 3 months, triple therapy or the addition of insulin is indicated.[12] For triple therapy, the preferred combination consists of metformin, an incretin (GLP-1 receptor agonist or DPP-4 inhibitor), and the addition of a TZD, a glinide, or a sulfonylurea. Because GLP-1 receptor agonists stimulate insulin secretion only in the presence of glucose, they carry a negligible risk of inducing hypoglycemia unless used with another insulin secretagogue such as a glinide or a sulfonylurea. In addition, they have been associated with delayed gastric emptying (which clinically manifests as nausea and, rarely, vomiting), increased satiety, and weight loss.[12]

Because of isolated reports of pancreatitis in patients taking GLP-1 receptor agonists as well as the DPP-4 inhibitor sitagliptin, these agents should not be used in patients with a history of pancreatitis.[18-20] In addition, although human relevance has not been shown, animal studies have demonstrated an in-

FIGURE 1. AACE/ACE Algorithm for Glycemic Control



AGI = alpha-glucosidase inhibitor; DPP4 = dipeptidyl peptidase-4; GLP-1 = glucagon-like peptide-1; MET = metformin; SU = sulfonylurea; TZD = thiazolidinedione.

[a] May not be appropriate for all patients; [b] For patients with diabetes and HbA1C < 6.5%, pharmacologic Rx may be considered; [c] If HbA1C goal not achieved safely; [d] Preferred initial agent; [e] DPP4 if ↑ PPG and ↑ FPG or GLP-1 if ↑ ↑ PPG ; [f] TZD if metabolic syndrome and/or nonalcoholic fatty liver disease; [g] AGI if ↑ PPG ; [h] Glinide if ↑ PPG or SU if ↑ FPG; [i] Low-dose secretagogue recommended; [j] 1) Discontinue insulin secretagogue with multidose insulin and 2) Can use pramlintide with prandial insulin; [k] Decrease secretagogue by 50% when added to GLP-1 or DPP-4; [l] If HbA1C < 8.5%, combination Rx with agents that cause hypoglycemia should be used with caution; [m] If HbA1C > 8.5%, in patients on dual therapy, insulin should be considered

Reprinted with permission from Rodbard HW, Jellinger PS, Davidson JA, et al. Statement by an American Association of Clinical Endocrinologists/American College of Endocrinology consensus panel on type 2 diabetes mellitus: an algorithm for glycemic control. *Endocr Pract*. 2009;15(6):540-559

crease in thyroid C-cell tumors with liraglutide, so this agent is contraindicated in patients with a personal or family history of medullary thyroid carcinoma or in patients with multiple endocrine neoplasia syndrome type 2.[20] When adding a DPP-4 inhibitor or a GLP-1 receptor agonist in patients who are already receiving an insulin secretagogue (such as a sulfonylurea), lowering the dose of the insulin secretagogue may be necessary to reduce the risk of hypoglycemia.[20,21]

Failure of triple therapy after 2 to 3 months indicates that β cells have impaired insulin secretory capacity, which necessitates insulin therapy.[12] Insulin therapy may take the form of basal, premixed, prandial, or basal-bolus insulin. The AACE/ACE algorithm recommends the use of the long-acting insulins glargine or detemir over regular human and NPH because of their relatively peakless action and more consistent effects.[12] (Key elements of initiating an insulin regimen are presented later in this guide.)

The AACE/ACE publication notes that physicians should consider discontinuing other antihyperglycemic agents (perhaps with the exception of metformin) due to potential side effects or lack of FDA approval for adjuvant use with insulin.[12]

Patients With HbA1C Levels of 7.6% to 9.0%. Because monotherapy is unlikely to be effective in controlling glycemia in patients with HbA1C levels in this range, dual therapy with metformin and another recommended agent is the initial step.[12] Metformin plus a GLP-1 receptor agonist is the preferred choice due to the GLP-1 receptor agonist's effect on limiting postprandial glucose excursions and promoting weight loss. A DPP-4 inhibitor is also a reasonable choice. TZDs, sulfonylureas, and glinides are acceptable choices, but have the potential for more serious side effects.[12]

If dual therapy is ineffective, options for triple therapy include metformin and either a GLP-1 receptor agonist or DPP-4 inhibitor, plus a TZD or sulfonylurea (see Figure 1 for order of preference).[12] Metformin, a TZD, and a sulfonylurea is also an acceptable triple-therapy regimen, but this combination is associated with an increased risk of weight gain and hypoglycemia. Because glinides, colesevelam, and alpha-glucosidase inhibitors have limited HbA1C-lowering capabilities, they are not considered appropriate for patients with HbA1C levels in this range.[12]

If triple therapy fails, insulin may be initiated.[12]

Patients With HbA1C Levels > 9%. In newly diagnosed patients with symptoms such as polyuria or polydipsia, or in patients who have failed noninsulin regimens, the immediate initiation of insulin is indicated if HbA1C levels exceed 9.0%.[12] Insulin therapy follows the same protocols as discussed for patients with lower HbA1C levels. If the patient is asymptomatic with a recent onset of diabetes, dual or triple therapy may be effective, and it is possible that some endogenous β-cell function may be preserved. Again, metformin is considered the key agent to use in dual or triple combination with one of the following choices (in order of preference)[12]:

- GLP-1 receptor agonist
- GLP-1 receptor agonist and sulfonylurea
- DPP-4 inhibitor
- DPP-4 inhibitor and sulfonylurea
- TZD
- TZD and sulfonylurea
- GLP-1 receptor agonist and TZD
- DPP-4 inhibitor and TZD

The addition of a sulfonylurea as a third agent is preferred over a TZD because of its more rapid onset of action and slightly greater efficacy.[12]

THE NATHAN ALGORITHM

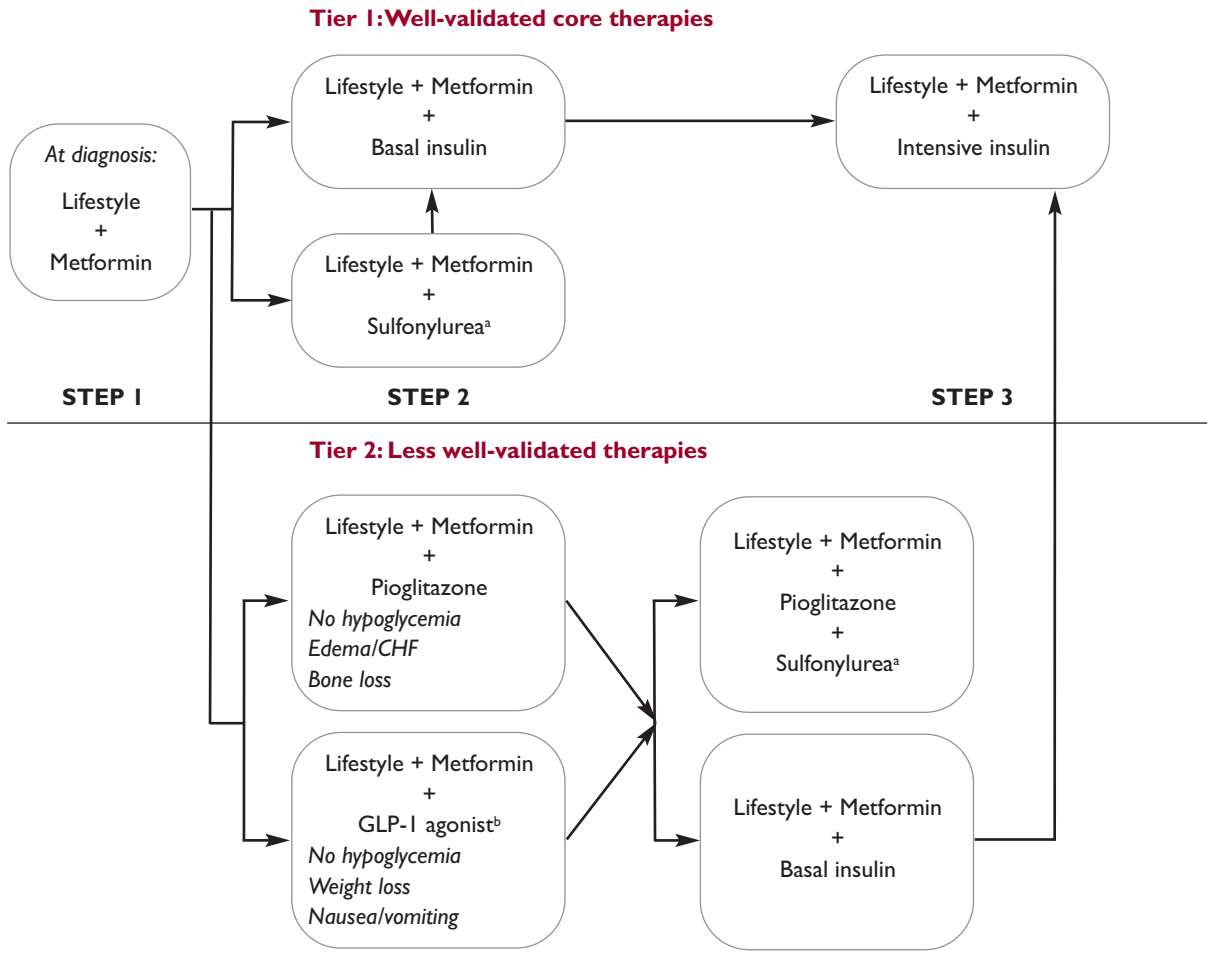
Like the AACE/ACE algorithm, the medication recommendations offered in the consensus statement by Nathan et al are primarily based on effectiveness in lowering glycemia, and also take into consideration tolerability, safety, and expense.[2] The consensus, however, includes step-wise interventions that the authors stratify as being well-validated (Tier 1) and less well-validated (Tier 2) for managing hyperglycemia (Figure 2). Tier 1 recommendations are the suggested preferred therapy for most patients with type 2 diabetes, although Tier 2 interventions also clearly warrant consideration (Figure 2).[2]

Step 1—Initiate Lifestyle Interventions and Metformin. Although lifestyle interventions should remain a cornerstone of therapy throughout the course of the disease, over time, the majority of patients fail to adhere to them or are unable to maintain adequate glycemic control with lifestyle interventions alone.[2,3] Thus, the consensus statement recommends that all patients newly diagnosed with type 2 diabetes also receive metformin, unless contraindicated (eg, in patients with renal dysfunction or significant heart failure), even if the patient is meeting the HbA1C goal without pharmacologic therapy.[2,3]

Step 2—Add Basal Insulin or Additional Oral Agents. If lifestyle interventions and metformin are not successful in reaching the target HbA1C level of less than 7% within 2 to 3 months of initiation, the Tier 1 section of the algorithm recommends that basal insulin or a sulfonylurea be added; the HbA1C level helps determine the best approach.[2] For patients with higher HbA1C levels (≥ 8.5%), insulin is the most appropriate choice because it typically lowers HbA1C levels by 1.5% to 3.5%. A sulfonylurea is a reasonable choice if HbA1C levels are lower (< 8.5%), as this class of drugs typically lowers HbA1C levels by 1% to 2%.[2]

Tier 2 regimens are also acceptable options for

FIGURE 2. Algorithm for the Metabolic Management of Type 2 Diabetes



Reinforce lifestyle interventions at every visit and check HbA1C every 3 months until levels are < 7%, and then check at least every 6 months. Interventions should be modified if HbA1C levels rise above 7%.
[a] Sulfonylureas other than glibenclamide (glyburide) or chlorpropamide.
[b] Insufficient clinical use to be confident regarding safety
CHF = congestive heart failure.
Reprinted with permission from Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement of the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care*. 2009;32(1):193-203.

Step 2, but are less well-validated than the Tier 1 regimens.[2] Tier 2 options include the addition of the TZD pioglitazone or a GLP-1 agonist to lifestyle modification and metformin. If either of these additions are unsuccessful, a sulfonylurea can be added to the pioglitazone regimen, or patients can be taken off the Step 2 agents and placed on a new regimen of lifestyle interventions, metformin, and basal insulin. Newer agents such as DDP-4 inhibitors are not included in Tier 2 because they gained FDA approval more recently and have less evidence to support their inclusion. In addition, although a third oral agent may be considered in patients close to, but above, goal (eg, HbA1C < 8%), the authors suggest that triple therapy is no more effective in reaching glycemic goals, but more costly than initiating or intensifying insulin.[2]

Of note, this algorithm recommends that clinicians use pioglitazone instead of rosiglitazone when initiating TZD therapy due to concerns over the cardiovascular risks associated with rosiglitazone.[2,22] These concerns were raised in meta-analyses focused on rosiglitazone, and there are currently no head-to-head trial results comparing the cardiovascular risks of this agent with those of pioglitazone. Although the TIDE trial (Thiazolidinedione Intervention With Vitamin D Evaluation) was designed to be a head-to-head evaluation of these two agents, the FDA recently put a partial clinical hold on the trial.[23] Still, both agents are contraindicated in patients with New York Heart Association (NYHA) Class III or IV congestive heart failure.[14] In addition to the cardiovascular concerns, TZDs may also increase the risk of edema, macular edema, anemia, and bone fracture in women.[24,25] Fi-

nally, these agents are contraindicated in patients with significant liver disease or if serum ALT exceeds 2.5 times the upper limit of normal.[24,26]

Step 3—Intensify Insulin Regimens. If the therapies described in Step 2 do not lead to the achievement of target HbA1C levels, then insulin therapy should be intensified to include additional injections of either premixed insulin, or short- or rapid-acting insulin at meal times.[2] Intensifying insulin regimens, however, can pose difficulties for some patients. Thus, the insulin regimen should be matched to the individual needs and capabilities of the patient.[2] Some factors to consider when choosing an insulin regimen for individual patients include[27-29]:

- Patient motivation
- The number of insulin injections required
- A patient's cognitive abilities, visual abilities, and manual dexterity
- A patient's dietary needs and eating habits
- Cost
- Avoidance of hypoglycemia

PRACTICAL STRATEGIES FOR INITIATING INSULIN THERAPY

The wide variety of available insulin agents (long-acting, intermediate-acting [NPH], short-acting [regular], and rapid-acting) allows for treatment flexibility and individualization of therapy. The most common types of insulins are presented in Table 2.

Starting with a once-daily injection of intermediate- or long-acting insulin is usually the easiest approach for insulin-naïve patients. When introducing or titrating insulin in insulin-naïve patients, keep the following tips in mind[12,27,30,31]:

- Glargine or detemir are less likely than NPH to result in hypoglycemia because they have nearly peakless time-action curves
- Start at bedtime with an initial dose of 10 to 20 U or 0.1 to 0.2 U/kg
- Various titration schedules are available, so choose one that makes the most sense for you, your patient, and the medication regimen
- Most patients need a total daily dose of 0.4 to 0.6 U/kg of basal insulin to reach a target HbA1C level of < 7%
- If nocturnal hypoglycemia occurs, stop titration
- If switching to glargine from once-daily NPH, use 100% of the NPH dose as glargine; if switching from twice-daily NPH, use 80% of the NPH dose as the starting dose of glargine

For some patients, once- or twice-daily premixed injections may be a satisfactory transitional step between basal and basal-prandial insulin regimens.[28,32]

TABLE 2. Types of Available Insulins, Premixes, and Pharmacokinetic Properties

TYPE OF INSULIN (BRAND)	TIME TO ONSET OF ACTION	TIME OF PEAK ACTION (HOURS)	DURATION OF ACTION (HOURS)
Long-Acting			
Glargine (Lantus)	1-2 hours	Minimal or no peak	24
Detemir (Levemir)	1-2 hours	Minimal peak	Up to 24
Intermediate-Acting			
NPH (Humulin N, Novolin N, ReliOn)	2-4 hours	4-10	10-16
Short-Acting			
Regular insulin (Humulin R, Novolin R, ReliOn)	0.5-1 hour	2-3	3-6
Rapid-Acting			
Aspart (NovoLog)	< 15 minutes	1-2	3-4
Lispro (Humalog)	< 15 minutes	1-2	3-4
Glulisine (Apidra)	< 15 minutes	1-2	3-4
Premixed			
70% NPH, 30% regular (Humulin 70/30, Novolin 70/30, ReliOn)	30-60 minutes	3-12	10-16
70% insulin aspart protamine, 30% aspart (NovoLog Mix 70/30)	5-15 minutes	1-4	10-16
75% lispro protamine, 25% lispro (Humalog Mix 75/25)	5-15 minutes	1-4	10-16
50% lispro protamine, 50% lispro (Humalog Mix 50/50)	5-15 minutes	1-4	10-16

Data derived from Insulin. Diabetes Forecast. American Diabetes Association, 2008. www.diabetes.org/uedocuments/df-rg-insulin-0108.pdf; Mooradian AD, Bernbaum M, Albert SG. Narrative review: a rational approach to starting insulin therapy. *Ann Intern Med*. 2006;145(2):125-134; Rodbard, HW, Blonde L, Braithwaite SS, et al. American Association of Clinical Endocrinologists medical guidelines for clinical practice for the management of diabetes mellitus. *Endocr Pract*. 2007;13(suppl 1):1-66.

Premixed insulin provides a combination of basal and prandial insulin in a preset ratio.[27] Patients can be started on a once-daily injection of 10 U at dinner, and a second injection can be added before breakfast, if necessary.[28] However, although these regimens are often perceived as convenient, they can present challenges for patients because they require strict adherence to the timing of meals, exercise, and injections, and it can be difficult to titrate doses properly.[31] In addition, a greater risk of hypoglycemia exists with premixed insulins than with basal-prandial regimens.[31]

Although most patients with type 2 diabetes do not start out using basal-prandial insulin regimens because of their complexity, these regimens afford the most physiologic approach to glycemic control.[1] Mealtime bolus insulin doses depend on both pre- and postprandial glucose levels and the carbohydrate content of meals.[33] Doses for basal-prandial regimens can be calculated in a variety of ways. If fasting blood glucose is on target with the basal insulin regimen, but HbA1C levels are still above 7% after 2 to 3 months, patients should check blood glucose levels before lunch, dinner, and bedtime and make the following adjustments[2]:

- If pre-lunch blood glucose is elevated, add rapid-acting insulin at breakfast
- If pre-dinner blood glucose is elevated, add rapid-acting insulin at lunch or NPH at breakfast
- If bedtime blood glucose is elevated, add rapid-acting insulin at dinner

A reasonable starting dose for rapid-acting or NPH insulin administered in this regimen is 4 units, to be adjusted by 2 units every 3 days until the target blood glucose is reached, although smaller and slower adjustments are also often recommended.[2] After 3 months, if HbA1C levels are still 7% or higher, a second injection may be needed. Two-hour postprandial levels should be checked and used to adjust preprandial rapid-acting insulin.[2,28]

Another simple method is to determine total daily insulin requirements based on factors that contribute to insulin sensitivity in tissues, such as physical activity, weight, and illness (Table 2).[34] Individual doses typically range between 0.2 and 0.8 units/kg.[31] About one-half of the total daily insulin required should be given as basal insulin. The remaining half should be divided among meals and given as rapid-acting insulin. In general, 30% to 40% of the rapid-acting insulin should be given at breakfast, 30% at lunch, and 30% to 40% at dinner. These percentages may vary with the carbohydrate and caloric content of the meal and should be adjusted according to SMBG.[31]

Carbohydrate-to-insulin ratios, which involve estimating carbohydrate count, can be used to more accurately determine bolus insulin requirements, although many individuals are unable or unwilling to use carbohydrate counting to calculate prandial insulin doses.[33] In addition, some evidence suggests that, in clinical reality, algorithms based on premeal blood glucose values compared with those based on carbohydrate counting are equally effective in controlling glycemia in patients with type 2 diabetes.[35]

For insulin therapy to be successful in controlling glycemia, insulin must be appropriately titrated.[28] Although starting doses may be between 0.1 to 0.2 units/kg per day, as doses are titrated to reach target glucose levels, they may approach 0.5 units/kg per day or more for some patients.[30] The key to successful titration is adjusting insulin doses in a timely fashion. Titration schedules and charts are widely available to provide guidance on adjusting insulin doses and vary according to the insulin regimen chosen.

Titration also requires good communication between the physician and patient. During the titration period, it is important to set up protocols for close patient follow-up that include[28]:

- Frequent patient visits or phone calls during initiation of insulin routine (eg, once weekly for the first month)
- Ways for patients to send in blood glucose monitoring data (eg, via phone, fax, or e-mail)
- Prompt physician response with instructions for dose adjustments

TABLE 3. Calculating 24-Hour Insulin Needs for Basal-Prandial Regimens

PATIENT CHARACTERISTICS	MULTIPLY WEIGHT (kg) BY:
Normal Weight	
Engages in strenuous exercise	0.3 U
Engages in moderate exercise	0.4 U
Engages in minimal exercise	0.5 U
Obese	
Engages in strenuous exercise	0.5 U
Engages in moderate exercise	0.6 U
Engages in minimal exercise	0.8 U
If patient has renal failure or comorbid illness with increased risk of hypoglycemia, subtract 2 U/kg from above values.	

Adapted from Leahy, JL. Intensive insulin therapy in type 1 diabetes mellitus. In Leahy JL, Cefalu WT, eds. Insulin Therapy. New York, NY: Marcel Dekker, pp. 87-112.

ADDRESSING PATIENT CONCERNS

Despite strong clinical evidence supporting the safety and efficacy of early insulin therapy in type 2 diabetes, many healthcare professionals are reluctant to initiate insulin therapy. The DAWN study (Diabetes Attitudes, Wishes, and Needs), a global study involving nearly 3,800 healthcare professionals, found that more than 50% of clinicians prefer to delay insulin therapy until "absolutely necessary."[36] This reluctance may be, in part, because of their patients' negative views about insulin.[36] This delay, however, can have serious consequences because it means that these patients may be at a later stage in the disease process and complications may have already developed or progressed.[37]

Healthcare professionals can take several steps to ensure that patients approach the transition to insulin without fear or apprehension[37-41]:

- Set the right tone for talking about insulin
- Start discussing insulin use at initial diagnosis, or soon thereafter, so that the eventual use of insulin becomes the logical and natural next step in therapy
- Reassure patients that they have not failed in some way; most patients with type 2 diabetes eventually require insulin
- Question patients to identify individual obstacles to insulin use and use this information to modify your approach
- Use insulin pens to emphasize simplicity
- Give an injection to the patient to demonstrate that the syringe is not painful
- Instill confidence in patients; nearly one-half do not feel that they are capable of determining correct insulin dosages and injection timing
- Introduce insulin regimens, SMBG, and other changes slowly to avoid overwhelming patients
- Refer patients to a certified diabetes educator (CDE) and/or a registered dietitian (RD) for help in fine tuning approaches to insulin regimens, meal planning, and SMBG

THE ROLE OF SMBG

SMBG may be a useful indicator of therapy success in patients on insulin injections, noninsulin therapies, and/or lifestyle modifications.[3] It may also be useful for tracking the effects of medication, exercise, and diet adjustments and monitoring for hypoglycemia.[3]

Practical Considerations. There is little consensus on the ideal frequency of SMBG in patients on once-daily insulin injections or oral agents only.[3] Results of studies examining the effects of frequent SMBG on HbA1C levels in patients on these types of medication regimens have been mixed, with some showing no benefit to frequent monitoring and others showing a modest benefit.[42,43] Despite the lack of definitive evidence on this matter, most clinicians find that regular SMBG is highly useful in identifying when and how to adjust pharmacologic therapy. It is particularly useful in patients whose HbA1C levels are above goal and in patients who are initiating or adjusting insulin regimens. One practical suggestion is to have patients perform SMBG several times daily for 1 week just before their next diabetes visit. This practice can provide the information physicians need to make appropriate treatment decisions.

ADA Goals[3]:

- Patients who use multiple daily insulin injections: ≥ 3 times daily
- Patients on insulin pump therapy: ≥ 3 times daily
- Patients who use insulin once daily: monitoring may be useful as needed
- Patients who use noninsulin therapies: monitoring may be useful as needed
- Patients on lifestyle therapy only: monitoring may be useful as needed

AACE Goals[12]:

- Patients starting on basal insulin therapy at bedtime or premixed insulin before dinner: test morning fasting glucose daily
- Increase the frequency of SMBG for each injection of insulin that is added

Regardless of the frequency of testing, patients who perform SMBG should keep logs of their blood glucose levels. These may be stored in some glucose meters that have downloadable software, or patients can keep simple paper logs to track and assess their progress. These logs should be reviewed with the patient at each diabetes visit. A sample glucose log is available for patients at www.MyDiabetesGoals-IQ.com.

The patient's ability to perform SMBG and change strategies based on those results requires significant education and follow-up. Referral to a CDE for SMBG-focused educational sessions is often the best choice for teaching these skills to patients.[3]

ADDRESSING HYPOGLYCEMIA

Goal[3]:
Prevent a plasma glucose < 70 mg/dL

The prevention of hypoglycemia is a critical component of management in patients with type 2 diabetes who use insulin. Patients using sulfonylureas may also have a slightly increased risk of serious hypoglycemia.[3] Balancing insulin, carbohydrate intake, and exercise is an important strategy for preventing hypoglycemia, but it is not always effective. If frequent episodes do not seem to correlate with dietary factors or exercise, a medication adjustment may be necessary.[44] Tool 3 offers a patient handout on strategies for recognizing, preventing, and managing hypoglycemia.

Practical Considerations. The foundation of managing hypoglycemia in patients with type 2 diabetes is providing regular patient education on the topic. Patients should be taught to recognize the signs and symptoms of hypoglycemia and treat the condition when it occurs.[37] Patients should understand[2,3,44]:

- The importance of eating at consistent times throughout the day and not skipping meals if they are taking insulin or a sulfonylurea
- That exercise can help maintain target blood sugar levels, but exercising more than usual can trigger hypoglycemia, especially when taking insulin or a sulfonylurea
- That they should immediately monitor blood glucose if they suspect they are hypoglycemic
- That, if they are hypoglycemic, they should immediately consume 15 to 20 grams of glucose, should perform SMBG 15 minutes after treatment, and should repeat treatment until their levels return to normal
- How an SMBG log (especially one that includes medication use, exercise, and meal patterns) can help identify events that trigger hypoglycemia
- That emergency glucagon kits are available by prescription and should be kept on hand by patients who have a significant risk of experiencing hypoglycemia; family members should receive instructions on how to use these kits in situations where hypoglycemia is severe and the patient cannot perform SMBG or take oral carbohydrate

REFFERING TO SPECIALTY CARE

The successful management of diabetes requires a coordinated team approach. Primary healthcare professionals can facilitate this by providing referrals to appropriate specialists when necessary. The use of a standardized form, such as the one presented in Tool 4, can facilitate the referral.

Although many patients can be successfully managed in the primary care setting, referral to an endocrinologist should be considered if:

- Glycemic goals are not being met over a reasonable amount of time
- Patients are experiencing repeated episodes of hypoglycemia
- Patients are experiencing extremes of hyperglycemia and hypoglycemia
- New diabetes-related complications develop
- Patients develop a severe, acute illness

Referral to a CDE can help newly diagnosed patients, as well as those who are having difficulty with medication management, insulin use, and SMBG. Referral to an RD for medical nutrition therapy can also be useful in helping patients implement dietary changes and recognize how food choices affect glycemic levels. Many diabetes education centers have their own outpatient referral forms that can be downloaded from the Internet.

CONCLUSION

Glycemic control is the key predictor of outcomes in type 2 diabetes, yet the majority of patients fail to achieve and maintain optimal HbA1C levels. Recent advances in oral antihyperglycemic agents and insulin regimens have increased therapeutic choices for the management of type 2 diabetes, but navigating these choices presents challenges for the primary healthcare professional. Step-wise approaches to therapy and the use of algorithms have been proven to optimize glycemic control. By adhering to these guideline-driven tools, primary care clinicians can overcome many of the barriers to successful management and improve outcomes for their patients.

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TOOL 1. HbA1C Pocket Card

HbA1C Goal: < 7.0% **AACE: ≤ 6.5%**

Perform screening tests:

- At initial diagnosis
- Every 2 to 3 months in patients not meeting goals
- Every 2 to 3 months in patients with changes to treatment
- Twice yearly in patients who are meeting goals

MEAN PLASMA GLUCOSE AND CORRESPONDING ESTIMATED HBA1C LEVEL

Mean Plasma Glucose (mg/dL)	Estimated HbA1C (%)
126	6
154	7
183	8
212	9
240	10
269	11
298	12

FOLD HERE

EXPECTED DECREASES IN HBA1C LEVELS ACCORDING TO INTERVENTION

Intervention/agent	Average Expected Decrease in HbA1C Level (%)
Lifestyle interventions	1.0-2.0
Metformin	1.5
GLP-1 receptor agonist	0.5-1.5
DPP-4 inhibitor	0.5-0.8
TZD	0.5-1.5
Insulin	1.5-3.5
Sulfonylurea	1.0-2.5
α-glucosidase inhibitor	0.5-0.8
Glinides	0.5-1.5
Pramlintide	0.5-1.0
Colesevelam	0.3-1.0

Data derived from Rodbard HW, Jellinger PS, Davidson JA, et al. Statement by an American Association of Clinical Endocrinologists/American College of Endocrinology consensus panel on type 2 diabetes mellitus: an algorithm for glycemic control. *Endocr Pract*. 2009;15(6):540-559; Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes: A consensus algorithm for the initiation and adjustment of therapy: a consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care*. 2009 Aug;29(8):193-203; American Diabetes Association. Standards of medical care in diabetes—2010. *Diabetes Care*. 2010;33(suppl 1):S11-S61; Fonseca VA, Rosenstock J, Wang AC, et al. Colesevelam HCl improves glycemic control and reduces LDL cholesterol in patients with inadequately controlled type 2 diabetes on sulfonylurea-based therapy. *Diabetes Care*. 2008 Aug;31(8):1479-1484; Pratley RE, Nauck M, Bailey T, et al. Liraglutide versus sitagliptin for patients with type 2 diabetes who did not have adequate glycaemic control with metformin: a 26-week, randomised, parallel-group, open-label trial. *Lancet*. 2010;375(9724):1447-1456.

TOOL 2. FDA-Approved Noninsulin Antihyperglycemic Medications

DRUG NAME (BRAND)	MECHANISM OF ACTION	INITIAL DOSE	MAXIMUM DOSE	CONTRAINDICATIONS/WARNINGS/ LIMITATIONS
Biguanide				
Metformin (Glucophage)	Suppresses hepatic glucose production in fasting and postprandial state	500 mg twice daily or 850 mg once daily in AM	2,000 mg in 2 divided doses	• Contraindicated in impaired renal function, congestive heart failure requiring treatment, acute myocardial infarction, septicemia, metabolic acidosis, excessive alcohol intake, during intravascular radiocontrast studies • May rarely cause lactic acidosis
GLP-1 agonists				
Exenatide (Byetta)	Glucose-dependent stimulation of insulin secretion and suppression of glucagon production	5 mcg twice daily	10 mcg twice daily	• Acute pancreatitis has been reported in patients using exenatide • Contraindicated in patients with severe renal impairment (creatinine clearance < 30 mL/min) and should be used with caution in patients with renal transplantation • Use caution when increasing dosage in patients with moderate renal impairment • Has not been studied in combination with insulin • May cause hypoglycemia in combination with other agents
Liraglutide (Victoza)	Glucose-dependent stimulation of insulin secretion and suppression of glucagon production	0.6 mg once daily, increased to 1.2 mg at 1 week	1.8 mg once daily	• There is a risk of thyroid c-cell tumors in mice and rats; significance for humans is unknown • Contraindicated in patients with a personal or family history of medullary thyroid cancer or multiple endocrine neoplasia syndrome • Has not been studied in patients with a history of pancreatitis • Has not been studied in combination with insulin
DPP-4 inhibitors				
Saxagliptin (Onglyza)	Inhibits metabolism of incretin hormones; increases first-phase insulin secretion, suppresses postprandial glucagon secretion, improves peripheral glucose uptake, suppresses hepatic glucose production	2.5 mg once dail	5 mg once daily	• Reduce dosage in patients with moderate to severe renal insufficiency (creatinine clearance < 50 mL/min) • Has not been studied in combination with insulin. • When used in combination with an insulin secretagogue, the incidence of hypoglycemia is increased; therefore, a lower dose of the insulin secretagogue may be required
Sitagliptin (Januvia)	Inhibits metabolism of incretin hormones; increases first-phase insulin secretion, suppresses postprandial glucagon secretion, improves peripheral glucose uptake, suppresses hepatic glucose production	100 mg once daily		• Reduce dosage in patients with moderate to severe renal insufficiency (creatinine clearance ≤ 50 mL/min) • Has not been studied in patients with a history of pancreatitis; patients should be observed carefully for signs and symptoms of pancreatitis (if pancreatitis is suspected, sitagliptin should be stopped immediately) • When used in combinations with an insulin secretagogue (such as a sulfonylurea) or insulin, the incidence of hypoglycemia is increased; therefore, a lower dose of the insulin secretagogue (or insulin) may be required
Glinides				
Repaglinide (Prandin)	Insulin secretagogue	0.5 mg with each meal, up to 4 times per day, for patients not previously treated or whose HbA1C is < 8%,; 1 or 2 mg with each meal preprandially, up to 4 times per day, for patients previously treated with blood glucose-lowering drugs and whose HbA1C is > 8%	4 mg with each meal, up to 4 times per day	• Contraindicated in diabetic ketoacidosis and type 1 diabetes • Should not be co-administered with gemfibrozil

TOOL 2. FDA-Approved Noninsulin Antihyperglycemic Medications (Continued)

DRUG NAME (BRAND)	MECHANISM OF ACTION	INITIAL DOSE	MAXIMUM DOSE	CONTRAINDICATIONS/WARNINGS/ LIMITATIONS
Glinides (Continued)				
Nateglinide (Starlix)	Insulin secretagogue	120 mg 3 times daily before meals; 60 mg 3 times daily if patient is near HbA1C goal	120 mg 3 times daily before meals	• Contraindicated in diabetic ketoacidosis and type 1 diabetes • Use with caution in moderate-to-severe-liver disease because it has not been studied in this population
Sulfonylureas				
Glyburide (DiaBeta, Micronase)	Insulin secretagogue; stimulate delayed, second phase insulin secretion	1.25-5 mg once daily	20 mg in 1 or 2 divided doses, once or twice daily (Half maximal dose often provides most benefit)	• Contraindicated in diabetic ketoacidosis • Possible increased risk of cardiovascular mortality • May cause profound hypoglycemia
Glipizide (Glucotrol)	Insulin secretagogue; stimulate delayed, second phase insulin secretion	5 mg once daily; 2.5 mg once daily in elderly patients with liver disease	20 mg in 2 divided doses (Half maximal dose often provides most benefit)	• Contraindicated in Type 1 diabetes, diabetic ketoacidosis • Possible increased risk of cardiovascular mortality • May cause profound hypoglycemia
Glimepiride (Amaryl)	Insulin secretagogue; stimulate delayed, second phase insulin secretion	1-2 mg once daily	8 mg once daily (Half maximal dose often provides most benefit)	• Contraindicated in diabetic ketoacidosis • Possible increased risk of cardiovascular mortality • May cause profound hypoglycemia
Thiazolidinediones				
Pioglitazone (Actos)	Increases insulin sensitivity of skeletal muscle, adipose tissue, and liver	15 or 30 mg once daily	45 mg once daily	• Contraindicated in NYHA Class III or IV heart failure • May cause or exacerbate heart failure • May increase risk of bone fracture in women, edema, macular edema, anemia
Rosiglitazone (Avandia)	Increases insulin sensitivity of skeletal muscle, adipose tissue, and liver	4 mg once daily or divided into 2 doses	8 mg per day	• Contraindicated in NYHA Class III or IV heart failure • May cause or exacerbate heart failure • May increase risk of bone fracture in women, edema, macular edema, anemia • Meta-analysis of clinical studies suggests an increased risk of myocardial ischemic events with rosiglitazone
Alpha-glucosidase inhibitors				
Acarbose (Precose) Miglitol (Glyset)	Inhibit oligosaccharide conversion to monosaccharides in the intestine; decreases postprandial hyperglycemia, slightly decreases fasting glucose	25 mg 3 times daily with meals	100 mg 3 times daily with meals	• Adverse gastrointestinal side effects are common and include abdominal discomfort, gas, and diarrhea • Rarely, cholestatic jaundice has been reported • Most effective when the diet contains at least 50% carbohydrate
Bile acid sequestrants				
Colesevelam (Welchol)		3.75 g once daily, or 1.875 g twice daily		• Contraindicated in patients with a history of bowel obstruction, if serum triglycerides are > 500 mg/dL, or in patients with a history of hypertriglyceridemia-induced pancreatitis

Data derived from prescribing information; Rodbard HW, Jellinger PS, Davidson JA, et al. Statement by an American Association of Clinical Endocrinologists/American College of Endocrinology consensus panel on type 2 diabetes mellitus: an algorithm for glycemic control. Endocr Pract. 2009;15(6):540-559; Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement of the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care. 2009;32(1):193-203.

TOOL 3. Patient Handout for Hypoglycemia

HYPOGLYCEMIA (LOW BLOOD SUGAR)

What is hypoglycemia?

Hypoglycemia is when blood sugar levels become too low—below 70 mg/dL. Ask your healthcare provider whether you are at risk of developing hypoglycemia.

What causes hypoglycemia?

- Using too much insulin
- Taking too many diabetes pills
- Not eating enough, or skipping meals or snacks
- Not eating enough carbohydrate with meals
- Changing your exercise routine
- Drinking alcohol in excess

It is also possible to have hypoglycemia even when you are carefully managing your blood sugar levels.

What does it feel like when blood sugar gets too low?

You may feel:

- Anxious
- Confused
- Dizzy
- Hungry
- Light-headed
- Nervous
- Shaky
- Sleepy
- Sweaty

You may have:

- Blurry or cloudy vision
- Heart palpitations (heart skips a beat or races)
- Tingling or numbness around the mouth and tongue
- Tremors

What to do if you have symptoms of hypoglycemia:

If you think your blood sugar is too low, check it with a glucose meter. If it's below 70 mg/dL, consume one of the following:

- Fruit juice (1/2 cup)
- Glucose tablets (15 grams)
- Hard candy (5 to 7 pieces)
- Honey or sugar (2 teaspoons)
- Milk (1/2 cup)
- Soft drink (non-diet, 1/2 cup)

Wait 15 minutes and check your blood glucose again. If it is still below 70 mg/dL, have another food item listed above. Wait another 15 minutes and repeat the blood glucose test. Have a small meal or snack that contains some carbohydrate after your blood glucose rises above 70 mg/dL.

If you are at risk of hypoglycemia, always carry with you glucose tablets or one of the foods listed above.

To prevent hypoglycemia:

- Avoid situations that may cause hypoglycemia
- Before making any changes to your diet or exercise routine, discuss them with your healthcare provider
- Keep a record of your blood glucose levels. Include the time of day, diabetes medications, when you had your last meal or snack, and what you were doing at the time (eg, watching TV, gardening, jogging, etc.)
- Talk to your healthcare provider if your blood glucose levels are often low

TOOL 4. Sample Specialist Referral Form

REFERRAL FROM:

PCP: _____

Clinic name: _____

Clinic address: _____

_____

Phone number: _____

Fax number: _____

E-mail address: _____

_____

Patient name: _____

DOB: _____

Address: _____

_____

Phone number: _____

REFERRAL TO:

Specialist provider: _____

Clinic name: _____

Address: _____

_____

Phone number: _____

Fax number: _____

E-mail address: _____

Type of diabetes: _____

Diagnosis code: _____

Duration: _____

REASON FOR REFERRAL:

_____

_____

CURRENT MEDICATIONS:

1.
2.
3.
4.
5.
6.
7.
8.

RECENT TESTS/EVALUATIONS:

Blood pressure: _____/_____

BMI: _____

HbA1C: _____

Total cholesterol: _____

HDL: _____

LDL: _____

Triglycerides: _____

Microalbuminuria: _____

Creatinine: _____

GFR: _____

DIABETES COMPLICATIONS:

_____ CVD

_____ Nephropathy

_____ Peripheral neuropathy

_____ Autonomic neuropathy

_____ Retinopathy

Primary Care Provider Signature: _____ **Date:** _____

IMPROVING GLYCEMIC CONTROL IN TYPE 2 DIABETES: A PRACTICAL GUIDE FOR PERFORMANCE IMPROVEMENT

CME/CE EVALUATION AND POST-TEST

Release Date: June 30, 2009 Expiration Date: May 31, 2011

SA080DIA09 IG3 6-30-09 1/3

To earn CME/CE credit, complete the following evaluation and post-test, answering 70% of the post-test questions correctly. If completing the evaluation in print form, please use all capital letters and print your name, address, and other information requested below. Keep a copy of the completed evaluation for your files.

Send originals to:
Med-IQ, 5523 Research Park Drive, Suite 210, Baltimore, Maryland, 21228, or fax to (443) 543-5210 by May 31, 2011. For mailed or faxed evaluations, allow 4 to 6 weeks from receipt of evaluation form for delivery of statement of credit.

The purpose of this evaluation is to receive your feedback so we may improve future educational activities. All responses are confidential but may be evaluated in aggregate. Thank you.

PARTICIPANT INFORMATION

Date of Participation in Activity: _____

First Name: _____ Last Name: _____

Degree/Profession: ❒ MD ❒ DO ❒ PharmD ❒ RPh ❒ PhD ❒ PA ❒ MBA

❒ RN ❒ NP ❒ LPN ❒ Other: _____

Specialty: _____

Address 1: _____

Address 2: _____

City/State/Zip: _____

Phone: _____ Fax: _____ E-mail: _____

Type of practice: ❒ Community/Private ❒ Academic ❒ Hospital ❒ HMO ❒ Other _____

Approximately how many patients do you see each week? _____

Of these patients, how many do you feel are at risk of diabetes? _____ %

ACTIVITY EVALUATION

Rate the extent to which this CME activity met the following learning objectives:	Minimally 1	2	3	4	5	6	Completely 7	N/A
1. Identify glycemic targets and implement screening recommendations for glycemia in patients with type 2 diabetes	❒	❒	❒	❒	❒	❒	❒	❒
2. Implement guideline- and algorithm-based approaches to achieve glycemic control in patients with type 2 diabetes	❒	❒	❒	❒	❒	❒	❒	❒
3. Discuss the roles that self-monitoring of blood glucose and specialist referral play in the management of type 2 diabetes	❒	❒	❒	❒	❒	❒	❒	❒

Rate the extent to which this CME activity:	Minimally 1	2	3	4	5	6	Completely 7	N/A
Met your expectations	❒	❒	❒	❒	❒	❒	❒	❒
Is applicable to your practice	❒	❒	❒	❒	❒	❒	❒	❒
Used appropriate teaching methods	❒	❒	❒	❒	❒	❒	❒	❒
Provided current scientific evidence to support content	❒	❒	❒	❒	❒	❒	❒	❒
Addressed barriers to optimal patient management	❒	❒	❒	❒	❒	❒	❒	❒
Provided useful non-educational resources *(eg, patient handouts, tools to assess practice, resources)*	❒	❒	❒	❒	❒	❒	❒	❒
Addressed the following 6 core competencies:								
Patient care	❒	❒	❒	❒	❒	❒	❒	❒
Medical knowledge	❒	❒	❒	❒	❒	❒	❒	❒
Interpersonal and communication skills	❒	❒	❒	❒	❒	❒	❒	❒
Professionalism	❒	❒	❒	❒	❒	❒	❒	❒
Systems-based practice	❒	❒	❒	❒	❒	❒	❒	❒
Practice-based learning and improvement	❒	❒	❒	❒	❒	❒	❒	❒

Compared with all other CME activities I have participated in over the past year, I would rate this program as:	Needs Improvement 1	2	3	Average 4	5	Outstanding 6	7
	❒	❒	❒	❒	❒	❒	❒

Did this activity provide fair and balanced content free from comercial bias? ❒ Yes ❒ No
(Commercial bias is defined as information presented that advocates a specific proprietary business product or service of a commercial interest.)
As a result of this learning experience, what will you do differently in the care of your patients? _____

Which of the following practice changes do you intend to implement as a result of participating in this learning experience?
A. I will measure HbA1C levels every 3 months in patients who are not maintaining adequate glycemic control
B. I will initiate a regimen of metformin and lifestyle modification in newly diagnosed type 2 diabetes patients
C. I will consider initiating insulin therapy earlier when appropriate in patients with type 2 diabetes
D. I will review patient SMBG logs at diabetes-related visits
E. I will use a new tool (eg, pocket card, referral form, lifestyle adherence form, etc.) in my practice (please specify): _____
F. Other (please specify): _____
G. None

How confident are you in your ability to choose appropriate pharmacologic therapy for your pateints with type 2 diabetes?
A. Extremely confident
B. Moderately confident
C. Somewhat confident
D. Not confident at all

How confident are you in your ability to adjust pharmacologic therapy based on SMBG results?
A. Extremely confident
B. Moderately confident
C. Somewhat confident
D. Not confident at all

Are there specific barriers to patient management that you feel better equipped to address as a result of this activity?
If so, please list them: _____

Are there specific barriers to patient management that this activity did not address? If so, please list them. _____

I would like to see CME/CE activities on these topics: _____

Other comments (eg, what can we do to improve future CME/CE activities?): _____

ATTESTATION AND SIGNATURE REQUIRED TO RECEIVE CREDIT:

Physicians: I claim ☐ _____ (maximum 1.0) *AMA PRA Category 1 Credit*™
Nurses: I claim ☐ _____ (maximum 1.0) contact hour for RNs, LPNs, LVNs, and NPs
Pharmacists: I claim ☐ _____ (maximum 1.0) contact hour/0.10 CEU

Signature: _____ **Date:** _____

Nurses: license # _____

1. **Which of the following statements about HbA1C levels is correct?**
   A. The ADA recommends target HbA1C levels of < 6%
   B. The AACE recommends target HbA1C levels of 7 % to 7.5%
   C. Individual patient circumstances should be taken into account when setting HbA1C goals
   D. It is never appropriate to set HbA1C goals above standard guideline recommendations

2. **You are seeing a 63-year-old patient with type 2 diabetes who is currently being managed with lifestyle therapy and metformin. His lab work from the past week reveals an HbA1C level of 6.4%, and his levels have been stable for the past year. You decide to continue his current medication regimen. Based on ADA recommendations, when should you test this patient's HbA1C levels again?**
   A. In 1 month
   B. In 3 months
   C. In 6 months
   D. In 12 months

3. **You have just diagnosed a 67-year-old female patient with type 2 diabetes. Her HbA1C level was 9.2% at diagnosis, and she has no contraindications to lifestyle or pharmacologic therapy. According to ADA guidelines and consensus statements, which of the following initial treatment strategies should be recommended for this patient?**
   A. Lifestyle therapy alone
   B. Lifestyle therapy and metformin
   C. Metformin alone
   D. Metformin and a sulfonylurea

4. **Which of the following is the most common side effect of metformin?**
   A. Gastrointestinal disturbance
   B. Hypoglycemia
   C. Weight gain
   D. Lactic acidosis

5. **You have been working to reach a target glycemic level of less than 7% in a 63-year-old male patient with diabetes. Over the past year, the patient has made changes in diet and physical activity and you have titrated the patient up to the maximum dose of metformin. Despite these efforts, the patient's HbA1C level at this visit is 8.8%. According to ADA guidelines and consensus statements, how should you adjust the patient's treatment regimen at this point?**
   A. Discontinue metformin and add a sulfonylurea
   B. Continue metformin and add a sulfonylurea
   C. Discontinue metformin and add a basal insulin
   D. Continue metformin and add a basal insulin

6. **When initiating insulin therapy in a patient with type 2 diabetes for the first time, a basal-bolus regimen is usually the easiest approach.**
   A. True
   B. False

7. **Which of the following medications is NOT an ADA-recommended treatment option, due its association with an increased risk of myocardial infarction?**
   A. Pioglitazone
   B. Rosiglitazone
   C. Exenatide
   D. Glimepiride

8. **According to ADA guideline recommendations, which of the following patients should be performing SMBG at least 3 times daily?**
   A. A patient taking 3 oral agents daily
   B. A patient on lifestyle therapy only
   C. A patient on metformin and a once-daily basal insulin injection
   D. A patient on a regimen of multiple daily insulin injections

9. **HB is a 62-year-old female patient with newly diagnosed type 2 diabetes whose HbA1C level is 8.1%. According to the AACE/ACE algorithm for glycemic control, which of the following would NOT be an appropriate option for initial dual therapy?**
   A. Metformin and a sulfonylurea
   B. Metformin and a GLP-1 agonist
   C. Metformin and a DPP-4 inhibitor
   D. Metformin and a short-acting insulin

10. **Which of the following patients would be best served with a referral to an endocrinologist?**
    A. A newly diagnosed patient with an HbA1C of 9.5%
    B. A patient who is not meeting glycemic goals in a reasonable amount of time
    C. A patient who is unable to successfully implement lifestyle recommendations
    D. A patient who is starting insulin therapy

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