

Treatment Algorithms Enable Effective Nurse- and Pharmacist-Directed Diabetes Care

The current medical care system fails patients with diabetes because of a lack of timely, appropriate clinical decisions. Specially trained nurses or pharmacists can facilitate better diabetes care.

REVIEWED BY MAYER B. DAVIDSON, MD

Evidence-based treatment recommendations for the management of patients with type 2 diabetes have been put forth by the American Diabetes Association (ADA) (Table 1). When put into practice, these recommendations can go a long way toward alleviating the devastating macro and microvascular complications of the disease.¹ When considering guidelines, however, clinicians must differentiate between process measures and outcome measures. Process measures are the number of tests or examinations carried out per period of time or whether an indicated treatment is given, and outcome measures are the actual results of the test or the effect of the treatment. Meeting process measure goals, however, does not always translate into improvements in outcomes.² This means that, for example, just because a patient has frequent A1C measures, this does not necessarily lead to lowered glycemia.

Mayer B. Davidson, MD, Program Director for the Center for Clinical Research Excellence in Diabetes and Metabolism, Charles Drew University of Medicine and Science, Los Angeles, discussed the use of detailed treatment algorithms in a recent article in *The Diabetes Educator* (2009;35:61–71). The following is a summary of that report as well as comments from Dr. Davidson's editorial in *Diabetes Care* (2009;32:370–372).

DIABETES CARE GOALS

Most type 2 diabetes patients do not meet recommended goals.² In a recent review, we found that 21% to 43% of patients had A1C levels >9.5%, only 22% to 46%

met the low-density lipoprotein cholesterol (LDL-C) goal, and 29% to 33% met the blood pressure goal. With regard to the ADA's combined goals for glycemia, lipids, and blood pressure, just 2% to 10% of patients were on target. Approaches to improve care, such as appointment reminders; keeping the treating physician in the loop with regard to the patient's progress; case management approaches; physician education; as well as multifaceted quality improvement interventions in the practice setting have not been successful.

Why? There are two critical barriers to good diabetes care: (1) the lack of time physicians have to spend with patients and (2) the lack of timely, appropriate clinical decisions or clinical inertia. A primary care physician typically has 10 to 15 minutes with each patient. Studies have shown that physicians pinpoint the lack of time as a primary obstacle to meeting clinical recommendations. Most patients are asymptomatic, and their care revolves around preventing of complications by glycemic control, managing lipids and blood pressure, and carrying out other process measures of diabetes care (Table 1). Therefore, other issues, especially those related to patient symptoms, receive the physician's attention. Furthermore, when patients are only seen every 3 months, glycemia, lipids, and blood pressure can be out of control for relatively long periods of time even if over target values had begun to be treated.

Clinical inertia is a major factor for poor outcomes in diabetes care patients.² Reports show that therapy is intensified only 20% of the time when patients' A1C levels are >8.0%. It took >3 months for changes to be made,

TABLE 1. ADA TREATMENT GUIDELINES

Guideline	Frequency	Goal
1. A1C	Every 6 months if goal attained; every 3 months otherwise	<7.0%
2. LDL-C	Yearly or more often as needed	<100 mg/dL
3. Triglycerides	Yearly or more often as needed	<150 mg/dL
4. Renal profile	Yearly or more often as needed	
(a) Dipstick for proteinuria	If $\geq 1+$, ^a ACE inhibitor unless contraindicated; if negative or trace, evaluation for microalbuminuria	
(b) Microalbuminuria	If positive ^b and confirmed, ACE inhibitor unless contraindicated	
5. Blood pressure	Measured at every diabetes visit	<130/80 mm Hg
6. Eye examination	Yearly dilated funduscopic examination except in type 1 diabetes patients who should receive one within 3 to 5 years of diagnosis	
7. Foot examination	Annual comprehensive foot examination. Patients with neuropathy should have a visual inspection of their feet at every scheduled visit for diabetes.	
8. Aspirin	75–162 mg/day unless contraindicated	
9. Smoking cessation		

ACE = angiotensin-converting enzyme.
^a With infection and menstrual bleeding ruled out.
^b Either albumin/creatinine ratio >30 $\mu\text{g}/\text{mg}$ or albumin concentration >20 $\mu\text{g}/\text{L}$.

and in one study it took 2.5 years before metformin was added in patients who were uncontrolled on a sulfonylurea. On average, A1C levels were >9.0% before the next step of drug intensification occurred. Among those patients not receiving lipid-lowering agents, only 5.6%, 8.7%, and 15.4% had started therapy when LDL-C was >100 mg/dL, >130 mg/dL, or >160 mg/dL, respectively. It's a similar story among diabetes patients with regard to undertreatment of hypertension—only 10%, 15%, and 14% had antihypertensive therapy initiated when their blood pressures were >130/80 mm Hg, >140/90 mm Hg, or >150/100 mm Hg, respectively.

I have been supervising nurses and pharmacists to use detailed treatment algorithms I developed (with the help of Anne L. Peters, MD) and refined during the past 20 years. Trained nurses and pharmacists use these treatment algorithms to make independent therapeutic decisions for diabetes patients in various clinical settings. When compared with the usual care these patients receive, algorithm-based results have been much better.³⁻⁷ Most recently in a Los Angeles County community health center,⁷ at enrollment 361 randomized patients had a mean A1C of 8.8%, 17% met the ADA goal of <7%,

and 50% met the ADA LDL goal. After 1 year of treatment using the algorithms (Tables 2 and 3), mean A1C was 7.0%, 60% of patients met the ADA glycemic goal, and 82% met the lipid goal.

The algorithms reflect Los Angeles County's limited formulary. The outcomes were accomplished using metformin, glipizide, glyburide, regular and neutral protamine Hagedorn (NPH) insulin, gemfibrozil, and a statin. Most providers, however, do not have the drug limitations reflected in Tables 2, 3, and 4.

DRUG SELECTION CRITERIA

Four criteria should be considered when selecting an agent over its competitors: (1) effectiveness, (2) side effects, (3) adherence issues, and (4) cost. With the exception of insulin—the most effective if used appropriately—no drug or class of drugs clearly stands out as more effective. Metformin was selected as the initial drug of choice at a recent ADA consensus conference⁸ not because it was more effective, but because of its lack of serious side effects and weight gain and low cost.

Sulfonylurea is added when patients are not adequately controlled on metformin because it is inexpensive, it is only

TABLE 2. GLYCEMIA TREATMENT ALGORITHM

Treatment Plan

1. Principles of treatment: Type 1 patients require insulin, type 2 diabetes is a progressive disease. The initial treatment for these patients is medical nutrition therapy, increased physical activity, and metformin. Over time, combinations of different classes of oral drugs are subsequently required. Over more time, insulin is often necessary.
2. Goals:
 - (a) FPG concentration <130 mg/dL.
 - (b) A1C level <7% (standardized assay with normal range of 4%–6%). This is the most important goal.
3. Progression of treatment in type 2 diabetes patients:
 - (a) Diet and exercise should be used initially and continuously in conjunction with all therapies.
 - (b) Monotherapy: All type 2 diabetes patients should be started on metformin, 500 mg twice daily with meals (unless contraindicated). Measure FPG concentration in 2 weeks. If value >130 mg/dL, increase by 1 step (500 mg).

Continue to increase by 1 step every 2 weeks until either:

- (1) FPG \leq 130 mg/dL (then wait 3 months and measure A1C) or
 - (2) Maximal tolerated dose is reached and FPG still >130 mg/dL. In that case, start a sulfonylurea, 10 mg glipizide, 5 mg glyburide, or 2 mg glimepiride. Glimepiride is preferred because it is taken only once per day, even at higher doses. Also, glyburide causes more hypoglycemia than glipizide or glimepiride.
- (c) Dual therapy: Continue to measure FPG every 2 weeks. Increase sulfonylurea by 1 step (10 mg for glipizide, 5 mg for glyburide, or 2 mg for glimepiride) until either:
- (1) FPG is \leq 130 mg/dL; then wait 3 months and measure an A1C level or
 - (2) Maximal dose of the sulfonylurea agent is reached (glipizide, 20 mg bid; glyburide, 10 mg bid; or glimepiride, 8 mg per day) and FPG is still >130 mg/dL. Measure A1C and if >7.0%, add a maximal dose of pioglitazone (45 mg).
 - (3) Equivalent doses (mg) of the three sulfonylurea agents are as follows:

Glimepiride	Glipizide	Glyburide
2	10	5
4	20	10
6	30	15
8 ^a	40*	20*

^a Maximal dose

(d) Triple therapy

- (1) Because it takes at least 8 weeks and can take up to 12 to 16 weeks before a maximal effect of a glitazone is seen, a decision on its effectiveness is made 4 months after starting pioglitazone.
- (2) If A1C >7.5% 4 months later, start bedtime insulin and discontinue pioglitazone.

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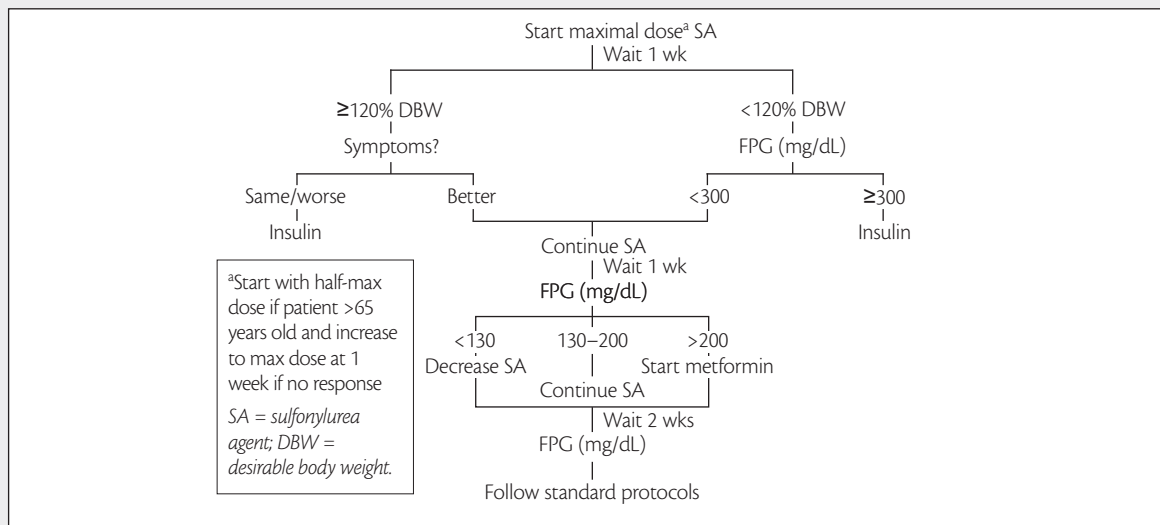
TABLE 2. GLYCEMIA TREATMENT ALGORITHM (CONTINUED)

- (e) Bedtime insulin
 - (1) Start obese patients with 16 units NPH insulin and lean patients with 10 units of NPH insulin at bedtime.
 - (2) Gradually increase insulin dose until SMBG values before breakfast are 70–130 mg/dL >50% of the time.
 - (3) Wait 3 months and measure an A1C level.
 - (4) If A1C >7.5%, switch to mixed/split regimen.
- (f) Two or more daily injections of insulin: adjust each component of the insulin regimen until $\geq 50\%$ of appropriate preprandial SMBG values are within target range (70–130 mg/dL).
- (g) Relationship of each component of the insulin regimen and SMBG test best reflecting its effect:

Insulin	Time Injected	Test Reflecting Insulin Action
Regular Lispro Aspart Glulisine	Before a meal	Both following meal, before which insulin is injected and before next meal or bedtime snack (if insulin taken before dinner).
NPH	Before breakfast	Before dinner
NPH	Before dinner or bedtime	Before breakfast
Glargine Detemir	Before breakfast or before dinner or half of dose each time	Before breakfast

4. Treatment of markedly symptomatic newly diagnosed type 2 diabetes patients

- (a) These patients have marked polyuria, polydipsia, and often blurring of vision and weight loss. Glucose concentrations frequently exceed 400 mg/dL. Almost all patients can be treated successfully with high doses of sulfonylurea agents.



FPG = fasting plasma glucose; NPH = neutral protamine Hagedorn; SMBG = self-monitored blood glucose.

rarely associated with serious hypoglycemia, and it causes only mild weight gain. Thiazolidinediones (TZDs) are effective in many patients when added as a third-line drug.⁹ There are three reasons to initiate an oral dipeptidyl dipeptidase (DPP)-4 inhibitor as the third drug when a TZD is contraindicated: (1) a study¹⁰ found sitagliptin (Januvia, Merck & Co., Inc.) effective when added to metformin plus sulfonylurea; (2) if the oral DPP-4 inhibitor is not used the next choice is an injectable agent, which presents possible adherence issues; and (3) the maximal effect is easily and quickly ascertained (ie, fasting plasma glucose concentrations are maximally lowered by 3 weeks), therefore, patients not achieving control with the DPP-4 inhibitor will be quickly identified.

COMPLIANCE

The injectable glucagon-like peptide-1 analog exenatide (Byetta, Amylin Pharmaceuticals, Inc. and Eli Lilly and Company) is not considered earlier in the treatment algorithm because of adherence issues and cost. But it is associated with weight loss, which may make it an attractive second-line option for some patients. If A1C is not <7.5% by 4 months after initiation, however, it should be discontinued and bedtime insulin initiated. Insulin is reserved as the final drug of choice because of adherence issues. Not only does it require self-administered injections, but it also requires self-monitoring of blood glucose (SMBG) and it is associated with potential hypoglycemia. Bedtime insulin plus oral antidiabetic agents is the first insulin regimen attempted; two or more insulin injections are used last.

A1C levels of 7.0% to 7.5% are tolerated before insulin is either started or intensified because of the aforementioned adherence issues. When insulin is started, patients undergo a disruption of lifestyle because of the requirement for SMBG and the increased possibility of hypoglycemia with even further disruptions if intensification of insulin therapy occurs. Five studies in >2,000 type 1¹¹⁻¹³ and type 2^{14,15} diabetes patients showed virtually no development or progression of retinopathy and nephropathy over 4 to 9 years when mean A1C levels were <7.0%, and the risk did not increase much with A1C between 7% and 7.5%.

HYPERTENSION TREATMENT

The hypertension algorithm (Table 4) was not developed when we evaluated nurse-directed care at the Los Angeles County Community Health Center,⁷ but it is now used. The ADA goals for systolic and diastolic blood pressure (Table 1) are being met in 60% and 90%, respectively, of more than 150 patients. This compares much more favorably than the 28% to 36% of patients in the literature

who met ADA systolic blood pressure goals.¹⁶

Angiotensin-converting enzyme inhibitors or aldosterone receptor antagonists are the preferred first-line agents, and thiazide diuretics are the preferred second-line drug (when serum creatinine concentration is <1.8 mg/dL or the estimated glomerular filtration rate is >50 mL/min).¹⁶ Note that beta-blockers are contraindicated in the setting of a dihydropyridine calcium channel blocker because the combination depresses cardiac function.

Algorithms improve diabetes care when providers have the time and knowledge to make appropriate, timely clinical decisions. Approved treatment algorithms when put into practice by trained and supervised nurses or pharmacists provide both the knowledge for and the timing of appropriate therapeutic decisions. This has been demonstrated in at least 19 randomized clinical trials, 14 of which used nurses and five used pharmacists, comparing their more favorable outcomes of care with usual care.²

The improvement in outcomes among diabetes patients whose care is directed by nurses and pharmacists that can make treatment decisions dictated by approved algorithms is clear.² When this model of diabetes care is followed, the nurse or pharmacist is almost as important of a team member as the patients themselves. Because the algorithms used have been approved by the supervising physician, the patient is receiving recommended care. Treating patients on insulin is particularly challenging for busy physicians, and knowledgeable nurses and pharmacists can be especially effective in working with these patients. Diabetes education is certainly necessary for successful outcomes, and nurses and pharmacists have the opportunity to reinforce it in the specific areas required by the patient (in addition to general background information). Considering all that is involved in treating and educating people with diabetes, it is really not surprising that outcomes are so significantly improved under nurses and pharmacists who can spend more time with patients and provide the appropriate care in a timely manner.

RESPONSE FROM THE AADE

“Current literature supports a team approach for care of patients with diabetes,” said Evan M. Sisson, PharmD, MSHA, CDE, from the Virginia Commonwealth University School of Pharmacy. “As the number of people with diabetes increases, so will the imperative for efficient delivery systems that match professional expertise with patient health needs.” Dr. Sisson is a member of the Board of Directors of the American Association of Diabetes Educators (AADE).

“The model described by Dr. Davidson decreases physician workload and increases patient access to care by delegating medication management authority to appropri-

TABLE 3. DYSLIPIDEMIA TREATMENT ALGORITHM

Treatment Plan (direct LDL-C measurements available)

1. Measure baseline lipid panel (hepatic transaminases should be measured every time lipids are).
2. All diabetic patients aged ≥ 40 years old should be taking a statin regardless of baseline LDL-C concentration.
3. Goal level of LDL-C is < 100 mg/dL or < 70 mg/dL if patient has overt cardiovascular disease (CVD).
4. Start a statin in all patients aged ≥ 40 years old and in those < 40 years whose LDL-C is above goal levels and who are at increased risk due to other cardiovascular risk factors.
5. In patients not at goal, measure LDL-C 1 month after starting a statin; measure LDL-C at monthly intervals, and increase dose of drug until goal level achieved.
6. Drug titration:
 - (a) Start simvastatin 10 mg qhs and double each month as follows until goal achieved; 10 mg to 20 mg to 40 mg to 80 mg; if goal is still not achieved, switch to 80 mg atorvastatin; if goal still not met 1 month later, add 10 mg of ezetimibe; if goal still not met 1 month later, **CONSULT MD.**
- OR-
- (b) Start ezetimibe plus simvastatin (Vytorin, Merck/Schering-Plough Pharmaceuticals) 10/10 mg qhs, and increase each month as follows until goal achieved: 10/10 mg to 10/20 mg to 10/40 mg to 80 mg atorvastatin plus 10 mg ezetimibe (note: Los Angeles county does not carry 10/80 Vytorin); if goal is not met 1 month later, **CONSULT MD.**
7. If initial triglyceride (TG) concentration is $\geq 1,000$ mg/dL, also start fenofibrate at 130^a mg qd; measure TG concentration in 1 month.
 - (a) If TG concentration remains $\geq 1,000$ mg/dL, continue fenofibrate and **CONSULT MD.**
 - (b) If TG concentration $< 1,000$ mg/dL, discontinue fenofibrate but restart if subsequent TG concentrations increase to $\geq 1,000$ mg/dL and **CONSULT MD.**
8. When LDL-C is at goal, if TG concentration is 200 to 999 mg/dL, calculate the non-high-density lipoprotein (HDL)-C (non-HDL-C = total C minus HDL-C); if this value > 130 mg/dL (> 100 mg/dL in patients with overt CVD), keep increasing the statin dose monthly (see 6a or 6b) until appropriate goal is reached.
9. If the patient reaches 80 mg atorvastatin plus 10 mg ezetimibe and the non-HDL-C value is $< 160^b$ mg/dL in patients without overt CVD or < 130 mg/dL in patients with overt CVD, simply follow the patient; if the non-HDL-C value is $\geq 160^b$ mg/dL in patients without overt CVD or ≥ 130 mg/dL in patients with overt CVD (and the patient is not taking fenofibrate), add 130^a mg fenofibrate.
10. When LDL-C (and non-HDL-C if TG concentrations are 200–999 mg/dL) is (are) at goal, measure lipids every 4 months during the subsequent year and every 6 months thereafter. Intensify treatment as described above if lipids increase above goal levels.

Treatment Plan (direct LDL-C measurements NOT available)

1. Measure baseline lipid panel (hepatic transaminases should be measured every time lipids are).
2. All diabetic patients aged ≥ 40 years should be taking a statin regardless of baseline LDL-C concentration.
3. Goal level of LDL-C is < 100 mg/dL or < 70 mg/dL if patient has overt CVD.
4. Start a statin in all patients aged ≥ 40 years and in those < 40 years whose LDL-C (or non-HDL-C if TG levels ≥ 400 mg/dL preclude calculating LDL-C) is above goal levels and who are at increased risk due to other cardiovascular risk factors.

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TABLE 3. DYSLIPIDEMIA TREATMENT ALGORITHM (CONTINUED)

5. If initial TG concentration <400 mg/dL and the patient is not at the LDL-C goal level, measure LDL-C 1 month after starting a statin; measure LDL-C at monthly intervals and increase dose of drug until goal level achieved.

6. Drug titration:

(a) Start simvastatin, 10 mg qhs, and double each month as follows until goal achieved. 10 mg to 20 mg to 40 mg to 80 mg; if goal is still not achieved, switch to 80 mg atorvastatin; if goal is still not met 1 month later, add 10 mg ezetimibe; if goal is still not met 1 month later, **CONSULT MD.**

-OR-

(b) Start combination of ezetimibe plus simvastatin 10/10 mg qhs and increase each month as follows until goal achieved: 10/10 mg to 10/20 mg to 10/40 mg to 80 mg atorvastatin plus 10 mg ezetimibe (Los Angeles county does not carry 10/80 Vytorin); if goal is not met 1 month later, **CONSULT MD.**

7. When LDL-C is at goal level, if TG concentration is 200 to 399 mg/dL, calculate the non-HDL-C (non-HDL-C = total C minus HDL-C); if this value is >130 mg/dL (>100 mg/dL in patients with overt CVD), keep increasing the statin dose monthly (see 6a or 6b above) until this goal is reached.

8. If the patient reaches 80 mg atorvastatin plus 10 mg ezetimibe and the non-HDL-C value is <160^b mg/dL in patients without overt CVD or <130 mg/dL in patients with overt CVD, simply follow the patient; if the non-HDL-C value is ≥160^b mg/dL in patients without overt CVD or 130 mg/dL in patients with overt CVD (and the patient is not taking fenofibrate), add 130^a mg fenofibrate.

9. If initial TG concentration is 400 to 999 mg/dL, calculate the non-HDL-C; if this value >130 mg/dL (>100 mg/dL in patients with overt CVD), keep increasing the statin dose (see 6a or 6b above) monthly until the appropriate goal is reached.

10. If the patient reaches 80 mg atorvastatin plus 10 mg ezetimibe and the non-HDL-C value is <160^b mg/dL in patients without overt CVD or <130 mg/dL in patients with overt CVD, simply follow the patient; if the non-HDL-C value is ≥160^b mg/dL in patients without overt CVD or ≥130 mg/dL in patients with overt CVD (and the patient is not taking fenofibrate), add 130^a mg fenofibrate.

11. If initial TG concentration is ≥1,000 mg/dL, also start fenofibrate at 130^a mg qd along with 10 mg simvastatin qhs; measure TG concentration in 1 month.

(a) If TG concentration remains ≥1,000 mg/dL, continue fenofibrate and **CONSULT MD.**

(b) If TG concentration is <1,000 mg/dL, discontinue fenofibrate but restart if subsequent TG concentrations increase to ≥1,000 mg/dL and **CONSULT MD.**

12. When LDL-C (and/or non-HDL-C if TG concentrations are 200–999 mg/dL) is (are) at goal, measure lipids every 4 months during the subsequent year and every 6 months thereafter. Intensify treatment as described above if lipids increase above goal levels.

^a This is the dose of generic fenofibrate, available in the Los Angeles County formulary. The dose under the brand name, Tricor (Abbott), is 145 mg once a day.

^b This value is chosen rather than the usually recommended level of ≥130 mg/dL because a pooled post hoc analysis of four publicly available large data sets showed that the increased risk in people both with and without diabetes did not start until the non-HDL-C levels were ≥160 mg/dL; there was no increased risk with levels 130 to 159 mg/dL compared with <130 mg/dL (Table 3 Diabetes Care. 2005;28:1916–1921).

TABLE 4. HYPERTENSION TREATMENT ALGORITHM

Treatment Plan

1. Initial hypertension treatment for blood pressure (BP) <160/100 mm Hg is medical nutritional therapy (MNT) and lifestyle modification.
2. Pharmacological therapy is initiated on any patient who does **not** meet goal of **≤130/80 mm Hg** and has failed MNT and lifestyle modification for approximately 4–8 weeks.
3. Principles of treatment to achieve the BP goal of **≤130/80 mm Hg**:
 - (a) To determine the effect of starting or changing the dose of an antihypertensive medication, measure the BP approximately 4 weeks after initiating or changing the dose.
 - (b) If BP goal of **≤130/80 mm Hg** is not reached at the maximal (tolerated) dose of a class of drugs, add the drug from the next class.

Algorithm for the treatment of hypertension in patients enrolled in the diabetes management program (DMP)

A. Nonpharmacologic therapy (lifestyle change)

1. Weight reduction toward desirable body weight of at least 5% to 10% of initial weight
2. Salt restriction to as close to 2 g/day as possible utilizing the DASH^a diet
3. Smoking cessation
4. Limit daily alcohol intake to <2 oz per day
5. Exercise (walking, swimming, etc, 30–45 minutes 3–4 times a week)
6. Caffeine cessation
7. Stress reduction
8. If BP is controlled at **≤130/80 mm Hg**, continue with nonpharmacological program.
9. Lifestyle modification for 8 weeks. If BP goal of **≤130/80 mm Hg** is not met, go to **B**.

B. First-line drug(s) for pharmacologic treatment (angiotensin-converting enzyme inhibitor [ACE-I] or angiotensin receptor blocker [ARB])

1. Start patient on benazepril 10 mg once daily
2. Measure K⁺ 2 weeks after each change of benazepril dose.
3. If K⁺ above the upper limit of normal, decrease to previous dose.
4. Increase benazepril to 20 mg if BP goal is not met at 4-week follow-up.
5. Measure K⁺ 2 weeks after dose increase. If above the upper limit of normal, decrease to previous dose.
6. Increase benazepril to 40 mg once daily if BP goal is not met at 4-week follow-up.
7. Measure K⁺ 2 weeks after dose increase. If above the upper limit of normal, decrease to previous dose.
8. If patient complains of a cough or angioneurotic edema (two other side effects in addition to hyperkalemia), discontinue benazepril and start losartan, an ARB, using a dose equivalency from the table.
9. (Because ARBs also raise K⁺ levels, they cannot be substituted for an ACE inhibitor if the latter causes hyperkalemia.)

DOSE EQUIVALENCY TABLE	
ACE Inhibitor	ARB
Benazepril 10 mg	Losartan 20 mg
Benazepril 20 mg	Losartan 50 mg
Benazepril 40 mg	Losartan 100 mg

10. If BP goal of **≤130/80 mm Hg** is not met at 4-week follow-up visit after maximal dose of an ACE inhibitor or ARB is prescribed, **go to second-line drug**.

(Continued)

TABLE 4. HYPERTENSION TREATMENT ALGORITHM (CONTINUED)

C. Second-line drug (diuretic): hydrochlorothiazide (HCTZ) (if estimated glomerular filtration rate (eGFR) is ≥ 50 mL/min [or if unavailable, serum creatinine is ≤ 1.8 mg/dL]) or indapamide) (if eGFR ≤ 50 mL/min [or if unavailable, serum creatinine is ≥ 1.9 mg/dL; see No. 4 below). To be used if BP goal of $\leq 130/80$ is not achieved with a maximal (tolerated) dose of an ACE inhibitor or ARB.

1. Add HCTZ 12.5 mg, once daily.
2. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit, increase HCTZ to 25 mg once daily (maximal dose).
3. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit, go to **third-line drug**.
4. If the eGFR is < 50 mL/min (or if unavailable, serum creatinine is ≥ 1.9 mg/dL), start indapamide 1.25 mg once daily.
5. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit, increase indapamide dose to 2.5 mg once daily (maximal dose).
6. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit, go to **third-line drug**.

D. Third-line drug (nondihydropyridine calcium channel blocker): diltiazem or verapamil. To be used if BP goal of $\leq 130/80$ mm Hg is not achieved with combination of maximal doses of the first- and second-line drugs.

1. Add diltiazem ER (or verapamil ER) 180 mg once daily.
2. If BP goal of $\leq 130/80$ mm Hg not met at 4 weeks follow up visit, increase to 180 mg twice daily (maximal dose).
3. If BP goal of $\leq 130/80$ mm Hg not met at 4 weeks follow up visit and patient at maximal doses of combination of the first-, second-, and third-line drugs, go to **fourth-line drug**.

E. Fourth-line drug (direct vasodilators): hydralazine. To be used if BP goal of $\leq 130/80$ mm Hg is not achieved with a combination of maximal doses of first-, second-, and third-line drugs.

1. Add hydralazine 50 mg twice daily.
2. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit, increase to 100 mg twice daily (maximal dose).
3. If BP goal of $\leq 130/80$ mm Hg is not met at 4-week follow-up visit **and** patient is taking maximal doses of four classes of drugs (ACE or ARB, diuretic, nondihydropyridine calcium channel blocker and direct vasodilator), **CONSULT MD.**

DASH = Dietary Approaches to Stop Hypertension (dashdiet.org).

All algorithms courtesy Mayer B. Davidson, MD, updated March 2009

ately trained nurses and pharmacists through a diabetes treatment algorithm. Certified diabetes educators are highly specialized health professionals (including nurses, pharmacists, and dietitians) whose role on the team is to spend the necessary time to improve diabetes self-care behaviors. Because of the intense specialization, diabetes educators are also valuable resources to ensure attainment of diabetes therapy goals, especially when given authority to make appropriate treatment decisions. Nurse practitioners have at least limited prescriptive privileges in most states. Several state medical boards also promote pharmacist-initiated medication therapy changes via collaborative practice agreements between physicians and pharmacists as a means to extend the reach of physicians to the communities they serve. The AADE supports these innovative practice models that improve care and self-management education for all patients with diabetes." ■

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