Goal Attainment in Patients with Type 2 Diabetes, Part 1

Jocelyn D. Jones, PharmD, BCPS, Linh B. ter Riet, PharmD, BCPS, Chenise Andrews, PharmD, Mekia Powell, PharmD, Laronne Williams, PharmD, and Frank S. Emanuel, PharmD

With only a small percentage of adult patients with diabetes meeting the recommended goals of therapy, these authors investigated whether patients at a military treatment facility were meeting their targets.

The prevalence of diabetes mellitus in the United States has increased from 4.9% in 1990[1] to 7.8% (23.6 million people) in 2007.[2] Additionally, 25.9% of the U.S. adult population (or 57 million people) have prediabetes, which increases their risk of developing type 2 diabetes, heart disease, and stroke.[2] Although likely underreported as a cause of death, diabetes was ranked seventh in 2006, with the risk of death among people with diabetes at twice that of people without diabetes of a similar age.[3] Heart disease and stroke accounted for about 68% and 16%, respectively, of diabetes-related deaths for people aged 65 years and older in 2004. Heart disease death and stroke rates are two to four times higher in people with diabetes than in people without the disease.[3] Other complications of diabetes include diabetic retinopathy and blindness; kidney disease, failure, and transplantation; nervous system damage, including peripheral neuropathies and amputations; periodontal gum disease; and diabetic ketoacidosis and hyperosmolar coma.

Although type 2 diabetes is a major risk factor for macrovascular disease and is considered a coronary heart disease (CHD) risk equivalent,[4] studies have shown that many of the complications of diabetes can be reduced through effective blood pressure, cholesterol, and hemoglobin A_{1c} (HbA_{1c}) control. Despite this clinical evidence, however, significant gaps still exist in the quality of care for these three measures in many patients with diabetes. In fact, fewer than 10% of adult patients with diabetes meet the recommended goals of therapy for HbA_{1c}, blood pressure, and cholesterol. Data from national commercial health care organizations show that 57% of patients with diabetes have low-density lipoprotein cholesterol (LDL) levels above 100 mg/dL, 30% have poor HbA_{1c} control, and 70% have blood pressure levels above 130/80 mm Hg (Table 1).[5]

In an effort to improve diabetes care, performance measures have been developed by the American Diabetes Association (ADA) and the National Committee for Quality Assurance to encourage health care organizations and providers to measure outcomes and develop quality improvement interventions. The Healthcare Effectiveness Data and Information Set (HEDIS), Diabetes Quality Improvement Project, and Diabetes Provider Recognition Program all provide national benchmark information for organizations to compare against and model their efforts.

The purpose of the study discussed here was to identify the adherence rates to the ADA 2006 diabetes treatment guidelines[6] in patients with type 2 diabetes receiving care at a military treatment facility (MTF) and to compare these results to the national benchmarks. In this first part of a two-part series, we present our findings on goal attainment rates for blood pressure, LDL, and HbA_{1c}. In part 2, we will discuss our results on medication treatment patterns and screening rates. Before reporting the details of our analysis, we describe the ADA standards of care for blood pressure, LDL, and HbA_{1c} control.

ADA STANDARDS OF CARE

At the beginning of every year, the ADA publishes the standards of medical care for patients with diabetes.[6] These standards are intended to provide health care professionals with guidance for diabetes management, treatment goals, and the information needed to evaluate the quality of patient care. These guidelines provide tremendous clinical value because of the increasing prevalence of diabetes and the increasing complexity of its management over the past decade.

Blood pressure

Hypertension is a common comorbidity of diabetes, affecting 75% of adults with diabetes.[3] Hypertension by itself is also a major risk factor for

Dr. Jones is an assistant professor of pharmacy practice in the College of Pharmacy and Pharmaceutical Sciences at Florida A&M University, Jacksonville. **Dr. ter Riet** is a medical outcomes specialist in the global research and development division at Pfizer Inc, Jacksonville, FL. At the time of this study, **Dr. Andrews**, **Dr. Powell**, and **Dr. Williams** were doctor of pharmacy candidates in the College of Pharmacy and Pharmaceutical Sciences at Florida A&M. **Dr. Emanuel** is an associate professor of pharmacy practice and the director of the Jacksonville practice division at Florida A&M. He is also a fellow of the American Society of Health System Pharmacists.

Table 1. 2007 HEDIS[a] performance measure benchmarks for diabetes care[5]			
Measure	Commercial, %	Medicare, %	Medicaid, %
Yearly eye examinations	54.7	62.3	51.4
Yearly HbA$_{1c}$[b] testing	87.5	87.2	78.0
Poor HbA$_{1c}$ control (> 9%)	29.6	27.3	48.7
Good HbA$_{1c}$ control (< 7%)	41.8	45.9	30.2
Yearly LDL[c] screening	83.4	84.8	71.1
LDL control (< 100 mg/dL)	43.0	46.9	30.6
Yearly diabetic nephropathy monitoring	79.7	85.4	74.6
Blood pressure control (< 130/80 mm Hg)	29.9	30.2	30.4
Blood pressure control (< 140/90 mm Hg)	61.4	57.8	57.3
[a]HEDIS = Healthcare Effectiveness Data and Information Set. [b]HbA$_{1c}$ = hemoglobin A$_{1c}$. [c]LDL = low-density lipoprotein cholesterol.			

cardiovascular disease (CVD) and microvascular complications, such as retinopathy and nephropathy. Blood pressure control can reduce the risk of CVD by 33% to 50% and the risk of microvascular complications by 33%.[3] Results from randomized, clinical trials have demonstrated a reduction in CVD events, stroke, and nephropathy by lowering systolic blood pressure (SBP) to less than 140 mm Hg and diastolic blood pressure (DBP) to less than 80 mm Hg in patients with diabetes.[6] The ADA recommends that patients with diabetes be treated to an SBP of less than 130 mm Hg and a DBP of less than 80 mm Hg.[6]

LDL and other lipids

Patients with type 2 diabetes have an increased prevalence of lipid abnormalities that contribute to increased rates of cardiovascular events. Lowering LDL has been shown to reduce the incidence of major cardiovascular events by 37% in primary prevention patients in the Collaborative Atorvastatin Diabetes Study[7]; by 23% in patients with type 2 diabetes, hypertension, and other risk factors for CVD in the Anglo-Scandinavian Cardiac Outcomes Trial–Lipid Lowering Arm[8]; and by 12% in secondary pre-

vention patients with diabetes in the Heart Protection Study.[9]

The ADA defines LDL goals based on the presence or absence of existing CVD. In patients without CVD, the LDL goal is less than 100 mg/dL.[6] For patients older than age 40, statin therapy to achieve LDL reductions of 30% to 40% is recommended, regardless of baseline LDL levels.[6]

All patients with CVD should be treated with a statin to achieve an LDL reduction of 30% to 40%, according to the ADA.[6] A lower LDL goal of less than 70 mg/dL, achieved with the help of a high dose statin, is an option.[6]

The ADA also recommends raising the levels of high-density lipoprotein cholesterol (HDL) to greater than 40 mg/dL. In women, an HDL goal of more than 50 mg/dL should be considered. And for triglycerides, the ADA recommends patients keep their levels below 150 mg/dL.[6]

HbA$_{1c}$

The HbA$_{1c}$ measurement provides a way to assess a patient's average glycemia over the preceding two to three months and evaluate treatment efficacy for glycemic control. Maintaining glucose levels as close to the

nondiabetic range as possible has been demonstrated to have a beneficial impact on retinopathy, nephropathy, and neuropathy. In the United Kingdom Prospective Diabetes Study, HbA$_{1c}$ control to a level of 7% in patients with type 2 diabetes resulted in a 12% reduction in any diabetes-related endpoint and a 25% reduction in microvascular endpoints.[10]

Glycemic control is fundamental to diabetes management and the ADA-recommended goal of therapy is to achieve an HbA$_{1c}$ level as close to normal as possible without developing hypoglycemia.[6] In general, the HbA$_{1c}$ goal for patients is less than 7%.[6] In individual patients, however, the HbA$_{1c}$ goal is a level as close to normal (less than 6%) as possible without significant hypoglycemia.[6]

METHODS

Study design

We performed a retrospective, observational, cohort analysis using computerized medical, pharmacy, and laboratory records for the most recent, complete, 12-month period. A standardized data collection form was developed to ensure consistency in data retrieval from the medical

Table 2. Demographics of study population (n = 299)	
Characteristic	Study population
Age in years, mean (range)	59.9 (18–85)
Gender, no. (%)	
Female	127 (42.5)
Male	166 (55.5)
Not documented	6 (2.0)
Race, no. (%)	
White	179 (59.9)
Black	44 (14.7)
Hispanic	1 (0.3)
Other	56 (18.7)
Not documented	19 (6.4)
Current smoker, no. (%)	25 (8.4)

Table 3. Blood pressure distribution of study patients (n = 297)	
Blood pressure measurement, mm Hg	No. (%) of patients
< 130/80	139 (46.8)
≥ 130/80 and < 140/90	76 (25.6)
≥ 140/90	82 (27.6)

records. Data collection was completed by pharmacy students on a scheduled research rotation at the MTF. This research project was approved by the investigational review board.

Patient population

Patients with a diagnosis of type 2 diabetes mellitus obtaining care for diabetes between June 2005 and June 2006 at the MTF were identified. A list of 1,592 patients who met the diagnostic and date criteria was generated and a representative sample of 300 patients was selected randomly for data collection and analysis. From this random sample, patients were included in the analysis if they were aged 18 years or older and were managed by an MTF provider. Patients were excluded if they had type 1 diabetes, were younger than age 18, or were being medically supervised by a civilian provider.

Outcomes

The primary outcomes assessed included blood pressure, lipid, and HbA_{1c} goal attainment rates as defined by the ADA 2006 guidelines. Secondary outcomes assessed included cardiovascular and diabetic disease complications and the following screening and prevention parameters: monitoring for HbA_{1c}, blood pressure, lipids, serum creatinine, and microalbumin; tobacco cessation counseling for current smokers; use of aspirin therapy, angiotensin converting enzyme inhibitors or angiotensin receptor blockers, and 3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitors (statins).

Data parameters and analysis

Demographic variables collected included age, gender, race, height, weight, tobacco use, and history of cardiovascular and diabetes complications. Laboratory and monitoring variables collected included HbA_{1c}; SBP; DBP; lipid profiles, including LDL, HDL, triglycerides, and total cholesterol; microalbumin; and serum creatinine. Medication assessments included use of aspirin, antiplatelet agents, warfarin, all blood pressure medications, all lipid lowering medications, and all diabetes medications.

Blinded and Health Insurance Portability and Accountability Act (HIPAA) compliant information from the data collection forms were entered into a Microsoft ACCESS 2000 (Mi-

crosoft Corporation, Seattle, WA) database and analyzed. Analysis results were reported using descriptive statistics. Statistical analysis was completed using Minitab (Minitab Inc, State College, PA) software and included chi square tests, two-sample t tests and one-way analysis of variance.

RESULTS

Complete data for 299 patients were available for analysis. The mean age of the study group was 59.9 years (range, 18 to 85 years). More than half of the patients were male and the majority were white (Table 2).

Blood pressure control

The mean blood pressure of the 297 patients with a recorded blood pressure measurement was 129.9/74.2 mm Hg, with the SBP ranging from 75 to 197 mm Hg and the DBP ranging from 44 to 103 mm Hg. Almost half (139, 46.8%) achieved the ADA blood pressure goal of less than 130/80 mm Hg, and 215 (72.4%) had a blood pressure less than 140/90 mm Hg (Table 3).

According to the 2007 national HEDIS benchmarks,[5] more MTF-treated study patients had blood pressure values below the thresholds of 130/80 and 140/90 mm Hg than patients enrolled in commercial health care organizations (Figure).
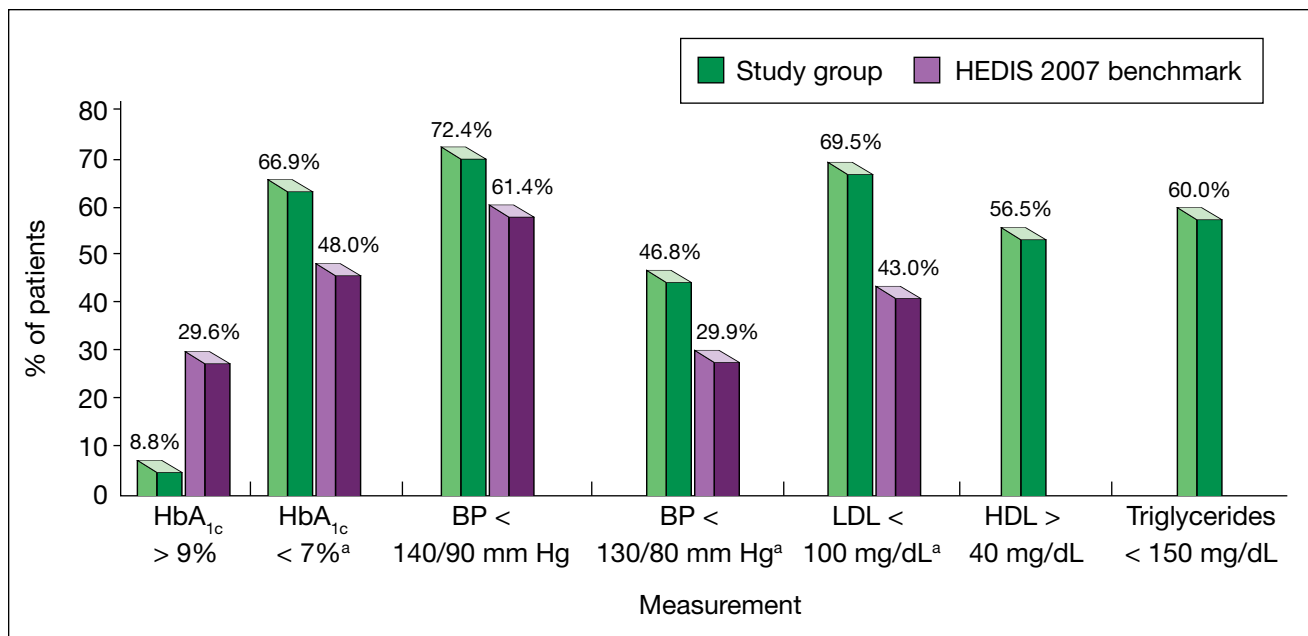
Figure. Goal attainment for hemoglobin A_{1c} (HbA$_{1c}$), blood pressure (BP), low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL), and triglycerides in the military treatment facility–treated study patients. HbA$_{1c}$, BP, and LDL levels are compared with commercial health care organization–treated patients with type 2 diabetes, according to the Healthcare Effectiveness Data and Information Set (HEDIS) 2007 national commercial benchmark. [a]American Diabetes Association standard of medical care for patients with diabetes.

LDL goal attainment

Of the 282 patients with an LDL level recorded, 224 had no CHD and 58 had CHD. Of the 224 patients without CHD who had an LDL level recorded, 152 (67.9%) had an LDL value below 100 mg/dL. Of all 238 patients without CHD, 171 (76.3%) were taking statins at doses that would reduce LDL by 30% to 40% (Table 4).

Among the 58 patients with CHD who had an LDL level recorded, 13 (22.4%) had an LDL value below 70 mg/dL and 44 (75.9%) had an LDL value below 100 mg/dL. Only 47 (77.1%) of the total 61 patients with CHD were prescribed a statin, and of those 47, 97.9% were taking statins at a dose that would reduce LDL by 30% to 40%. Overall, the LDL goal attainment rate for all study patients was 69.5%.

According to the 2007 national HEDIS benchmarks,[5] more patients in the study group had LDL levels below the ADA goal of 100 mg/dL than patients enrolled in commercial health care organizations.

Only 19 (6.4%) of patients in the study group were enrolled in the pharmacist-managed lipid clinic. In comparing patients managed by the lipid clinic with those who were not, there were no statistical differences between the two groups in LDL goal attainment rates (52.6% compared with 70.7%, respectively, P = .098) or mean LDL levels (97.7 mg/dL compared with 89 mg/dL, P = .186). This comparison was limited, however, by the small number of patients and was not a prespecified outcome measure.

Other lipid parameters

The mean HDL level for the 285 patients with this level recorded was 44.7 mg/dL (range, 15 to 95 mg/dL). Fifty-six percent of the patients had an HDL level greater than 40 mg/dL and 11.2% had an HDL level of 60 mg/dL or greater. Of the 121 women in the study with an HDL measurement, 46 (38%) had an HDL value greater than 50 mg/dL.

The mean triglyceride level for the 285 patients with this level recorded was 157.3 mg/dL (range, 45 to 525 mg/dL) and 60% of the patients had triglyceride levels below 150 mg/dL.

Overall, 71.2% of the patients had some form of dyslipidemia—either high LDL or triglyceride levels or low HDL levels. Only 5%, however, had a combination of all three.

Glycemic control

The mean HbA$_{1c}$ level was 6.9% (range, 4.9% to 13.2%). Of the 296 patients with a recorded HbA$_{1c}$ level, 198 (66.9%) had a level less than 7% and 47 (16%) had a level less than 6% (Table 5). Only 8.8% of the patients

Table 4. LDL[a] level and statin therapy distribution for study patients with and without CHD[b]			
Measure	All patients[c]	Patients with existing CHD[d]	Patients without CHD[e]
LDL level in mg/dL, mean (range)	89.6 (10–212)	88.9 (39–189)	89.8 (10–212)
LDL threshold, no. (%)			
< 70 mg/dL	71 (25.2)	13 (22.4)	58 (25.9)
≥ 70 and <100 mg/dL	125 (44.3)	31 (53.5)	94 (42.0)
< 100 mg/dL	196 (69.5)	44 (75.9)	152 (67.9)
≥ 100 and < 130 mg/dL	62 (21.9)	8 (13.8)	54 (24.1)
≥ 130 and < 160 mg/dL	14 (4.9)	3 (5.2)	11 (4.9)
≥ 160 mg/dL	10 (3.6)	3 (5.2)	7 (3.1)
Statin therapy used, no. (%)	220[f] (73.6)	47 (77.1)	173 (72.7)
Statin therapy used at doses expected to lower LDL by 30%–40%, no. (%)	217 (72.6)	46 (75.4)	171 (71.8)

[a]LDL = low-density lipoprotein cholesterol. [b]CHD = coronary heart disease. [c]n = 282 for mean LDL and LDL threshold measures; n = 299 for statin therapy measures. [d]n = 58 for mean LDL and LDL threshold measures; n = 61 for statin therapy measures. [e]n = 224 for mean LDL and LDL threshold measures; n = 238 for statin therapy measures. [f]Thirty-two (40.5%) of the 79 patients who were not taking a statin had LDL values > 100 mg/dL.

had poor HbA$_{1c}$ control (defined as an HbA$_{1c}$ value greater than 9%).

According to the 2007 national HEDIS benchmarks,[5] fewer patients in the study group had poor control of their diabetes and more had good HbA$_{1c}$ control than patients enrolled in commercial health care organizations.

DISCUSSION

Overall, we found that there were fewer patients with type 2 diabetes in the MTF-treated study group with poor HbA$_{1c}$ control and significantly more patients with HbA$_{1c}$, blood pressure, and LDL values under control than patients with type 2 diabetes treated in commercial health care organizations, according to 2007 national HEDIS benchmarks.[5]

How do our findings compare with other study results?

We compared our findings with other studies investigating type 2 diabetes treatment goal attainment. One study was published in 2006 by Yan and colleagues and evaluated LDL goal attainment in outpatients with diabetes, established CVD, or both. The results demonstrated that 59.6% of the 1,968 diabetic patients with CVD and 44.8% of the 2,836 diabetic patients without CVD achieved the recommended LDL goal of less than 100 mg/dL.[11] The mean LDL levels for the two groups were 97.1 mg/dL and 108.7 mg/dL, respectively.

Our analysis also showed lower rates of LDL goal attainment in the group of patients without CHD (67.9% compared with 75.9% in the patients with CHD). We found lower mean LDL levels and higher goal attainment levels in both groups of patients, however, compared to those reported by Yan and colleagues.

Andros and colleagues evaluated blood pressure goal attainment rates in 4,224 patients with type 1 and type 2 diabetes enrolled in a commercial managed care organization. Thirty-one percent of the study group achieved their blood pressure goals of below 130/80 mm Hg, with a mean blood pressure of 130.3/77.9 mm Hg.[12] We found a lower mean blood pressure level in our study's patient population. In addition, we found that a greater proportion of patients attained the blood pressure goal.

Lawrence and colleagues evaluated HbA$_{1c}$ goal attainment rates in relationship to medication possession ratios for sulfonylureas and metformin.[13] In the 1,668 patients evaluated in the managed care organization, 44.5% had HbA$_{1c}$ values less than or equal to 7%. By contrast, in our analysis, we found 70.3% of our population had HbA$_{1c}$ values less than or equal to 7%.

What makes MTF treatment different?

With a mean age of 59.9 years, our diabetes population was slightly older than the managed care populations evaluated by Lawrence and colleagues (mean age 51 to 52 years)[13] and Andros and colleagues (mean age 52 years)[12] and slightly younger than the outpatients evaluated by Yan

Table 5. HbA$_{1c}$[a] control in the study patients (n = 296)	
HbA$_{1c}$ level, %	No. (%) of patients
< 6	47 (15.9)
< 7	198 (66.9)
> 7 and < 8	55 (18.6)
> 8 and < 9	17 (5.7)
> 9	26 (8.8)
[a]HbA$_{1c}$ = hemoglobin A$_{1c}$.	

and colleagues (mean age 66 years).[11] Similarly, the proportion of men in our study population (56%) was slightly greater than those of Lawrence and colleagues (41% to 48%)[13] and Andros and colleagues (54%)[12] and slightly lower than that of Yan and colleagues (65%).[11] The difference in demographics may have contributed somewhat to the outcomes in our analysis. At the MTF, however, several other factors are more likely to influence rates of blood pressure, cholesterol, and HbA$_{1c}$ control.

First, the MTF routinely monitors and reports HEDIS performance rates for diabetes. These data are used to identify and contact patients with HbA$_{1c}$ values greater than 9% so that the patients may be seen by a dedicated diabetes disease management nurse for intervention and follow-up care. Similarly, patients identified as having uncontrolled hypertension and dyslipidemia are contacted by a dedicated disease management nurse responsible for CVD interventions and follow-up care.

Second, the MTF provides clinical pharmacy support for dyslipidemia through the pharmacist-managed lipid clinic. Patients requiring more intensive interventions are referred to the lipid clinic for ongoing monitoring and education.

Third, patients who have been newly diagnosed with diabetes and those whose disease is difficult to control are seen by a certified diabetes educator who provides one-on-one counseling, nutrition education, and training in blood glucose monitoring and insulin injection. All of these factors likely contributed to the high goal attainment rates observed in our analysis. ●

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