



























## AREAS IN NEED OF IMPROVEMENT

Clearly, quality of care standards for diabetes care will continue to evolve as the evidence base grows and clinical recommendations change. Challenges in measuring quality include: (1) the application of measures to populations that have not been well studied; (2) the ongoing difficulties of case-mix risk adjustment, data availability, quality, and uniformity; (3) addressing disparities in glycemic and cardiovascular risk factor control by age and race; and (4) the development of new or novel performance measures that are consistent with the goals of patients. One of the greatest technical challenges will be developing approaches that account for physicians' efforts to individualize diabetes care, since this is at the core of high-quality clinical practice. How do stakeholders develop measures that reward physicians for the hard task of tailoring goals and treatments to patient health status and patient preferences?

A striking deficiency in efforts to measure quality of diabetes care is the sole focus of current measures on the care of people with established diabetes. Body mass index, widely considered to be the major driver of the current diabetes epidemic, is not a conventional indicator of quality of care. Randomized clinical trials demonstrated that intensive lifestyle modification is effective in preventing or delaying the onset of diabetes among those who are at high risk (impaired fasting glucose, impaired glucose tolerance, or A1c 5.7%–6.4% [39–46 mmol/mol]) (104,105,106). Even modest weight loss (7%–10% decrease in weight) can result in improved glycemic control and prevention of diabetes among those who are at high risk (106). ADA recommendations for persons at high risk of diabetes include weight loss interventions, increasing physical activity, and consideration of metformin therapy (26), although no drugs have been cleared

by the U.S. Food and Drug Administration for clinical use in the prevention of diabetes. Despite the strong evidence base supporting weight loss, lifestyle interventions, and metformin for the prevention of diabetes, measures related to prevention of diabetes are typically not part of the quality of care rubric. Quality indicators almost exclusively focus on treatment of persons with diagnosed diabetes. Quality measures that reflect primary prevention of diabetes and weight loss represent a novel area in need of consideration (60).

Extending quality of care to address prevention of diabetes, hypoglycemia, patient satisfaction, patient quality of life, complications such as infection and pneumonia, medication side effects, and rates of rehospitalization and use of urgent care may not only improve outcomes for individuals but may help identify system factors that could improve care across the board.

### LIST OF ABBREVIATIONS

A1c . . . . . glycosylated hemoglobin	HEDIS . . . . . Healthcare Effectiveness Data and Information Set
ADA . . . . . American Diabetes Association	LDL . . . . . low-density lipoprotein
DCCT . . . . . Diabetes Control and Complications Trial	NHANES . . . . . National Health and Nutrition Examination Survey
DQIP . . . . . Diabetes Quality Improvement Project	UKPDS . . . . . United Kingdom Prospective Diabetes Study

### CONVERSIONS

Conversions for A1c, cholesterol, and glucose values are provided in *Diabetes in America Appendix 1 Conversions*.

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### DUALITY OF INTEREST

Drs. Selvin, Narayan, and Huang reported no conflicts of interest.

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APPENDICES

**APPENDIX 41.1.** Age- or Sex-Standardized Risk Factor Control Among Adults Age ≥20 Years With Diagnosed Diabetes, by Year and Race/Ethnicity, U.S., 1988–1994 and 1999–2010

RISK FACTORS	NHANES III 1988–1994			NHANES 1999–2004			NHANES 2005–2010		
	Non-Hispanic White (N=595)	Non-Hispanic Black (N=416)	Mexican American (N=475)	Non-Hispanic White (N=609)	Non-Hispanic Black (N=372)	Mexican American (N=424)	Non-Hispanic White (N=758)	Non-Hispanic Black (N=573)	Mexican American (N=394)
<b>Mean (standard error)</b>									
Age at diabetes diagnosis (years)	51.7 (0.83)	46.9 (0.90)	49.7 (1.48)	47.7 (0.96)	44.6 (0.84)	43.4 (0.98)	49.8 (0.69)	46.7 (0.56)	45.1 (0.96)
Duration of diabetes (years)	9.5 (0.48)	10.5 (0.62)	7.7 (0.67)	13.6 (0.79)	12.2 (0.74)	11.3 (0.81)	11.2 (0.41)	11.0 (0.42)	10.3 (0.61)
<b>Percent (standard error)</b>									
<b>Diabetes treatment*</b>									
Insulin only	25.1 (2.14)	37.3 (2.32)	18.7 (2.84)	17.1 (2.16)	20.5 (1.89)	10.2 (2.09)	17.0 (1.65)	14.7 (1.53)	12.0 (1.72)
Oral only	44.7 (3.26)	35.4 (2.34)	57.2 (3.81)	54.1 (2.88)	54.7 (2.90)	66.2 (1.75)	54.8 (2.34)	57.2 (2.63)	60.7 (2.37)
Insulin and oral	3.0 (0.74)	6.5 (1.46)	3.9 (0.94)	10.2 (1.86)	12.1 (2.16)	9.0 (1.80)	16.1 (1.28)	15.4 (1.65)	10.2 (1.48)
No meds	27.2 (2.69)	20.8 (2.01)	20.3 (2.80)	18.6 (2.78)	12.7 (1.91)	14.6 (1.63)	12.2 (1.86)	12.7 (1.64)	17.2 (1.91)
<b>Hypertension</b>									
Treated*	45.5 (2.60)	59.0 (2.51)	36.9 (4.29)	55.1 (2.01)	71.3 (3.02)	51.0 (2.41)	63.2 (2.01)	74.4 (2.14)	51.4 (2.20)
Controlled†	17.0 (3.77)	20.3 (3.75)	12.0 (2.94)	39.9 (4.45)	28.3 (3.13)	40.2 (4.60)	45.3 (3.05)	40.1 (2.24)	53.1 (2.54)
Uncontrolled	83.0 (3.77)	79.7 (3.75)	88.0 (2.94)	60.1 (4.45)	71.7 (3.13)	59.8 (4.60)	54.7 (3.05)	59.9 (2.24)	46.9 (2.54)
Blood pressure <130/80 mmHg	34.1 (2.83)	28.0 (2.78)	36.7 (4.76)	46.7 (3.55)	35.7 (2.65)	44.9 (2.89)	51.6 (2.45)	43.4 (2.05)	53.0 (3.04)
<b>Hypercholesterolemia</b>									
Treated*	14.9 (2.05)	14.5 (1.98)	12.8 (4.53) <sup>1</sup>	44.6 (2.73)	30.1 (2.53)	35.4 (3.37)	56.3 (2.43)	48.5 (2.06)	50.5 (3.73)
Controlled†	31.9 (7.63)	21.0 (4.63)	40.2 (12.58) <sup>1</sup>	47.4 (3.64)	53.4 (7.14)	44.6 (5.42)	68.6 (2.82)	59.8 (3.72)	64.6 (4.19)
Uncontrolled	68.1 (7.63)	79.0 (4.63)	59.8 (12.58)	52.6 (3.64)	46.6 (7.14)	55.4 (5.42)	31.4 (2.82)	40.2 (3.72)	35.4 (4.19)
Total cholesterol <200 mg/dL	31.5 (2.82)	34.4 (2.98)	41.9 (4.21)	48.7 (2.16)	56.2 (2.83)	50.0 (2.45)	70.0 (2.17)	61.3 (2.35)	60.5 (2.62)
LDL cholesterol <100 mg/dL	7.4 (2.26) <sup>1</sup>	13.3 (3.42)	20.1 (5.33)	38.7 (4.18)	41.7 (5.23)	34.1 (4.21)	61.7 (3.34)	42.0 (3.73)	43.8 (3.48)
Daily aspirin use	21.1 (2.33)	10.8 (1.84)	8.4 (2.26)	27.5 (2.50)	12.6 (1.79)	16.2 (1.71)	‡	‡	‡
Retinopathy§	14.7 (1.89)	24.7 (2.27)	23.3 (4.09)	23.8 (2.68)	28.7 (2.10)	26.4 (2.15)	19.5 (1.58)	23.5 (1.84)	20.7 (2.15)
Retinopathy	18.8 (3.47)	25.7 (3.57)	25.8 (3.94)	‡	‡	‡	28.7 (2.28)	40.9 (3.80)	39.1 (4.84)
History of CVD¶	20.6 (2.60)	19.7 (2.63)	13.8 (2.37)	26.7 (2.08)	22.4 (2.66)	18.3 (2.07)	25.8 (1.58)	22.6 (1.91)	16.2 (1.47)
Current smoking	18.1 (2.89)	23.5 (3.04)	14.2 (2.14)	19.6 (1.87)	23.1 (2.14)	18.6 (1.69)	17.5 (1.39)	20.0 (1.92)	13.4 (1.78)

Estimates are standardized to the National Health Interview Surveys 2009–2010 diabetic population using age groups 20–44, 45–64, and ≥65 years, except for age at diabetes diagnosis and duration of diabetes, which are standardized by sex to the National Health Interview Surveys 2009–2010 diabetic population. Conversions for cholesterol values are provided in *Diabetes in America Appendix 1 Conversions*. CVD, cardiovascular disease.

\* Self-reported use of insulin or diabetes pills; self-reported use of medication to lower blood pressure; self-reported use of medication to lower cholesterol.

† Controlled medication-treated hypertension based on blood pressure <130/80 mmHg; controlled medication-treated hypercholesterolemia based on total cholesterol <200 mg/dL.

‡ Not determined.

§ Based on self-report.

|| Based on fundus photography.

¶ Defined as myocardial infarction and congestive heart failure in the NHANES III 1988–1994, as angina and coronary heart disease were not determined; defined as myocardial infarction, congestive heart failure, angina, coronary heart disease in NHANES 1999–2010.

<sup>1</sup> Relative standard error >30%–40%

SOURCE: National Health and Nutrition Examination Surveys (NHANES) III (1988–1994), 1999–2010

## APPENDIX 41.2. Risk Factor Control Among Adults ≥20 Years With Diagnosed Diabetes, by Year and Age, U.S., 1988–1994 and 1999–2010

RISK FACTORS	NHANES III 1988–1994			NHANES 1999–2004			NHANES 2005–2010		
	Age (Years)			Age (Years)			Age (Years)		
	20–44 (N=170)	45–64 (N=519)	≥65 (N=808)	20–44 (N=165)	45–64 (N=566)	≥65 (N=805)	20–44 (N=204)	45–64 (N=858)	≥65 (N=928)
<b>Mean (standard error)</b>									
Age at diabetes diagnosis (years)	32.1 (1.02)	47.5 (0.63)	61.3 (0.58)	30.1 (0.81)	43.3 (1.04)	56.1 (0.81)	28.8 (0.98)	45.6 (0.40)	59.4 (0.54)
Duration of diabetes (years)	5.8 (0.83)	8.7 (0.53)	11.7 (0.52)	6.9 (0.84)	11.5 (1.01)	16.8 (0.73)	7.6 (0.73)	9.5 (0.38)	13.5 (0.44)
<b>Percent (standard error)</b>									
<b>Diabetes treatment*</b>									
Insulin only	32.1 (7.09)	19.3 (2.21)	32.1 (1.99)	23.6 (4.04)	10.4 (1.76)	18.7 (1.99)	25.5 (3.22)	13.1 (1.66)	12.6 (1.29)
Oral only	36.1 (7.13)	49.4 (4.10)	41.8 (2.24)	48.7 (4.21)	58.2 (2.74)	56.4 (2.30)	45.2 (3.54)	58.2 (2.50)	61.2 (2.43)
Insulin and oral	<sup>3</sup>	5.2 (1.22)	2.1 (0.62)	4.4 (1.60) <sup>1</sup>	12.6 (2.20)	10.4 (1.50)	9.5 (2.38)	15.4 (1.16)	15.1 (1.74)
No meds	28.5 (5.78)	26.2 (3.39)	24.0 (2.36)	23.3 (4.28)	18.7 (2.31)	14.5 (1.77)	19.7 (2.89)	13.3 (1.60)	11.2 (1.53)
<b>Hypertension</b>									
Treated*	23.8 (4.38)	50.2 (3.27)	52.1 (2.69)	25.6 (3.84)	55.2 (2.50)	69.6 (2.22)	35.4 (3.70)	64.1 (2.41)	72.3 (1.91)
Controlled†	23.0 (8.40) <sup>1</sup>	18.2 (4.46)	13.5 (2.98)	26.1 (7.61)	39.8 (4.20)	30.5 (3.13)	43.0 (7.43)	48.8 (3.02)	37.1 (1.88)
Uncontrolled	77.0 (8.40)	81.8 (4.46)	86.5 (2.98)	73.9 (7.61)	60.2 (4.20)	69.5 (3.13)	57.0 (7.43)	51.2 (3.02)	62.9 (1.88)
Blood pressure <130/80 mmHg	59.3 (6.72)	33.5 (3.01)	21.5 (2.27)	53.8 (5.65)	48.1 (3.38)	30.9 (2.84)	57.1 (4.45)	54.8 (2.49)	42.6 (1.85)
<b>Hypercholesterolemia</b>									
Treated*	5.7 (2.75) <sup>2</sup>	16.1 (3.17)	16.7 (1.90)	28.6 (4.87)	41.5 (2.92)	44.1 (2.18)	36.5 (3.62)	57.7 (2.35)	55.5 (2.01)
Controlled†	<sup>3</sup>	33.2 (10.48) <sup>1</sup>	25.5 (6.94)	30.2 (9.66) <sup>1</sup>	45.3 (4.10)	57.1 (4.32)	53.1 (7.51)	58.2 (3.33)	79.2 (2.80)
Uncontrolled	62.7 (28.04) <sup>2</sup>	66.8 (10.48)	74.5 (6.94)	69.8 (9.66)	54.7 (4.10)	42.9 (4.32)	46.9 (7.51)	41.8 (3.33)	20.8 (2.80)
Total cholesterol <200 mg/dL	45.1 (9.00)	26.6 (3.40)	36.7 (2.53)	44.1 (4.93)	47.4 (2.81)	55.2 (2.74)	62.2 (3.89)	60.8 (2.32)	76.7 (1.84)
LDL cholesterol <100 mg/dL	<sup>3</sup>	11.5 (4.15) <sup>1</sup>	12.4 (3.06)	40.2 (7.21)	32.1 (4.47)	43.9 (5.12)	47.1 (6.95)	52.2 (3.60)	61.6 (2.81)
Daily aspirin use	6.5 (3.02) <sup>2</sup>	16.4 (3.08)	25.9 (2.58)	8.8 (3.48) <sup>1</sup>	20.8 (3.08)	30.0 (2.29)	‡	‡	‡
Retinopathy§	11.5 (3.77) <sup>1</sup>	18.2 (2.17)	17.7 (1.78)	25.2 (4.64)	24.0 (2.61)	26.3 (2.34)	20.1 (3.47)	20.3 (1.96)	21.4 (1.38)
Retinopathy	21.2 (9.67) <sup>2</sup>	18.5 (2.44)	21.7 (2.90)	‡	‡	‡	20.6 (6.53)	33.1 (3.11)	34.7 (2.40)
History of CVD¶	1.1 (0.52) <sup>2</sup>	17.9 (3.02)	30.5 (2.95)	5.5 (2.11) <sup>1</sup>	19.4 (2.50)	38.6 (2.56)	5.0 (1.58) <sup>1</sup>	19.9 (1.47)	34.9 (1.93)
Current smoking	31.6 (6.46)	21.6 (3.31)	9.6 (1.33)	34.7 (4.23)	26.0 (2.29)	7.4 (1.37)	26.0 (3.85)	20.9 (1.62)	7.8 (0.69)

Estimates are crude and not standardized. Conversions for cholesterol values are provided in *Diabetes in America Appendix 1 Conversions*. CVD, cardiovascular disease.

\* Self-reported use of insulin or diabetes pills; self-reported use of medication to lower blood pressure; self-reported use of medication to lower cholesterol.

† Controlled medication-treated hypertension based on blood pressure <130/80 mmHg; controlled medication-treated hypercholesterolemia based on total cholesterol <200 mg/dL.

‡ Not determined.

§ Based on self-report.

|| Based on fundus photography.

¶ Defined as myocardial infarction and congestive heart failure in the NHANES III 1988–1994, as angina and coronary heart disease were not determined; defined as myocardial infarction, congestive heart failure, angina, coronary heart disease in NHANES 1999–2010.

<sup>1</sup> Relative standard error >30%–40%

<sup>2</sup> Relative standard error >40%–50%

<sup>3</sup> Estimate is too unreliable to present; ≤1 case or relative standard error >50%.

SOURCE: National Health and Nutrition Examination Surveys (NHANES) III (1988–1994), 1999–2010