Burden of Type 1 Diabetes

Incidence and Prevalence of Type 1 Diabetes

- T1D is the major type of diabetes in youth
  - Accounts for ≥85% of all diabetes cases in patients <20 years of age
- Incidence is increasing by 2% to 5% worldwide
- U.S. prevalence is approximately 1 in 300

T1D, type 1 diabetes.

Maahs DM, et al. *Endocrinol Metab Clin North Am*. 2010;39:481-497. Menke A, et al. *Epidemiology*. 2013;24:773-774.

Diabetes in Children and Young Adults

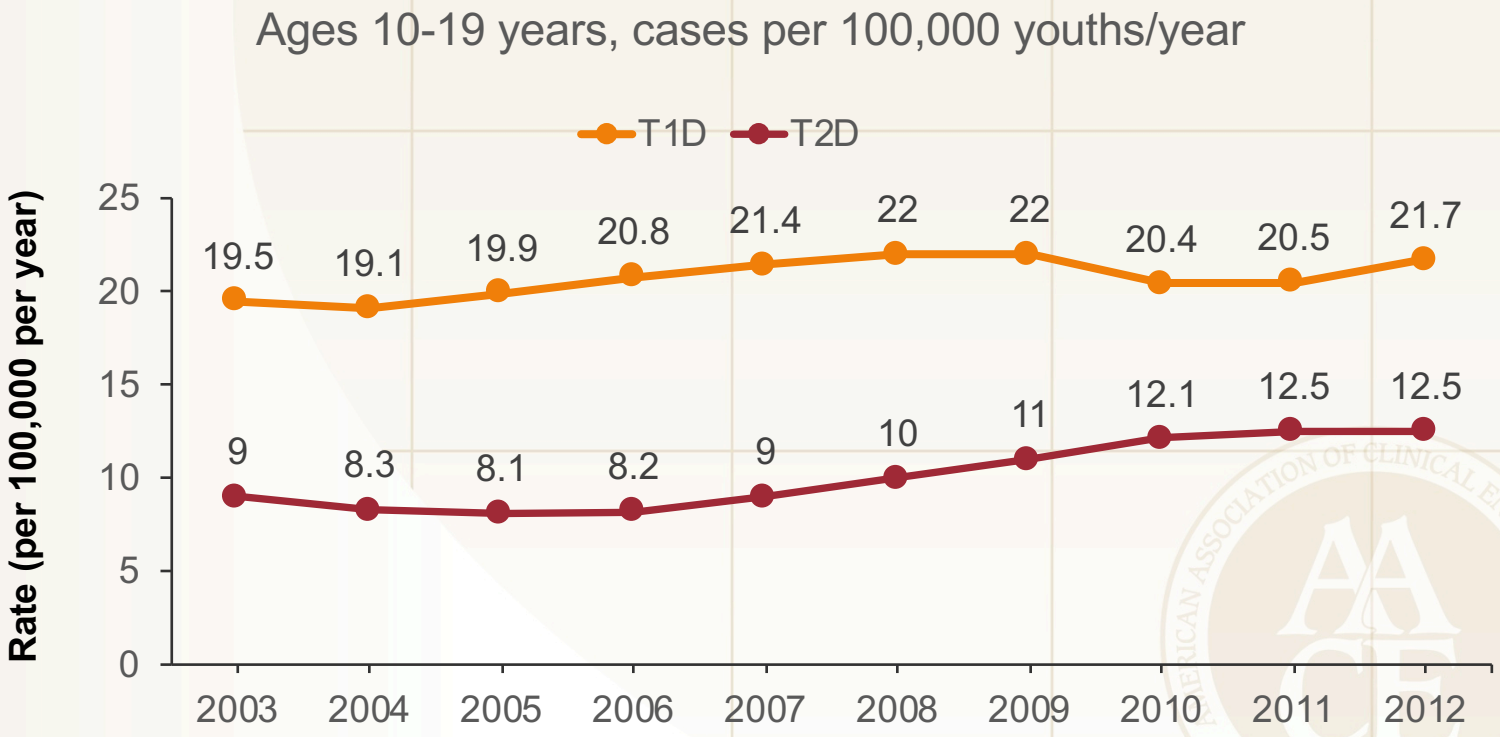
- In the past, diabetes in youth was almost always T1D, but more T2D is no longer “adult onset” diabetes only
- Nearly all children with diabetes diagnosed <10 years have T1D
  - Majority of non-Hispanic youth with diabetes diagnosed have T1D
- However, among US children 10-19 years at diagnosis
  - Half of African-American and Hispanic patients have T2D
  - More than half of Asian/Pacific Islanders and American Indians have T2D

T1D, type 1 diabetes; T2D, type 2 diabetes.

Dabelea D, et al. *JAMA.* 2007;297:2716-2724.

Incidence of Diabetes in Youth, 2003-2012

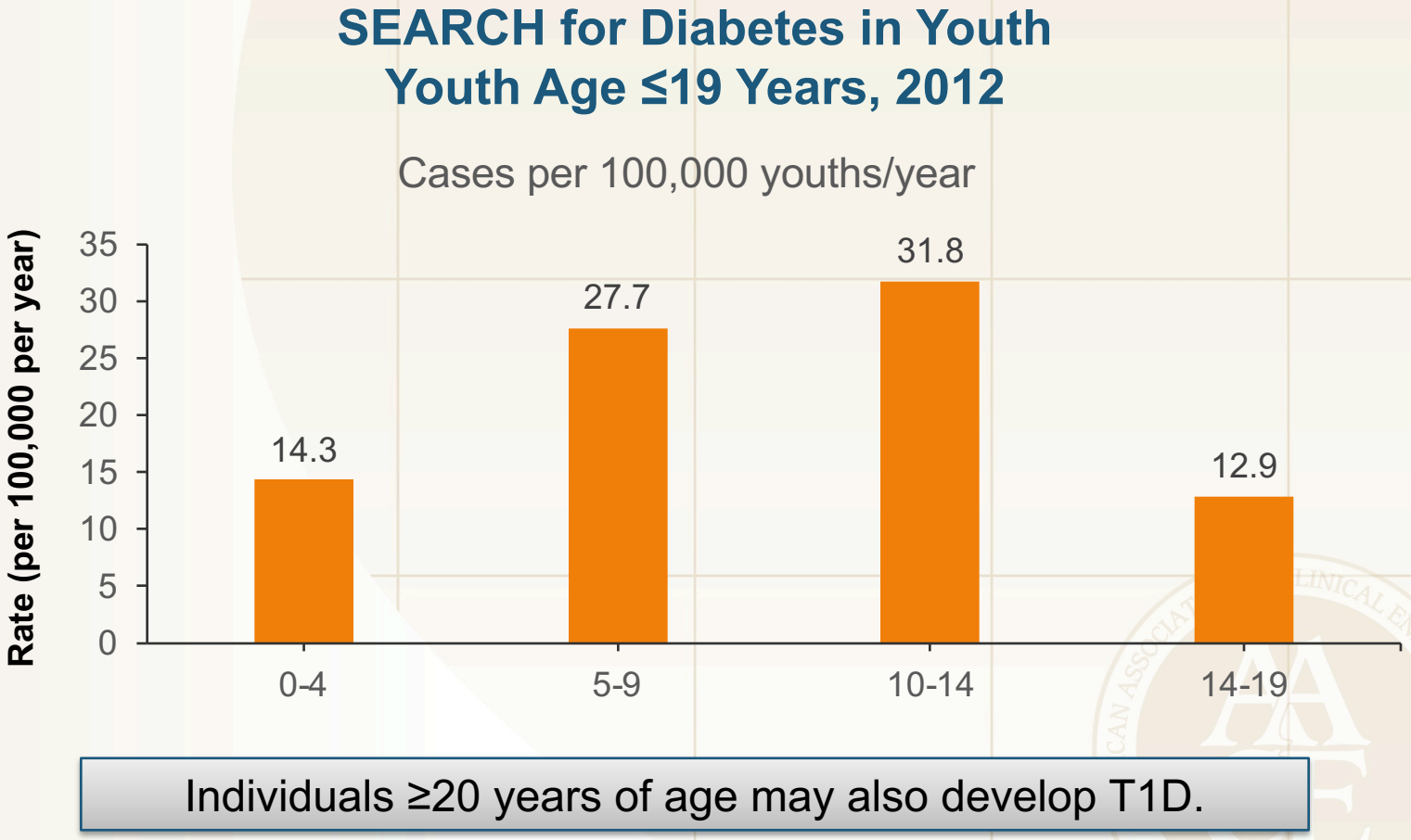
SEARCH for Diabetes in Youth
Youth Age ≤19 Years, 2012



T1D, type 1 diabetes; T2D, type 2 diabetes.

Mayer-Davis EJ, et al. *N Engl J Med*. 2017;376:1419-1429.

T1D Age at Diagnosis Among Youth

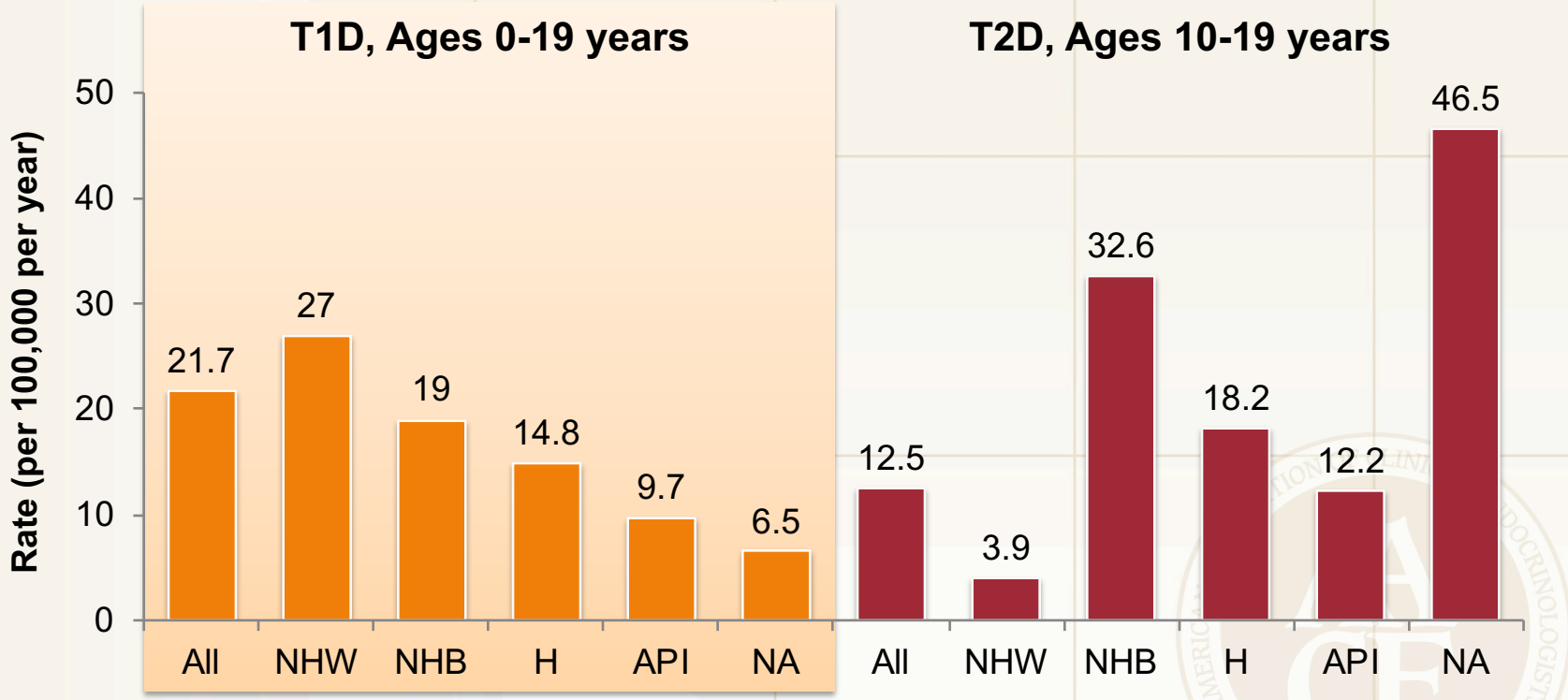


Individuals ≥20 years of age may also develop T1D.

Mayer-Davis EJ, et al. *N Engl J Med*. 2017;376:1419-1429.

Annual Incidence of Diabetes in US Children and Adolescents

SEARCH for Diabetes in Youth
Youth Age ≤19 Years, 2012



API, Asians/Pacific Islanders; H, Hispanics; NA, Native American; NHB, non-Hispanic blacks; NHW, non-Hispanic whites; T1D, type 1 diabetes; T2D, type 2 diabetes.

Mayer-Davis EJ, et al. *N Engl J Med*. 2017;376:1419-1429. CDC. National diabetes statistics report, 2017. https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf.

Immunological Changes and Incidence of Type 1 Diabetes

- Rising incidence of T1D is associated with altered immunophenotype at diagnosis
- Prevalence of IA-2A and ZnT8A has increased significantly
- IAA and GADA prevalence and levels have not changed
- Suggests T1D is now characterized by a more intense humoral autoimmune response

IAA, autoantibodies to insulin; GADA, GAD; IA-2A, islet antigen-2; T1D, type 1 diabetes; ZnT8A, zinc transporter 8.

Long AE, et al. *Diabetes*. 2012;61:683-686.

Postulated Contributing Factors for T1D Risk

- Infections*
- Early childhood diet (dietary proteins)*
- Vitamin D exposure
- Environmental pollutants
- Increased height velocity
- Obesity
- Insulin resistance*

*Evidence strengthening for an association

T1D, type 1 diabetes.

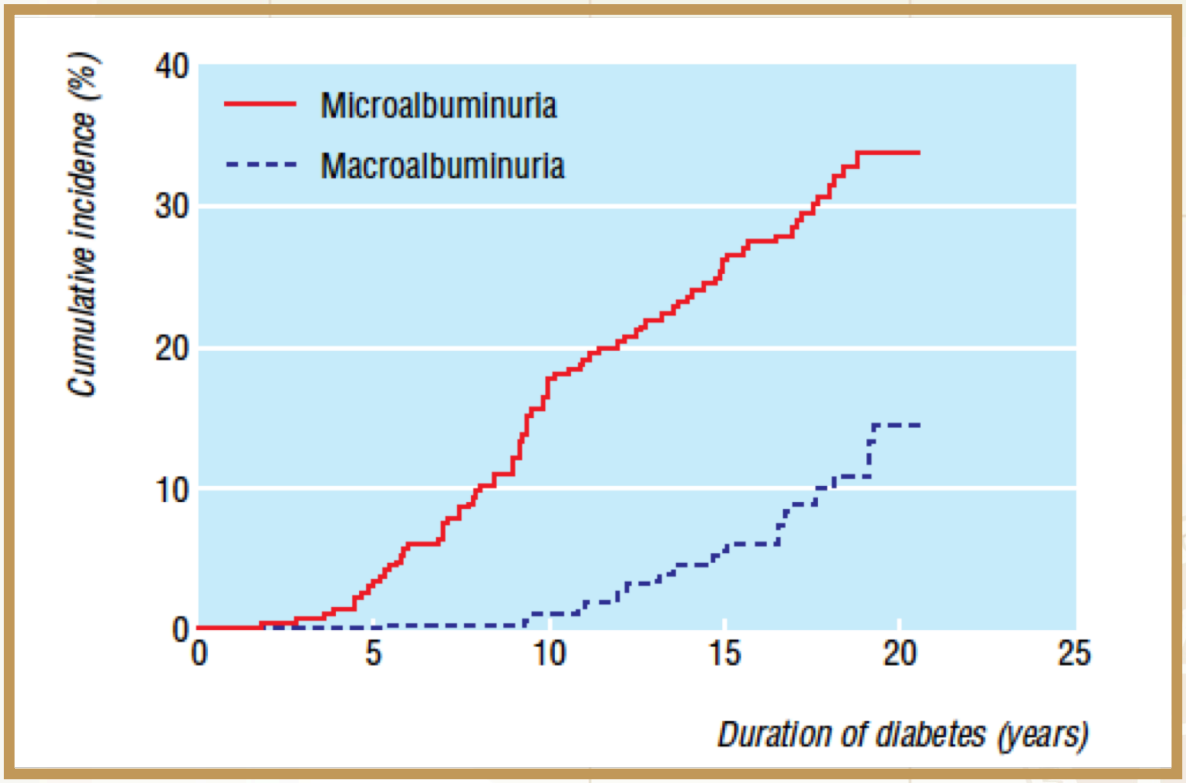
Forlenza GP, Rewers M. *Curr Opin Endocrinol Diabetes Obes*. 2011;18:248-251.

Mortality in Childhood-Onset T1D

- Mortality rate: 2.2/1000 person-years
- Most common cause of death <30 years of age
  - Acute metabolic complications of diabetes (eg, diabetic ketoacidosis)
- Most common cause of death >30 years of age
  - Cardiovascular disease

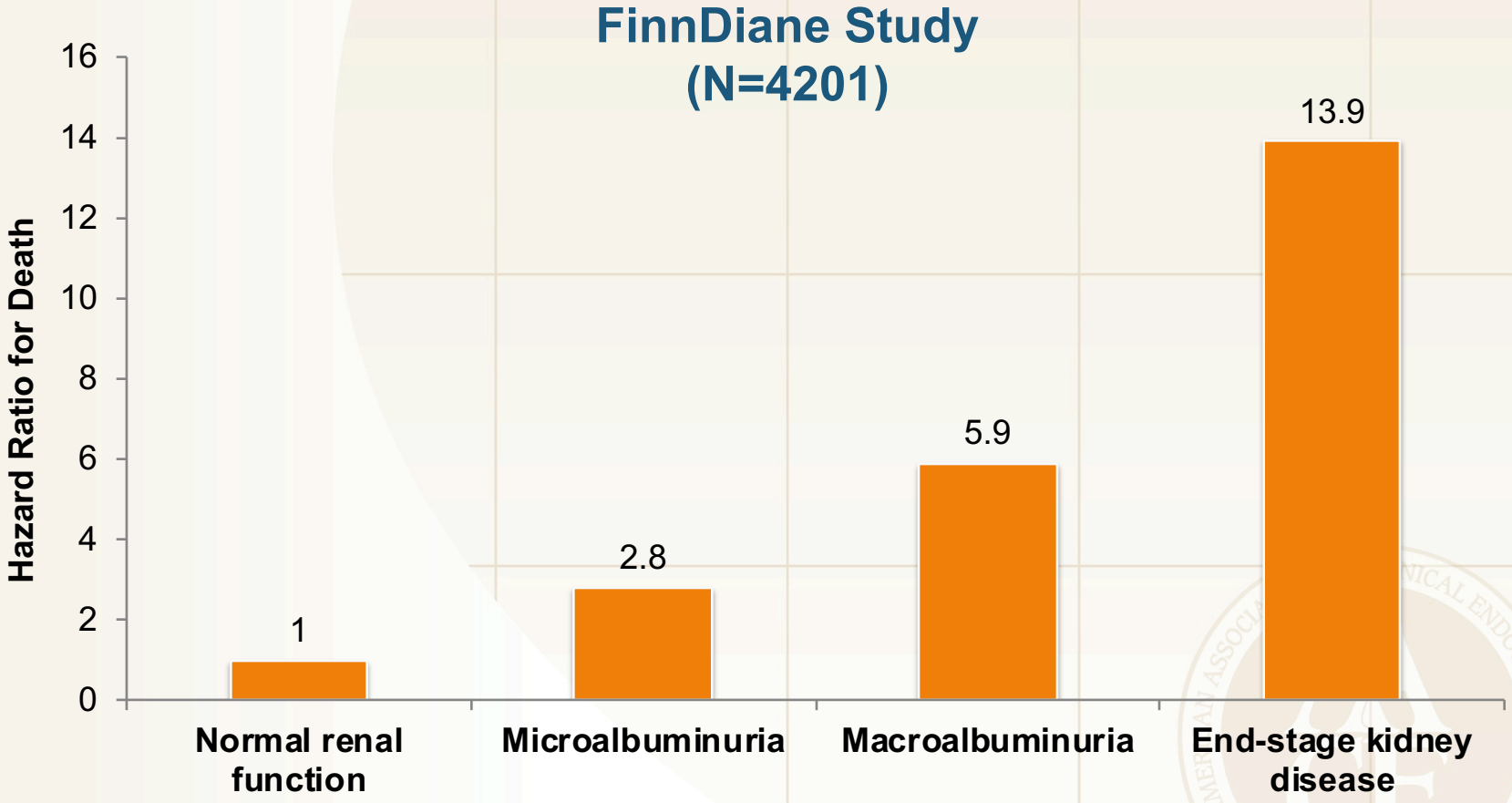
Skrivarhaug T, et al. Diabetologia. 2006;49:298-305. Patterson CC, et al. Diabetologia. 2007;50:2439-2442. Libby P, et al. Circulation. 2005;111:3489-3493.

Development of Microalbuminuria and Macroalbuminuria in T1D



Hovind P, et al. *BMJ*. 2004;328:1105.

T1D Mortality Correlates With Renal Function



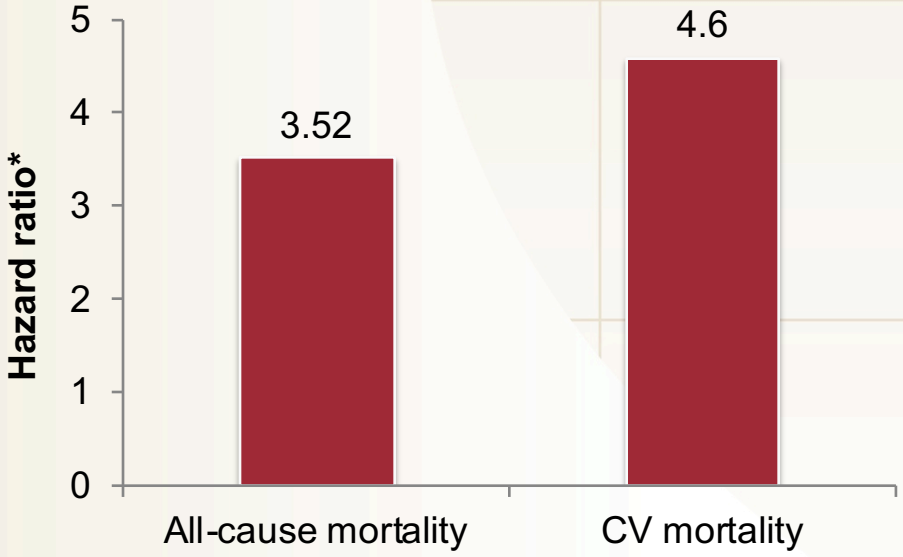
Risk of mortality in individuals with T1D associated each level of albuminuria and end-stage kidney disease.

Groop P, et al. *Diabetes.* 2009;58:1651-1658.

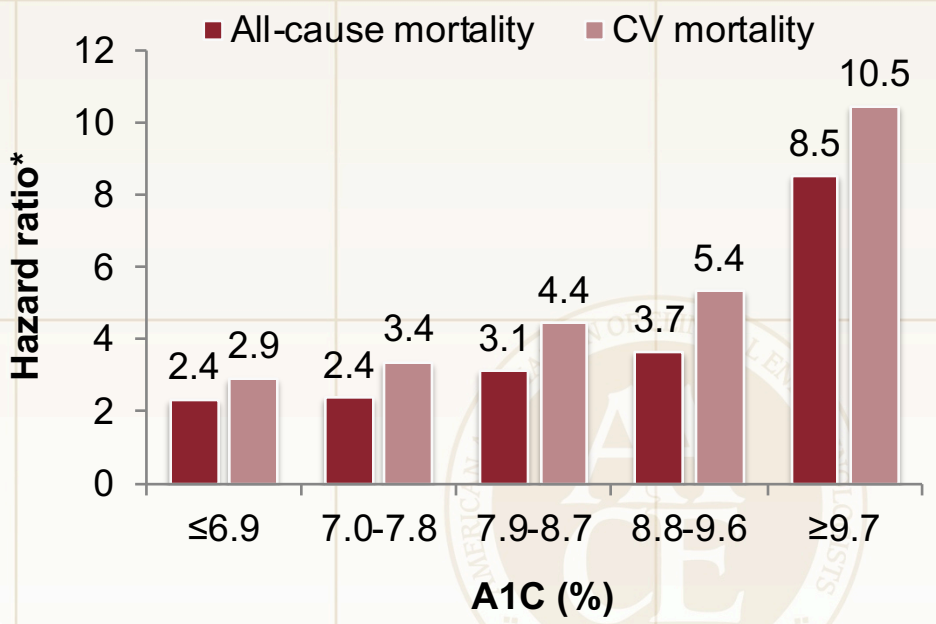
Mortality in Patients With T1D

Swedish National Diabetes Register
(n=33,915 with T1D; n=169,249 without diabetes)

Mortality Risk vs Patients Without Diabetes



Mortality Risk by A1C Level



*Adjusted for age, diabetes duration, sex, birthplace, education, CVD status, and cancer status.

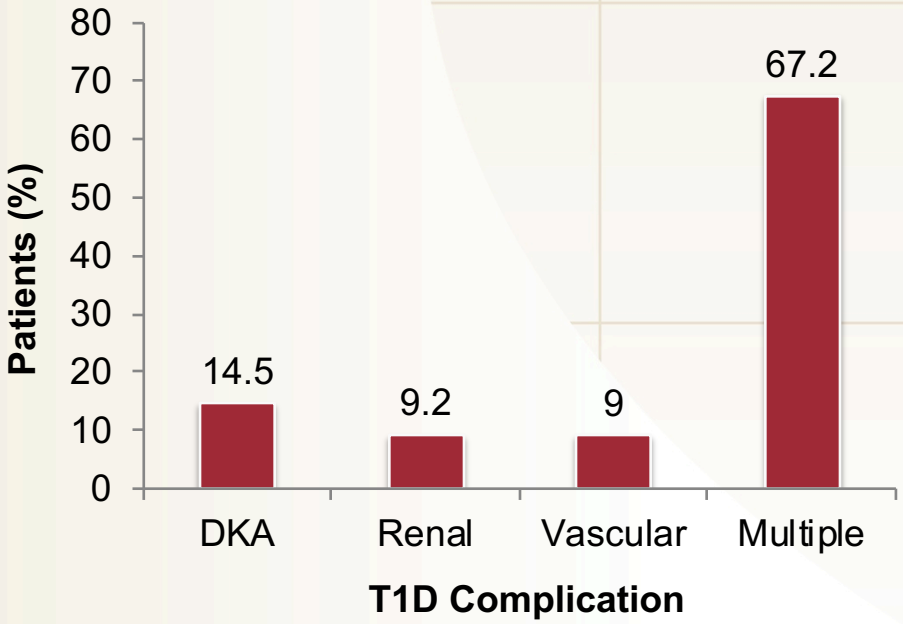
CVD, cardiovascular disease; T1D, type 1 diabetes.

Lind M, et al. *N Engl J Med*. 2014;371:1972-1982.

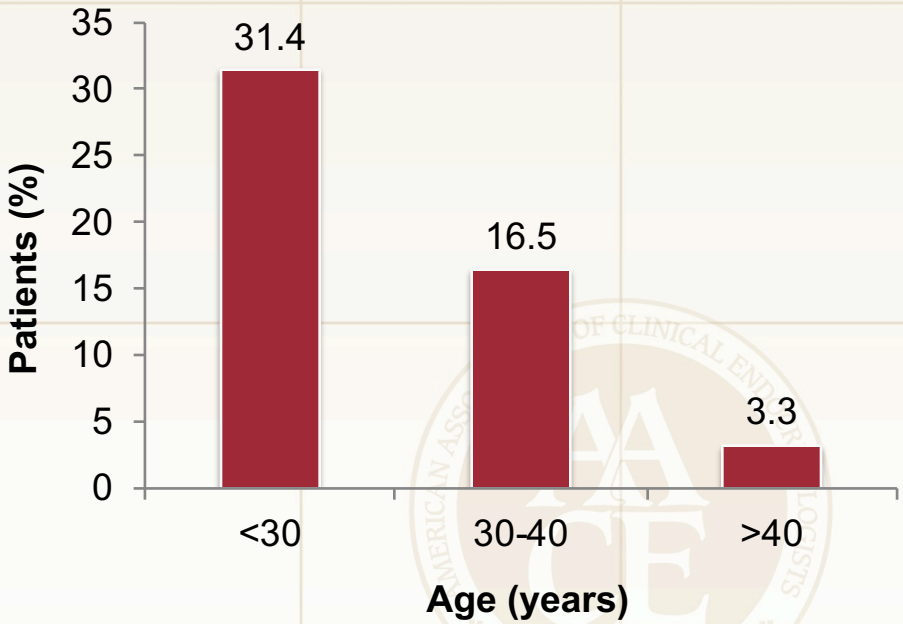
T1D-Related Mortality

Swedish National Diabetes Register (n=33,915)

Cause of Diabetes-Related Death, All Patients



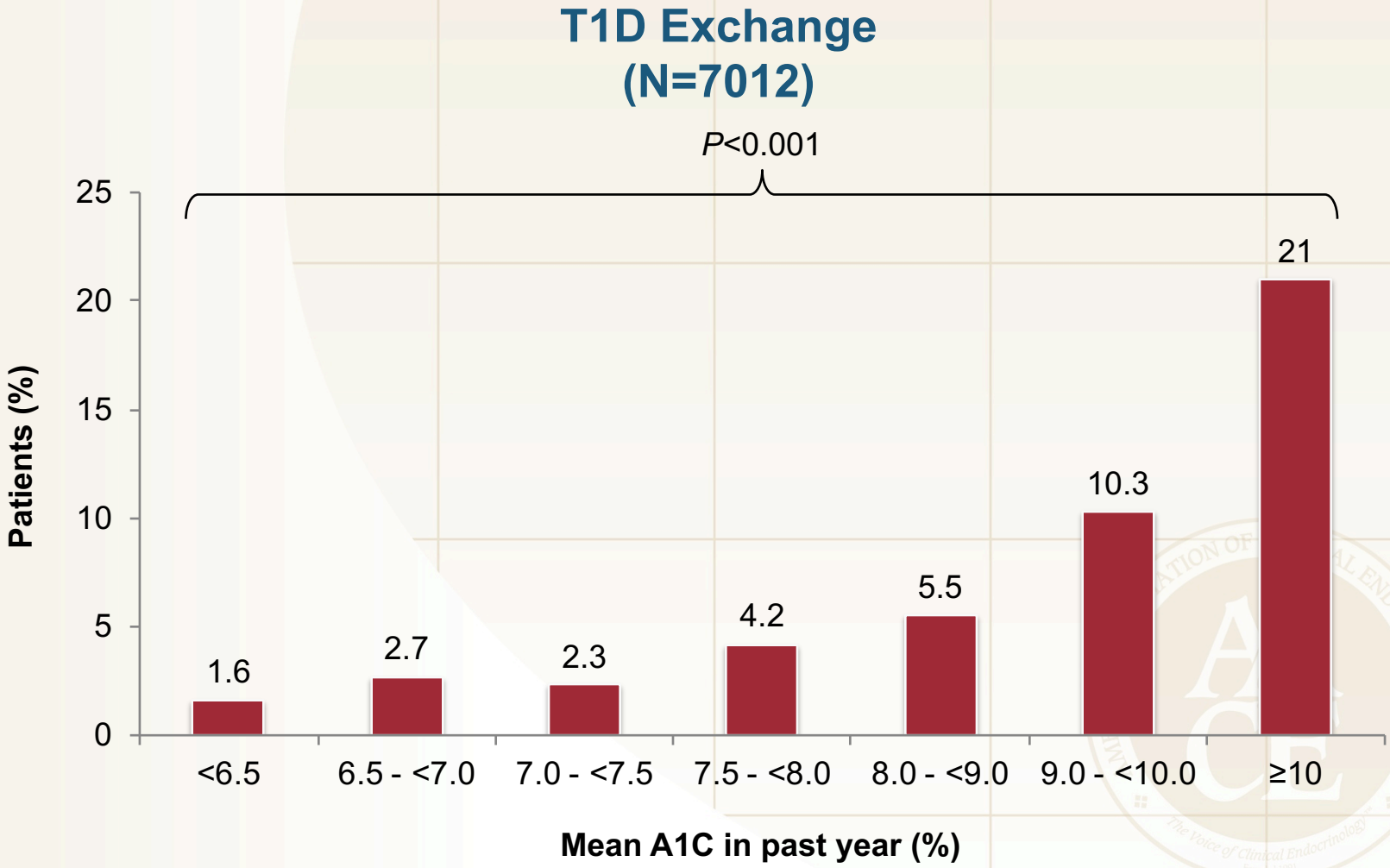
DKA Mortality



DKA, diabetic ketoacidosis; T1D, type 1 diabetes.

Lind M, et al. *N Engl J Med*. 2014;371:1972-1982.

Rates of DKA Over 12 Month Period in Adults with T1D

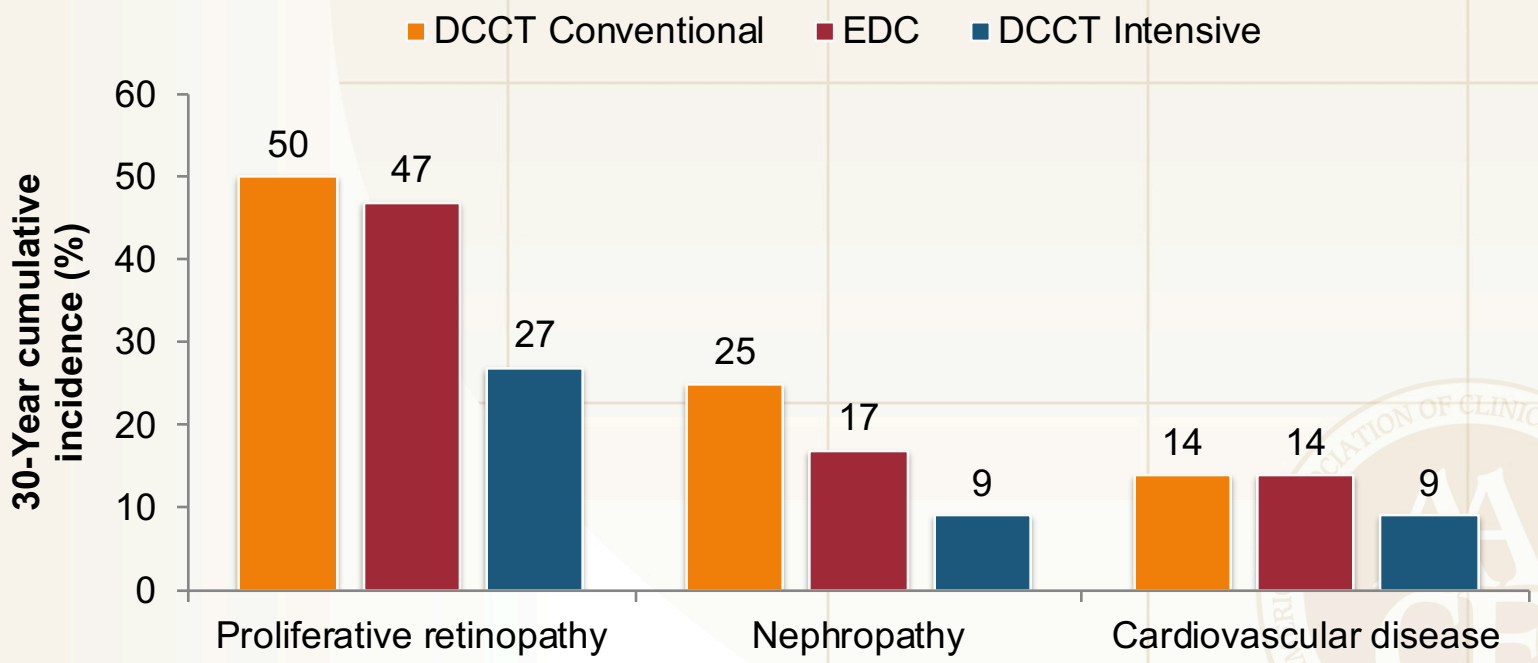


DKA, diabetic ketoacidosis; T1D, type 1 diabetes.

Weinstock RS, et al. *J Clin Endocrinol Metab*. 2013;98:3411-3419.

Intensive Therapy Reduces Diabetes Complications Rates

DCCT (N=1441) and Pittsburgh Epidemiology of Diabetes Complications Study (N=161)



DCCT, Diabetes Control and Complications Trial; EDC, Pittsburgh Epidemiology of Diabetes Complications cohort.

Nathan DM, et al. *Arch Intern Med*. 2009;169:1307-1316.

Type 1 Diabetes Is Costly

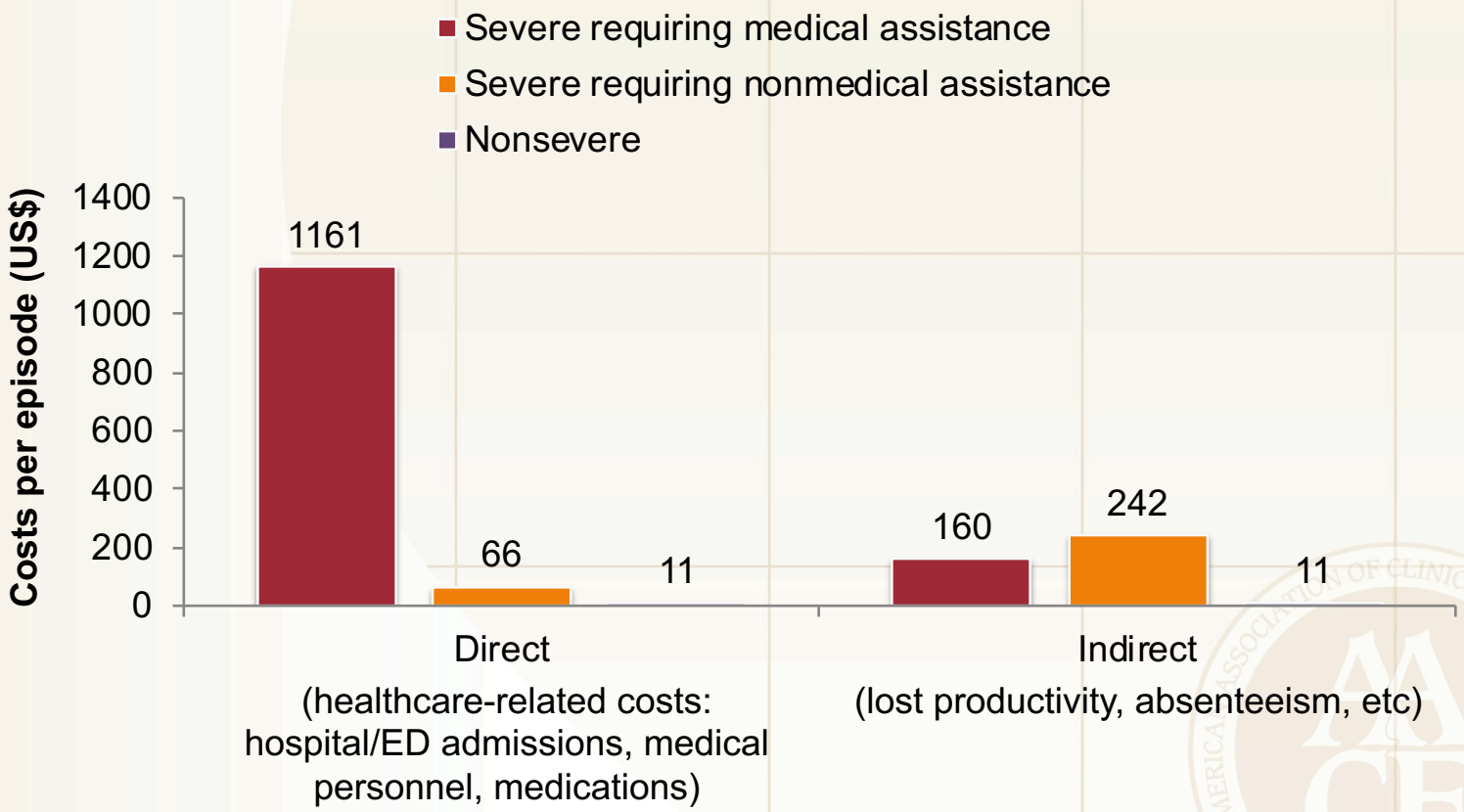
Expected Lifetime Medical and Indirect Costs Attributed to T1D (2005 Dollars)

Age of onset	Number of new patients	Medical (millions)	Income loss (millions)
3-9	6,483	$746	$1,208
10-19	11,980	$1,489	$2,923
20-29	3,528	$337	$1,130
30-39	3,976	$395	$1,279
40-45	2,464	$309	$776
Total	**28,430**	**$3,276**	**$7,316**

T1D, type 1 diabetes.

Tao BT, Taylor DG. *Endocrinol Metab Clin North Am*. 2010;39:499-512.

Hypoglycemia in Type 1 Diabetes Is Costly



T1D, type 1 diabetes.

Foos V. *J Med Econ*. 2015;18:420-432.