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Recent Trends in Cardiovascular Mortality in the United States and Public Health Goals

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IMPORTANCE Heart disease (HD) and cancer are the 2 leading causes of death in the United States. During the first decade of the 21st century, HD mortality declined at a much greater rate than cancer mortality and it appeared that cancer would overtake HD as the leading cause of death.

OBJECTIVES To determine whether changes in national trends had occurred in recent years in mortality rates due to all cardiovascular disease (CVD), HD, stroke, and cancer and to evaluate the gap between mortality rates from HD and cancer.

DESIGN, SETTING, AND PARTICIPANTS The Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research data system was used to determine national trends in age-adjusted mortality rates due to all CVD, HD, stroke, and cancer from January 1, 2000, to December 31, 2011, and January 1, 2011, to December 31, 2014, overall, by sex, and by race/ethnicity. The present study was conducted from December 30, 2105, to January 18, 2016.

MAIN OUTCOMES AND MEASURES Comparison of annual rates of change and trend in gap between HD and cancer mortality rates.

RESULTS The rate of the decline in all CVD, HD, and stroke mortality decelerated substantially after 2011, and the rate of decline for cancer mortality remained relatively stable. Reported as percentage (95% CI), the annual rates of decline for 2000-2011 were 3.79% (3.61% to 3.97%), 3.69% (3.51% to 3.87%), 4.53% (4.34% to 4.72%), and 1.49% (1.37% to 1.60%) for all CVD, HD, stroke, and cancer mortality, respectively; the rates for 2011-2014 were 0.65% (−0.18% to 1.47%), 0.76% (−0.06% to 1.58%), 0.37% (−0.53% to 1.27%), and 1.55% (1.07% to 2.04%), respectively. Deceleration of the decline in all CVD mortality rates occurred in males, females, and all race/ethnicity groups. For example, the annual rates of decline for total CVD mortality for 2000-2011 were 3.69% (3.48% to 3.89%) for males and 3.98% (3.81% to 4.14%) for females; for 2011-2014, the rates were 0.23% (−0.71% to 1.16%) and 1.17% (0.41% to 1.93%), respectively. The gap between HD and cancer mortality persisted.

CONCLUSIONS AND RELEVANCE Deceleration in the decline of all CVD, HD, and stroke mortality rates has occurred since 2011. If this trend continues, strategic goals for lowering the burden of CVD set by the American Heart Association and the Million Hearts Initiative may not be reached.

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With the exception of the flu pandemic years of 1918-1920, heart disease (HD) has been the leading cause of death in the United States since 1910,[1] with cancer and stroke among the 5 leading causes of death every year since 1924.[2] From 2000 to 2010, age-adjusted mortality decreased 30% for HD and 36% for stroke, but cancer mortality declined only 13%.[3] Heart disease mortality approached that of cancer, suggesting that cancer might soon replace HD as the leading cause of death.

The decrease in HD mortality in the United States has been attributed to expanded use of evidence-based medical therapies as well as changes in risk factors and lifestyle modifications at a population level.[4,5] Longstanding emphasis on cardiovascular disease (CVD) prevention has led to a concept of cardiovascular health.[6] The American Heart Association has a strategic goal of improving the cardiovascular health of all Americans by 20% while reducing deaths from CVD and stroke by 20% from 2010 to 2020.[7] The Million Hearts Initiative was announced in 2011, with the goal of preventing 1 million myocardial infarctions and strokes by 2017.[8]

We evaluated the most recent trends in mortality attributed to all CVD, HD, stroke, and cancer from 2000 to 2014 to gauge whether there have been any recent changes in the pattern of decline in all CVD mortality and to assess trends in the gap between HD and cancer mortality.

Key Points

Question Are there changes in national trends in recent years in mortality rates due to cardiovascular disease (CVD), heart disease (HD), stroke, and cancer?

Findings The rate of decline in all CVD, HD, and stroke mortality decelerated substantially after 2011. Deceleration of the decline in all CVD mortality rates occurred in males, females, and all race/ethnicity groups, and the gap between HD and cancer mortality persisted.

Meaning If this deceleration trend continues, strategic goals for lowering the burden of CVD set by the American Heart Association and the Million Hearts Initiative may not be reached.

Methods

Mortality

Mortality rates throughout the United States for 2000-2014 were ascertained using the Centers for Disease Control and Prevention's Wide-Ranging Online Data for Epidemiologic Research data set, which includes the assigned cause of death from all death certificates filed in the 50 states and the District of Columbia.[9] Categorization of the presumed underlying cause of death used *International Statistical Classification of Diseases and Related Health Problems, Tenth Edition* codes as follows: all CVD (codes I00-I99), HD (codes I00-I09, I11, I13, and I20-I51), cerebrovascular disease (codes I60-I69), and cancer (malignant neoplasms [codes C00-C97]). Based on the National Human Subjects Protection Advisory Committee's recommendations, this study did not require institutional review board approval because it analyzes government-issued public use data without individual identifiable information. The present study was conducted from December 30, 2105, to January 18, 2016.

Statistical Analysis

Mortality rates were age-adjusted using the direct method, with the 2000 US Census[10] as the standard population, using the following age categorization: younger than 1 year, 1 to 4, 5 to 14, 15 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65 to 74, 75 to 84, and 85 years or older. Poisson regression (with allowance for overdispersion, ie, variance > mean) was used for point and interval estimation of age-adjusted annual rates of change for January 1, 2000, to December 31, 2011, and January 1, 2011, to December 31, 2014, by fitting a piecewise linear spline for the 2 calendar time intervals, with a Wald test of the difference in rates (slopes).

Results

All CVD Mortality

Age-adjusted mortality rates declined from 2000 to 2014 for all CVD (341.3 in 2000 vs 219.9 in 2014; rate decline of 35.6%), HD (257.6 vs 167.0; rate decline of 35.2%), and stroke (60.9 vs 36.5; rate decline of 40.1%) (**Table 1** and **Figure**, A). There was a deflection point in these trends in 2011, with substantial slowing in the decline from 2011 to 2014 (**Table 2**). From 2000 to 2011, the mean annual age-adjusted rate (percentage [95% CI]) of decline was 3.79% (3.61% to 3.97%) for all CVD, 3.69% (3.51% to 3.87%) for HD, and 4.53% (4.34% to 4.72%) for stroke; from 2011 to 2014, the respective rates of decline were 0.65% (−0.18% to 1.47%), 0.76% (−0.06% to 1.58%), and 0.37% (−0.53% to 1.27%) (Table 2). The US population and the total number of all CVD, HD, and stroke deaths increased from 2011 to 2014, with resultant slightly higher crude mortality rates in 2014 compared with 2011 for all CVD (253.3 vs 251.4 per 100 000 person-years), HD (192.7 vs 191.5 per 100 000 person-years), and stroke (41.7 vs 41.4 per 100 000 person-years).

Sex and Race/Ethnicity

Males had higher mortality rates than females for all conditions throughout the period (eTable 1 and eTable 2 in the Supplement and Figure, B and C). The annual rates (percentage [95% CI]) of decline of all CVD changed from 3.98% (3.81% to 4.14%) for females and 3.69% (3.48% to 3.89%) for males during 2000-2011 to 1.17% (0.41% to 1.93%) and 0.23% (−0.71% to 1.16%), respectively, during 2011-2014 (Table 2). Similar changes were evident for HD and stroke mortality.

Non-Hispanic (NH) blacks had the highest mortality for all CVD and HD in all years, followed by NH whites, NH American Indian/Alaskan Natives, Hispanics, and NH Asian/Pacific Islanders (Figure, D-F, and eFigure and eTables 3-7 in the Supplement). Each of the racial/ethnic groups, except NH American Indian/Alaskan Native, had significant differences in the annual change in mortality rates for all CVD, HD, and stroke between 2000-2011 and 2011-2014 (Table 2).

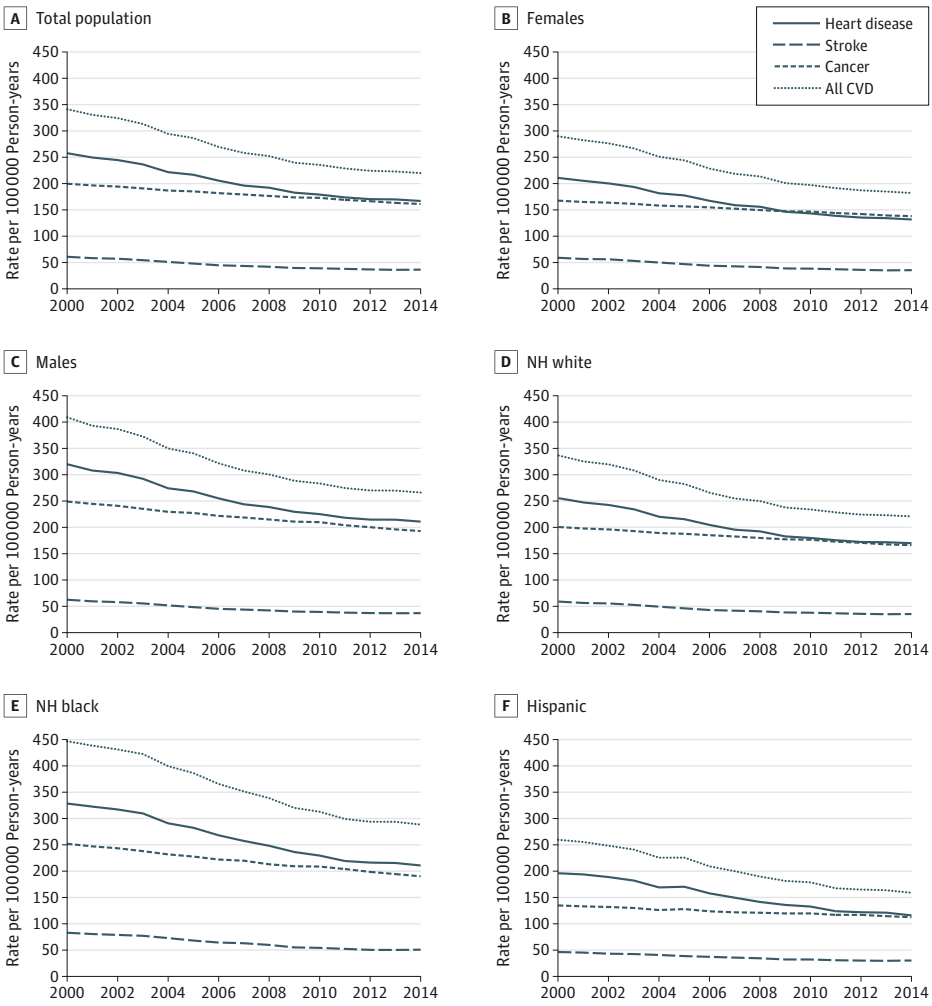
Table 1. Trends in Mortality

Year	Population, No.	CVD		HD		Stroke		Cancer		HD vs Cancer Gap
		No. of Deaths	AAMR[a]	No. of Deaths	AAMR[a]	No. of Deaths	AAMR[a]	No. of Deaths	AAMR[a]	AAMR
2000	281 421 906	941 526	341.3	710 760	257.6	167 661	60.9	553 091	199.6	58.0
2001	284 968 955	926 999	330.5	700 142	249.5	163 538	58.4	553 768	196.5	53.0
2002	287 625 193	923 339	324.3	696 947	244.6	162 672	57.2	557 271	194.3	50.3
2003	290 107 933	907 180	313.2	685 089	236.3	157 689	54.6	556 902	190.9	45.4
2004	292 805 298	865 863	294.4	652 486	221.6	150 074	51.2	553 888	186.8	34.8
2005	295 516 599	860 843	286.6	652 091	216.8	143 579	48.0	559 312	185.1	31.7
2006	298 379 912	827 741	269.6	631 636	205.5	137 119	44.8	559 888	181.8	23.7
2007	301 231 207	810 257	258.2	616 067	196.1	135 952	43.5	562 875	179.3	16.8
2008	304 093 966	808 525	252.2	616 828	192.1	134 148	42.1	565 469	176.4	15.7
2009	306 771 529	784 742	239.7	599 413	182.8	128 842	39.6	567 628	173.5	9.3
2010	308 745 538	784 454	235.5	597 689	179.1	129 476	39.1	574 743	172.8	6.3
2011	311 591 917	783 475	228.6	596 577	173.7	128 932	37.9	576 691	169.0	4.7
2012	313 914 040	787 431	224.3	599 711	170.5	128 546	36.9	582 623	166.5	4.0
2013	316 128 839	800 937	222.9	611 105	169.8	128 978	36.2	584 881	163.2	6.6
2014	318 857 056	807 775	219.9	614 348	167.0	133 103	36.5	591 699	161.2	5.8

Abbreviations: AAMR, age-adjusted mortality rate; CVD, cardiovascular disease; HD, heart disease.

[a] Age-adjusted mortality rate per 100 000 person-years, directly standardized to the 2000 US Census population.[9]

Figure. Age-Adjusted Mortality Rates in the United States, 2000-2014



Rates shown for the total population and subgroups.

Table 2. Mortality Rates and Annual Rates of Change

Population	AAMR[a]			Annual Rate of Change, % (95% CI)[b]		P Value[c]
	2000	2011	2014	2000-2011	2011-2014	
All CVD						
Total	341.3	228.6	219.9	3.79 (3.61 to 3.97)	0.65 (−0.18 to 1.47)	<.001
Male	409.0	274.6	266.1	3.69 (3.48 to 3.89)	0.23 (−0.71 to 1.16)	<.001
Female	290.0	191.4	182.1	3.98 (3.81 to 4.14)	1.17 (0.41 to 1.93)	<.001
NH white	336.5	228.6	221.0	3.71 (3.52 to 3.90)	0.33 (−0.56 to 1.21)	<.001
NH Asian/Pacific Islander	213.1	137.4	125.9	3.88 (3.63 to 4.13)	2.32 (1.31 to 3.32)	.008
Hispanic	259.6	167.4	158.9	3.93 (3.73 to 4.13)	1.90 (1.06 to 2.74)	<.001
NH black	446.8	299.1	288.4	3.71 (3.53 to 3.88)	1.29 (0.5 to 2.07)	<.001
NH American Indian/Alaskan Native	267.4	211.2	202.0	2.31 (1.87 to 2.74)	0.43 (−1.4 to 2.22)	.08
Heart Disease						
Total	257.6	173.7	167.0	3.69 (3.51 to 3.87)	0.76 (−0.06 to 1.58)	<.001
Male	320.0	218.1	210.9	3.56 (3.36 to 3.76)	0.34 (−0.56 to 1.23)	<.001
Female	210.9	138.7	131.8	3.95 (3.77 to 4.12)	1.38 (0.55 to 2.20)	<.001
NH white	255.5	175.6	169.9	3.56 (3.37 to 3.75)	0.42 (−0.46 to 1.30)	<.001
NH Asian/Pacific Islander	146.1	93.8	86.4	3.82 (3.54 to 4.10)	2.33 (1.21 to 3.44)	.023
Hispanic	196.0	123.9	116.0	4.12 (3.90 to 4.35)	2.24 (1.29 to 3.18)	<.001
NH black	328.4	216.3	210.8	3.71 (3.52 to 3.89)	1.31 (0.48 to 2.14)	<.001
NH American Indian/Alaskan Native	197.8	161.0	153.3	2.02 (1.53 to 2.51)	0.64 (−1.4 to 2.64)	.24
Stroke						
Total	60.9	37.9	36.5	4.53 (4.34 to 4.72)	0.37 (−0.53 to 1.27)	<.001
Male	62.4	37.9	36.9	4.54 (4.28 to 4.80)	0 (−1.21 to 1.19)	<.001
Female	59.1	37.2	35.6	4.51 (4.35 to 4.66)	0.60 (−0.13 to 1.33)	<.001
NH white	59.0	36.7	35.4	4.59 (4.40 to 4.79)	0.10 (−0.84 to 1.03)	<.001
NH Asian/Pacific Islander	53.0	31.8	28.5	4.65 (4.33 to 4.97)	2.63 (1.32 to 3.93)	.008
Hispanic	46.4	30.7	30.2	3.74 (3.51 to 3.97)	0.98 (0.02 to 1.93)	<.001
NH black	82.9	52.3	50.9	4.33 (4.15 to 4.51)	1.15 (0.33 to 1.97)	<.001
NH American Indian/Alaskan Native	49.6	34.7	32.1	3.54 (2.86 to 4.20)	1.62 (−1.30 to 4.46)	.25
Cancer						
Total	199.6	169.0	161.2	1.49 (1.37 to 1.60)	1.55 (1.07 to 2.04)	.82
Total male	248.9	204.0	192.9	1.78 (1.68 to 1.89)	1.77 (1.33 to 2.21)	.96
Total female	167.6	144.0	138.1	1.34 (1.22 to 1.46)	1.45 (0.95 to 1.95)	.71
NH white	200.6	173.0	166.2	1.32 (1.20 to 1.45)	1.45 (0.91 to 1.98)	.70
NH Asian/Pacific Islander	122.0	106.7	99.8	1.24 (1.03 to 1.44)	1.79 (1.04 to 2.54)	.21
Hispanic	134.9	117.0	112.4	1.30 (1.17 to 1.43)	1.07 (0.58 to 1.56)	.43
NH black	252.0	204.0	190.2	2.00 (1.89 to 2.11)	1.96 (1.50 to 2.40)	.87
NH American Indian/Alaskan Native	143.8	141.2	138.5	0.22 (−0.13 to 0.57)	2.32 (0.97 to 3.65)	.009

Abbreviations: AAMR, age-adjusted mortality rate; CVD, cardiovascular disease; NH, non-Hispanic.

[a] Per 100 000 person-years.

[b] Age-adjusted by Poisson regression.

[c] *P* value for difference in annual rate of change between 2000-2011 and 2011-2014 periods.

Cancer Mortality and Gap Between HD and Cancer Mortality

The overall decline in cancer mortality nationally was 19.2% between 2000 and 2014 (199.6 vs 161.2), and the annual rate of change was not significantly different in 2011-2014 compared with 2000-2011. The gap between HD and cancer mortality rates has remained essentially unchanged since 2011 (Table 1 and Figure, A).

Discussion

The rates of decline of all CVD, HD, and stroke decelerated dramatically between 2011 and 2014. If the rates of decline from 2000 to 2011 had persisted, HD mortality in the United States would have been below that of cancer mortality in 2013, but the pattern of HD and cancer being the first and second leading causes of death, respectively, has endured.[11]

Nationally, chronic diseases are the primary causes of disability and death.[12] The Centers for Disease Control and Prevention advocates that public health and health care systems deploy integrated approaches that bundle proven interventions and address multiple risk factors and conditions simultaneously to create population-wide changes that may effectively address the burden of chronic diseases.[12] Increased emphasis on measures to reduce risk factors at the individual and community levels, including public bans on smoking and lower target levels of low-density lipoprotein cholesterol and blood pressure, have contributed to improved control of risk factors over time.[13,14]

Ma et al[15] found that HD and stroke declined more slowly in the latter part of the 2000-2013 period, from a 3.9% annual percentage change from 2000-2010 to 1.4% from 2010-2013 for HD and from 5.5% annual percentage change from 2001-2007 to 3.0% in 2007-2013 for stroke, so that our findings may represent a continuation of these trends to the point of near stagnation.[15] It is unknown whether small annual reduction rates in HD and stroke mortality rates will persist. It is possible that the early part of the 21st century experienced a particularly high rate of decline in CVD mortality because of the implementation of the prevention programs noted earlier and that the decline might have slowed as implementation approached a saturation level in the community.

The use of the cardiopreventive medications (ie, aspirin and statins) has increased in recent years. The percentage of adults (age ≥18 years) reporting regular aspirin use increased from 11.7% in 2005 to 19.0% in 2010,[16] as assessed by the National Health Interview Survey,[17] with a 70% prevalence of low-dose aspirin use for secondary prevention of CVD noted in 2012. Statin use among adults 40 years or older increased from 16.3% in 2003-2004 to 23.2% in 2011-2012 based on National Health and Nutrition Examination Survey (NHANES) data.[18]

The American Heart Association uses 7 metrics for the assessment of cardiovascular health.[19] Based on NHANES data,[19] the percentage of adults achieving ideal cardiovascular health for blood pressure, cholesterol, and smoking increased from 1999 to 2012; the percentage meeting ideal levels for body mass index and glucose decreased from 1999 to 2012; and the percentage meeting the ideal level for diet was near zero. The percentage of adults meeting ideal cardiovascular health for physical activity could not be compared over time because of assessment method changes.

Based on NHANES data from 1988 to 2008,[20] if current trends continue, estimated cardiovascular health is projected to improve by 6% between 2010 and 2020, which is short of the American Heart Association's goal of 20% improvement.[19] Anticipated declines in the prevalence of smoking, high cholesterol levels, and hypertension (in males) would be offset by substantial increases in the prevalence of obesity and diabetes.[20]

A significant concern is the possibility that CVD mortality rates stop decreasing and perhaps even increase, as suggested by provisional estimates though the third quarter of 2015 of higher mortality rates than in 2014 for HD and stroke,[21] in part owing to the increasing prevalence of obesity and diabetes at epidemic proportions.[22,23] The NHANES estimate of the prevalence of adult obesity increased from 22.9% in 1988-1994 to 34.9% in 2011-2012,[24,25] and the prevalence of diabetes nearly tripled, from 2.5% in 1990 to 7.2% in 2013.[26] An estimated 29 million US adults have diabetes.[27]

It is hoped that increased access to medical care and preventive services resulting from the Affordable Care Act will lead to improved cardiovascular outcomes. The health insurance mandate of the Affordable Care Act has been associated with a 30% decline in the percentage of uninsured adults from 17.1% in the fourth quarter of 2013, just before the mandate began, to 11.9% in the fourth quarter of 2015.[28]

The age-adjusted total CVD and stroke mortality rates both declined by 6.6% from 2010 to 2014. Total CVD and stroke mortality rates would need to decrease by more than 2% annually—much higher than the recent rate of decline—to achieve the American Heart Association's 2020 goal of 20% reductions. The Million Hearts Initiative's primary goal of preventing 1 million myocardial infarctions and strokes cannot be measured, since we do not have adequate data to estimate their incidence,[29] but a leveling of the decline in CVD mortality rates during the implementation of the Million Hearts Initiative is inconsistent with achievement of its goal.

Conclusions

Given the high absolute burden and associated costs of HD and stroke,[19] continued vigilance and innovation are essential in our efforts to address the ongoing challenge of CVD prevention. However, the recent deceleration in the rate of decline in HD mortality is alarming and warrants expanded innovative efforts to improve population-level CVD prevention.

ARTICLE INFORMATION

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Study concept and design: Sidney, Go, Rana.
Acquisition, analysis, or interpretation of data: Sidney, Quesenberry, Jaffe, Sorel, Nguyen-Huynh, Kushi, Rana.
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Statistical analysis: Quesenberry.
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REFERENCES

1. Leading causes of death, 1900-1998. http://www.cdc.gov/nchs/data/dvs/lead1900_98.pdf. Accessed December 15, 2015.

2. Hoyert DL. 75 Years of mortality in the United States, 1935-2010. *NCHS Data Brief*. 2012;(88):1-8.

3. Murphy SL, Xu JQ, Kochanek KD. Deaths: final data for 2010. *Natl Vital Stat Rep*. 2013;61(4):1-117.

4. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in US deaths from coronary disease, 1980-2000. *N Engl J Med*. 2007;356(23):2388-2398.

5. Ford ES, Capewell S. Proportion of the decline in cardiovascular mortality disease due to prevention versus treatment: public health versus clinical care. *Annu Rev Public Health*. 2011;32:5-22.

6. Labarthe DR. From cardiovascular disease to cardiovascular health: a quiet revolution? *Circ Cardiovasc Qual Outcomes*. 2012;5(6):e86-e92.

7. Lloyd-Jones DM, Hong Y, Labarthe D, et al; American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the AHA's strategic Impact Goal through 2020 and beyond. *Circulation*. 2010;121(4):586-613.

8. Frieden TR, Berwick DM. The "Million Hearts" initiative—preventing heart attacks and strokes. *N Engl J Med*. 2011;365(13):e27.

9. Centers for Disease Control and Prevention. Underlying cause of death, 1999-2014 request. http://wonder.cdc.gov/ucd-icd10.html. Accessed January 14, 2016.

10. Klein RJ, Schoenborn CA. *Age Adjustment Using the 2000 Projected US Population*. Hyattsville, MD: National Center for Health Statistics; January 2001. Healthy People Statistical Notes, No. 20.

11. Xu J, Murphy SL, Kochanek KD, Bastian BA. Deaths: Final Data for 2013. *Natl Vital Stat Rep*. 2016;64(2):1-119.

12. Bauer UE, Briss PA, Goodman RA, Bowman BA. Prevention of chronic disease in the 21st century: elimination of the leading preventable causes of premature death and disability in the USA. *Lancet*. 2014;384(9937):45-52.

13. Mann D, Reynolds K, Smith D, Muntner P. Trends in statin use and low-density lipoprotein cholesterol levels among US adults: impact of the 2001 National Cholesterol Education Program guidelines. *Ann Pharmacother*. 2008;42(9):1208-1215.

14. Steinberg BA, Bhatt DL, Mehta S, et al. Nine-year trends in achievement of risk factor goals in the US and European outpatients with cardiovascular disease. *Am Heart J*. 2008;156(4):719-727.

15. Ma J, Ward EM, Siegel RL, Jemal A. Temporal trends in mortality in the United States, 1969-2013. *JAMA*. 2015;314(16):1731-1739.

16. Zhou Y, Boudreau DM, Freedman AN. Trends in the use of aspirin and nonsteroidal anti-inflammatory drugs in the general US population. *Pharmacoepidemiol Drug Saf*. 2014;23(1):43-50.

17. Fang J, George MG, Gindi RM, et al. Use of low-dose aspirin as secondary prevention of atherosclerotic cardiovascular disease in US adults (from the National Health Interview Survey, 2012). *Am J Cardiol*. 2015;115(7):895-900.

18. Gu Q, Paulose-Ram R, Burt VL, Kit BK. *Prescription Cholesterol-Lowering Medication Use in Adults 40 and Over: United States, 2003-2012*. Hyattsville, MD: National Center for Health Statistics; 2014. NCHS Data Brief, No. 177.

19. Mozaffarian D, Benjamin EJ, Go AS, et al; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*. 2016;133(4):e38-e360.

20. Huffman MD, Capewell S, Ning H, Shay CM, Ford ES, Lloyd-Jones DM. Cardiovascular health behavior and health factor changes (1988-2008) and projections to 2020: results from the National Health and Nutrition Examination Surveys. *Circulation*. 2012;125(21):2595-2602.

21. National Center for Health Statistics. Vital Statistics Rapid Release. Quarterly provisional estimates for selected causes of death: United States, 2014—quarter 3, 2015. http://www.cdc.gov/nchs/products/vsrr/mortality-dashboard.htm. Published February 24, 2016. Accessed March 4, 2016.

22. Imes CC, Burke LE. The obesity epidemic: the United States as a cautionary tale for the rest of the world. *Curr Epidemiol Rep*. 2014;1(2):82-88.

23. Mainous AG III, Baker R, Koopman RJ, et al. Impact of the population at risk of diabetes on projections of diabetes burden in the United States: an epidemic on the way. *Diabetologia*. 2007;50(5):934-940.

24. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999-2000. *JAMA*. 2002;288(14):1723-1727.

25. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA*. 2014;311(8):806-814.

26. CDC's Division of Diabetes Translation. National Diabetes Surveillance System. Long-term trends in diabetes. http://www.cdc.gov/diabetes/statistics/slides/long_term_trends.pdf. Published October 2014. Accessed March 20, 2016.

27. Centers for Disease Control and Prevention. *National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014*. Atlanta, GA: US Dept of Health & Human Services;2014.

28. Marken S. US uninsured rate 11.9% in fourth quarter of 2015. http://www.gallup.com/poll/188045/uninsured-rate-fourth-quarter-2015.aspx. Published January 7, 2016. Accessed March 20, 2016.

29. Sidney S, Rosamond WD, Howard VJ, Luepker RV; National Forum for Heart Disease and Stroke Prevention. The "heart disease and stroke statistics—2013 update" and the need for a national cardiovascular surveillance system. *Circulation*. 2013;127(1):21-23.

Invited Commentary

Slowing Progress in Cardiovascular Mortality Rates
You Reap What You Sow

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There are few public health success stories greater than the dramatic declines in cardiovascular disease (CVD) mortality rates achieved from about 1970 to 2010 in almost all Western countries. In many countries, age-adjusted death rates fell 70% or more during this period. Driven by the critical observations of epidemiologic studies and by novel insights into cardiovascular disease pathogenesis, there were major leaps forward in our ability to prevent CVD events and prevent fatality among those with acute CVD events such as myocardial infarction, stroke, and acute decompensated heart failure.

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The recognition of causal risk factors, including tobacco use, atherogenic cholesterol profiles, elevated blood pressure, and dysglycemia and their upstream enablers of unhealthy dietary patterns and sedentary lifestyle, led to widespread public health initiatives, societal/environmental changes, and individual behavioral changes. In turn, these facilitated substantial reductions in smoking prevalence, lower cholesterol levels, and somewhat lower blood pressure levels in the US population (primordial and primary prevention). At the same time, the introduction of evidence-based preventive medications targeting blood pressure and low-density lipoprotein cholesterol reduction to treat individuals at risk for CVD (primary prevention) has increasingly reduced incident CVD events. Just as important in reducing CVD mortality rates was the sequential introduction of evidence-based therapies for individuals with acute CVD events and improved care after these events (secondary and tertiary prevention). Training of hospital staff in resuscitation and defibrillation; use of aspirin, β-blockers, antithrombotics, angiotensin-converting enzyme inhibitors, and statins; use of thrombolytics and primary revascularization strategies for acute myocardial infarction and stroke; and improved surgical and catheter-based revascularization techniques and heart failure care all appear to have contributed to reductions in CVD mortality over the decades. Thus, both public health and health care progress contributed roughly equally to these declines.[1] Indeed, the inflection point in CVD mortality rates in the United States, when increases observed for the entire