HHS Public Access

Author manuscript

JAMA. Author manuscript; available in PMC 2016 January 13.

Published in final edited form as:

JAMA. 2015 January 13; 313(2): 147–155. doi:10.1001/jama.2014.16969.

Community-Wide Cardiovascular Disease Prevention Programs and Health Outcomes in a Rural County, 1970–2010

N. Burgess Record, MD, **Daniel K. Onion, MD, MPH**, **Roderick E. Prior, MD**, **David C. Dixon, MD**, **Sandra S. Record, RN**, **Fenwick L. Fowler, BA**, **Gerald R. Cayer, BS, MPH**, **Christopher I. Amos, PhD**, and **Thomas A. Pearson, MD, PhD, MPH**

Franklin Memorial Hospital, Farmington, Maine (N. B. Record, Prior, Dixon, S. S. Record, Cayer); Maine-Dartmouth Family Medicine Residency, Augusta (Onion); Department of Community and Family Medicine, Geisel School of Medicine at Dartmouth, Hanover, New Hampshire (Onion, Amos); Western Maine Community Action, Wilton (Fowler); University of Florida Health Science Center, Gainesville (Pearson)

Abstract

IMPORTANCE—Few comprehensive cardiovascular risk reduction programs, particularly those in rural, low-income communities, have sustained community-wide interventions for more than 10 years and demonstrated the effect of risk factor improvements on reductions in morbidity and mortality.

OBJECTIVE—To document health outcomes associated with an integrated, comprehensive cardiovascular risk reduction program in Franklin County, Maine, a low-income rural community.

DESIGN, SETTING, AND PARTICIPANTS—Forty-year observational study involving residents of Franklin County, Maine, a rural, low-income population of 22 444 in 1970, that used the preceding decade as a baseline and compared Franklin County with other Maine counties and state averages.

INTERVENTIONS—Community-wide programs targeting hypertension, cholesterol, and smoking, as well as diet and physical activity, sponsored by multiple community organizations, including the local hospital and clinicians.

Corresponding Author: Roderick E. Prior, MD, 243 High St, Farmington, ME 04938 (rprior04938@myfairpoint.net).

Author Contributions: Drs N. B. Record and Prior had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: N. B. Record, Onion, Dixon, S. S. Record, Fowler, Pearson.

Acquisition, analysis, or interpretation of data: N. B. Record, Onion, Prior, S. S. Record, Cayer, Amos, Pearson.

Drafting of the manuscript: N. B. Record, Onion, Prior, Dixon, S. S. Record, Fowler, Amos, Pearson.

Critical revision of the manuscript for important intellectual content: N. B. Record, Onion, Prior, Dixon, S. S. Record, Cayer, Amos, Pearson.

Statistical analysis: N. B. Record, Prior, Amos.

Administrative, technical, or material support: Prior, Dixon, S. S. Record, Fowler, Cayer, Pearson.

Study supervision: Onion, Pearson.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr N. B. Record and Ms S. S. Record reported that they and Franklin Memorial Hospital hold minority interests in Franklin ScoreKeeper, a company formed to develop and market the software developed by the FCHP. No other disclosures were reported.

Additional Contributions: None of the authors or contributors received personal compensation for their assistance.

MAIN OUTCOMES AND MEASURES—Resident participation; hypertension and hyperlipidemia detection, treatment, and control; smoking quit rates; hospitalization rates from 1994 through 2006, adjusted for median household income; and mortality rates from 1970 through 2010, adjusted for household income and age.

RESULTS—More than 150 000 individual county resident contacts occurred over 40 years. Over time, as cardiovascular risk factor programs were added, relevant health indicators improved. Hypertension control had an absolute increase of 24.7%(95%CI, 21.6%–27.7%) from 18.3%to 43.0%, from 1975 to 1978; later, elevated cholesterol control had an absolute increase of 28.5% (95%CI, 25.3%-31.6%) from 0.4% to 28.9%, from 1986 to 2010. Smoking quit rates improved from 48.5% to 69.5%, better than state averages (observed − expected [O − E], 11.3%; 95% CI, 5.5%–17.7%; $P < .001$), 1996–2000; these differences later disappeared when Maine's overall quit rate increased. Franklin County hospitalizations per capita were less than expected for the measured period, 1994–2006 (O − E, −17 discharges/1000 residents; 95% CI −20.1 to −13.9; $P < .001$). Franklin was the only Maine county with consistently lower adjusted mortality than predicted over the time periods 1970–1989 and 1990–2010 (O − E, −60.4 deaths/100 000; 95%CI, −97.9 to −22.8; $P < .001$, and −41.6/100 000; 95% CI, −77.3 to −5.8; $P = .005$, respectively).

CONCLUSIONS AND RELEVANCE—Sustained, community-wide programs targeting cardiovascular risk factors and behavior changes to improve a Maine county's population health were associated with reductions in hospitalization and mortality rates over 40 years, compared with the rest of the state. Further studies are needed to assess the generalizability of such programs to other US county populations, especially rural ones, and to other parts of the world.

Reducing the burden of cardiovascular disease (CVD) has been a public health priority for more than 50 years and will continue to be in the foreseeable future.[1] Preventive interventions have been attempted in many different settings, including communities, schools, faith groups, worksites, and health care facilities.[2] Most efforts have focused on single risk behaviors (diet, tobacco use, physical inactivity), single clinical risk factors (hypercholesterolemia, hypertension), earlier recognition, and treatment of overt disease. A few relatively brief, comprehensive, community-wide risk-reduction studies with nonintervention comparison populations in urban settings[3–7] reported inconsistent results[8] and often lacked sustained interventions or consistent engagement with local health care systems. Few studies have sustained interventions, documented preventive services, monitored changes in risk factors and behaviors, and measured associated reductions in morbidity and mortality. Very few involved rural, socially disadvantaged communities,[9,10] which typically lag behind metropolitan areas in cardiovascular mortality improvements.[11,12]

We describe a set of interventions to improve population health and their associated outcomes over 40 years in Franklin County, a low-income, rural county in west central Maine. In the late 1960s, local community groups identified CVD prevention as a priority. A new Community Action Agency (CAA), a new nonprofit medical group practice (Rural Health Associates [RHA]), and later the community's hospital initiated and coordinated their efforts.[13,14] We report what this community collaboration, using modest start-up grants and many volunteers, did over decades to improve health care access and integrate clinical care with population-wide prevention programs. Specifically, we report rates of smoking

cessation and control of hypertension and elevated cholesterol. We also extend prior mortality observations[15] by 16 years, as well as report hospitalization and mortality rates by household income for Franklin County compared with other Maine counties over a 50-year observation period.

Methods

Beginning in the 1970s, several Franklin County initiatives to improve local health were begun (Table 1 and eFigure 1 and eMethods in the Supplement). The local CAA and physician and other community leaders convened to evaluate and improve local health, recruit primary care clinicians, and found a nonprofit, multispecialty medical and dental group practice (RHA), with 1 central and 3 remote clinics. Federal grants funded planning and implementation of a comprehensive capitated health insurance plan for 3000 indigent residents, the Franklin Area Health Plan, which eventually expanded to a commercial capitated health plan. With hospital medical staff sponsorship, RHA established in 1974 the community-wide Franklin Cardiovascular Health Program (FCHP).[15,16] Over time, many other local public and nonprofit organizations collaborated on various components of these community efforts. Participants included the hospital, local businesses, schools, and the local University of Maine campus, which developed a health education degree program and trained local CAA outreach workers.

The FCHP adapted a community-based clinic model, sending nurses and trained community volunteers into town halls, church basements, schools, and worksites. Early encounters emphasized screening, but FCHP staff also encouraged return for monitoring, counseling, and periodic rescreening. People with uncontrolled health conditions were referred to physicians for treatment. Ongoing results of patient monitoring were sent to the person's physician, who often reciprocally referred to FCHP for interval monitoring between doctor visits. In its first decade, FCHP emphasized detection and control of hypertension.[17,18] Subsequently, it added programs to detect and control hyperlipidemia (1986), minimize tobacco use (1988), and co-manage diabetes in medical practices (2000), and from the beginning, it promoted physical activity and healthy eating. The FCHP adapted elements of contemporary, innovative national[3,5–7] and international[4,9] programs. Strategies included using (1) evidence-based targets, interventions, and standard operating procedures; (2) measurable and monitored objectives; (3) lay and professional leadership; (4) primary care clinician and community participation in program design, implementation, and evaluation; (5) coordination with and supplementation of medical practices; (6) risk factor screening, referral, and follow-up, with education and individual health coaching[19] predominantly by a large cadre of volunteer local nurses in multiple community, school, worksite, and health care settings; (7) patient, physician, and health coach collaboration, including practice-based nurse care management[20] ; and (8) monitoring and tracking systems that FCHP created (Table 1 and eMethods and eFigure 1 in the Supplement).

Outcomes

The outcomes monitored over the decades were adult participation measured by total and individual person encounters with program staff; intermediate risk factor outcomes

(hypertension, hyperlipidemia, and smoking); morbidity, measured by income- and age-adjusted hospitalization rates compared with other Maine counties; and mortality, measured by overall and cardiovascular-specific age- and income-adjusted mortalities compared with other Maine counties.

For hypertension, hypercholesterolemia, and smoking cessation, program efficacy was monitored based on local guidelines and, once available, national guidelines.[21–24] Beginning in 1985, county-of-residence hospitalization and mortality rates from Maine public sources were available from data sources described next.

Data Sources

The FCHP paper and computerized medical record systems provided aggregated data from 1974–2009 on screening and follow-up encounters, demographics, behavioral risk factors, and hypertension and cholesterol control. A reanalysis of previously reported data[17,18] was done on the first 4 years of FCHP. United States Census reports provided demographic data, including county population, age, education level, and median household income for 1970–2010.[25] The Maine Center for Disease Control's Office of Data, Research, and Vital Statistics (ODRVS) provided mortality rate data for 1960–1967 and indirectly for 1968–2010 from the US Centers for Disease Control and Prevention's (CDC) Wonder website,[26] using *International Classification of Diseases* codes for coronary heart disease and stroke to reflect CVD. The ODRVS provided smoking data from the US CDC's Behavioral Risk Factor Surveillance System (BRFSS) for 1994–2011.[27] Franklin Memorial Hospital and the Maine Health Data Organization[28] provided 1994–2006 hospitalization data based on county of residence. The beginning and ending dates of reported outcome data sets vary because of availability. The University of Southern Maine institutional review board stated that this study was exempt from review on March 7, 2014.

Data Analysis

Data were aggregated at a Maine county level, and the other 15 Maine counties were used for comparison with Franklin. The period 1960–1970 was used as a baseline for comparison with the described community interventions period, which began in the early 1970s. Maine county–level age-adjusted mortality rates for the 1960s were available only in ODRVS final report form, already age-adjusted to the US 1940 standard population. Without those raw data to age-adjust to a more contemporaneous population, we age-adjusted subsequent decade data to 1940 to maintain comparability of mortality rates over the entire 50-year period 1960–2010. Cardiovascular and total mortality data were summed to rolling 3-year averages to improve statistical power. Hospitalization rate analyses omitted Maine's southernmost county, because a substantial proportion of its population's hospitalizations occur in adjacent states and hence are unavailable for analysis. Obstetric and neonatal hospitalizations were omitted from the overall hospitalization rate analysis to conform to usually reported hospitalization rates.

Smoking quit rates were calculated from BRFSS questions on "ever smoking" and "presently smoking" as the number of people who reported quitting, divided by quitters plus present smokers. Changes in rates of hypertension and cholesterol control and smoking

cessation were analyzed using χ^2 statistics, *t* tests, or both. Maine vs Franklin County comparisons were analyzed for significance using *t* tests. Maine county hospitalization and mortality rates were adjusted for income and the goodness-of-fit of the relationship tested using linear regression methods developed by the Institute for Healthcare Improvement[29] using data from the County Health Rankings.[30] Outlier analysis was performed by calculating the regression models, excluding Franklin County from the Maine county data, calculating the expected Franklin County income adjusted rate based on the regression model, and comparing the difference between Franklin County's actual (observed) vs expected value, based on all other Maine counties using *t* test scores. Statistical analyses were performed using SYSTAT version 13.00.05. Significance threshold was set at 2-sided $P < .05$.

Results

Franklin County is a sparsely populated (22 444 in 1970, 30 768 in 2010), predominantly white, rural county in west central Maine (Table 2). Over the past 40 years, its residents became poorer and older, but its ratio of population to primary care physician improved.

One-on-one interactions between a county resident and a nurse or other health coach in any one of several programs were recorded by FCHP tracking systems (Figure 1). Encounters averaged 5000 per year from 1974–1994 and 3000 per year subsequently. By 2010, more than 150 000 encounters, an average of greater than 5 encounters per Franklin County resident, had been documented.

CVD Risk Factors and Behaviors

In its first 4 years, FCHP screened about 50% of county adults. Individuals with hypertension showed significant movement from detection to treatment and control ($\chi^2_4=210$, $P < .001$); the proportion in control increased from 18.3% to 43.0%, an absolute increase of 24.7% (95% CI, 21.6%–27.7%; $P < .001$) (Figure 2A). After introducing cholesterol screening in 1986, FCHP reached 40% of county adults within 5 years, half of whom had elevated cholesterols. Over subsequent decades, cholesterol control had an absolute increase of 28.5% (95% CI, 25.3%–31.6%), from 0.4% to 28.9% ($\chi^2_{48}=5499$, $P < .001$) (Figure 2B), from 1986 to 2010; individuals with more visits manifested better control ($\chi^2_{10}=598$, $P < .001$) (eFigure 2 in the Supplement). Similarly, after initiation of multiple community smoking cessation projects (eFigure 3 in the Supplement), community-wide smoking quit rates improved significantly, from 48.5% to 69.5%, and became significantly higher than that for the rest of Maine, which improved from 58% to 61% in 1996–2000 (observed − expected [O − E], 11.3%; 95% CI, 5.5%–17.7%; $P < .001$). Both the Franklin and rest-of-Maine quit rates remained significantly above US median rates since that time (Franklin County vs US quit rates for 1996–2000: O − E, 17.7%; 95% CI, 12.4%–23.0%; for 2001–2005: O − E, 7.7%; 95% CI, 1.6%–13.9%; and for 2006–2010: O − E, 10.2%; 95% CI, 6.6%–13.7%) (Figure 2C).

Hospitalizations

Maine hospitalization rates were strongly associated with household income (R^2 = 0.72; 95% CI, 0.33 to 0.90; P < .001; Figure 3). For the period for which data were available, 1994–2006, Franklin County's observed hospitalization rate was significantly lower than predicted by household income (O – E, −17 discharges/1000 population; 95% CI, −20.1 to −13.9; P < .001).

Mortality

After being at or above overall Maine mortality rates in the 1960s, Franklin County rates (age-adjusted deaths/100 000/y) decreased below Maine rates for almost the entire period 1970–2010 (Figure 4), with differences that reached statistical significance during 2 time periods, 1970–1985 and 2001–2006. Cardiovascular specific mortality rates decreased similarly (eFigure 4 in the Supplement). The greatest divergences coincided with periods of peak efforts to improve health care access, detect and control hypertension and hypercholesterolemia, and reduce smoking (Figure 1).

Franklin County mortality rate divergences from Maine averages were greater when adjusted for income (Figure 5). During the 1960s, Franklin County age- and income-adjusted mortality rates were not significantly different from the rest of Maine (O − E, +7.9 deaths/100 000 people; 95% CI, −22.0 to +37.9; P = .36) (Figure 5A). During 1970–1989, despite static relative income, Franklin mortality rates were the lowest in Maine (O − E, −60.4 deaths/100 000; 95% CI, −97.9 to −22.8; P < .001) (Figure 5B). During 1990–2010, Franklin's household income decreased relative to other Maine counties, but Franklin continued to show significantly lower mortality than predicted by income (O − E, −41.6 deaths/100 000; 95% CI, −77.3 to −5.8; P = .005) (Figure 5C) with rates comparable with those of more affluent counties. At the same time, the proportion of mortality variance among Maine counties explained by household income increased from 14% in 1960–1969 (95% CI, 0% to 55%, P = .17), to 38% in 1970–1989 (95% CI, 2% to 74%, P = .01), and to 81% (95% CI, 51% to 93%, P < .001) in 1990–2010. With the exception of Franklin County, Maine county death rates were increasingly related to income levels from 1960 to 2010.

Discussion

In a rural Maine county, we observed consistent temporal associations between sustained community-wide preventive interventions and several health outcomes, including health behaviors, risk factor control, hospitalization rates, and mortality. Substantial improvements were observed for hypertension control, cholesterol control, and smoking cessation within Franklin County. These were temporally associated with favorable rates of hospitalization and cardiovascular and all cause mortality compared with the rest of Maine. The increasing association of total mortality variance with household income in Maine throughout this 50-year period appears to have affected Franklin less than other counties. The lower overall hospitalization rates were associated with $5 450 362 reductions in total in- and out-of-area hospital charges for Franklin County residents per year (eTable in the Supplement).

The strengths of this study include (1) community-wide support from local physicians, nurses, community leaders, volunteers, and the local hospital; (2) the unusually long, continuous interventions and observation period; (3) the stability of the population over the observation period; and (4) the acceptance of the program by the community.

Several limitations must be considered. As in most observational studies, proving a causal connection between the multifactorial interventions and health outcomes is challenging. The ecological study design leaves open the possibility that the intervention-outcome associations observed could be due to other factors. Nor does the design permit distinguishing any effects of improving health care access from those of community-wide efforts to reduce unhealthy behaviors or identifying which of the various interventions were more effective. Improved primary care access was associated with programmatic interventions. Demographic changes over time could have confounded the observed changes. Franklin County residents did become older and poorer. Available data on net migration were similar to Maine and adjoining counties.[15] Very recent mortality trends, unadjusted for income, were back to state averages, perhaps associated with the observed further declines in local household income, waning effort intensity, or “catch up” by the rest of the state, as many counties developed programs modeled on those in Franklin. But the outcome associations over a long time period suggest that any confounder would have to have been active over the same period. However, despite these limitations, the most plausible explanation for the observed health benefits appears to be the sustained community-wide programs to improve health.

Cardiovascular and total mortality data from vital statistics sources have been used as reliable health outcomes.[31] Two recent national analyses[29,30] identified Franklin County as having unusually favorable current health indicators compared with the rest of Maine; both also reveal substantial county-level variation in health with very few US counties demonstrating better health than would be predicted by their household incomes. Primary and secondary prevention interventions are likely responsible for rapid declines in CVD mortality nationally since 1990.[32] Total and CVD age-adjusted mortality declines in Franklin County and Maine over these 40 years often preceded that national decline. Franklin’s insurance program for a large segment of its low-income population for the first 15 years of the program may also have jump-started improvements, as Medicaid expansion appears to have recently done in Massachusetts.[33]

The intervention programs in Franklin County adopted and continually updated evidence-based health risk assessment and intervention strategies. They were unusual for their early adoption and persistence over decades. In1970, few intervention programs were in place for Franklin to follow.[3,4] Other published rural cardiovascular intervention programs were not initiated untilthe1980s.[9,10] Calls for comprehensive, multisector community interventions[34,35] were not forthcoming for another 20 years. Subsequently, the role of social determinants, especially education and income, in heart disease, stroke, and other chronic diseases have been well documented in studies of both individuals and populations.[36–38] Rural counties, including Franklin, have been falling behind in these determinants, with stagnant household incomes, increasing poverty, and an increasingly elderly population. National data also document slower heart disease mortality declines in

rural compared with urban populations.[11,12] Rural communities, with high poverty rates and below-average health care access, are often“late-adopter communities,” resisting “diffusion of innovation.”[39]

Several key factors may explain why Franklin County residents have had better outcomes than their peers elsewhere in Maine. Late-adopter communities frequently fail to engage innovation unless additional efforts are expended to organize the community, to ensure personal health services, and to enact policy and environmental changes.[40] Such efforts did occur in Franklin, likely explaining why it became an early adopter, only later matched by the rest of the state, as the smoking and mortality data demonstrate. Rural Health Associates and its physician group rapidly improved financial access as well as local access to dental, specialty, and primary care, subsequently maintained in large part by the single county hospital. The FCHP initiated multiple risk factor intervention programs and rallied community support for public policies and initiatives to discourage smoking and encourage better diet and physical activity for all citizens. Also likely important were program sponsorships by multiple community organizations, consistent with the role of “social capital” in health.[41] Despite annual variations over time as program funding, enthusiasm, and the economy fluctuated, the total number of people engaged in the programs demonstrated that multisector, comprehensive, and locally administered programs have been active at many levels in Franklin County since the early 1970s, despite static household incomes.

Three major CVD prevention projects in the 1980s (Stanford,[42,43] Minnesota,[44] and Pawtucket[6]) contributed substantially to subsequent models[45,46] but failed to show reduced CVD morbidity and mortality. In contrast, the prospective, controlled Finnish North Karelia[47] project documented sustained, population-wide risk factor improvement and decreased deaths from CVD and cancer.[48,49] It and Franklin shared distinguishing program characteristics: indigenous impetus, rural community ownership, multidecade longevity, flexible interventions, sustained risk factor and client tracking and follow-up, professional nursing prominence, and programmatic integration with primary medical care.[14,16] The last may well facilitate reconciliation of individual vs population health goals.[50]

Is the Franklin County experience relevant to other US communities? The Affordable Care Act created new opportunities to implement changes such as these elsewhere and to measure their effects on noncommunicable diseases and health care costs.[51] Among them are requirements that tax-exempt hospitals assess the health needs of their communities and develop implementation strategies to meet those needs.[52] In 2009, US hospitals spent 7.5% of their operating expenses on community benefits, but largely on charity care.[53] Only 0.4% was spent on population health improvements like those described here. The experience in Franklin County suggests that community health improvement programs may be both feasible and effective. This may be especially true in socioeconomically disadvantaged communities where the needs are the greatest, as the increasing association of lower household income with higher mortality in Maine suggests.

Conclusions

Sustained, community-wide programs targeting cardiovascular risk factors and behavior changes to improve a Maine county's population health were associated with reductions in hospitalization and mortality rates over 40 years, compared with the rest of the state. Further studies are needed to assess the generalizability of such programs to other US county populations, especially rural ones, and to other parts of the world.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding/Support: Logistical and financial support was provided by Franklin Memorial Hospital. Federal support beginning in 1972 until the mid-1980s came from the Office of Economic Opportunity and the Rural Health Care Service Outreach grant program; multiple small grants of $10 000 to $80 000 over the past 40 years, mostly during the initial 2 decades came from the Federal Health Underserved Rural Area grant program, the Bingham Program, the Regional Medical Program, Maine Bureau of Health, Maine Department of Human Services 314(d) grants, Western Maine Community Partnership, the Healthy Communities Coalition, Franklin Memorial Hospital, the United Way, and others, the details for which are no longer available.

Role of the Sponsors: There was no sponsor and no direct financial support for this report beyond the participation in the study group, from which this article eventually emerged, of some present (G.R.C,) and past (N.B.R., S.S.R., D.C.D., R.E.P.) Franklin Memorial Hospital employees. The hospital and ScoreHealth System provided some administrative support, such as meeting space and clerical services. Neither the hospital nor other partial funders over the decades listed here had any controlling role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

We gratefully acknowledge the vital contributions of Clinton C. Conant, BS, MS, and Paul A. Judkins Jr, BA, both now deceased, for their original leadership in the community and the formation of Rural Health Associates. We also thank Richard Batt, BS,MBA, then president of the local hospital, for recognizing the potential of the Franklin Cardiovascular Health Program (FCHP) to advance area community health; John W. Whittington, MD (Institute for Healthcare Improvement [IHI]) for sharing his outcome vs income adjustment methodology, publishing the IHI internal study of outlier US counties online for public access, and general encouragement; David Harris, RN, PhD (University of Southern Maine), and Sheena Bunnell, PhD, MBA (University of Maine at Farmington), for their advice in study concept and design; Michael Rowland, MD, MPH, and Jay Naliboff, MD (Franklin Memorial Hospital), for study group participation and current Franklin Community Health Network information; Jane Arcari, LPN (FCHP), for more than 20 years of diligent FCHP information system development and support, and who, along with Dwight Payne, BS (ScoreHealth System), and Nicole Ditata, MCHES (Healthy Community Coalition of Greater Franklin County), provided data for this article; Kim E. Haggan (Maine Center for Disease Control's Office of Data, Research, and Vital Statistics) for her provision of Maine vital statistics records; and W. Gregory Feero, MD (Maine-Dartmouth Family Medicine Residency), James L Glazer, MD (North Conway, New Hampshire, Memorial Hospital/Tufts University School of Medicine), Susan Thomas, MD (ScoreHealth System), and Daniel L. Meyer, PhD (DEWN Associates, Readfield, Maine), for their critical manuscript reviews.

REFERENCES

1. Murray CJL, Lopez AD. Measuring the global burden of disease. N Engl J Med. 2013; 369(5):448–457. [PubMed: 23902484]
2. Pearson TA, Palaniappan LP, Artinian NT, et al. American Heart Association Council on Epidemiology and Prevention. American Heart Association Guide for Improving Cardiovascular Health at the Community Level, 2013 update. Circulation. 2013; 127(16):1730–1753. [PubMed: 23519758]
3. Farquhar JW, Maccoby N, Wood PD, et al. Community education for cardiovascular health. Lancet. 1977; 1(8023):1192–1195. [PubMed: 68285]
4. Puska P. The North Karelia project. WHO Chron. 1973; 27(2):55–58. [PubMed: 4695971]

5. Mittelmark MB, Luepker RV, Jacobs DR, et al. Community-wide prevention of cardiovascular disease. Prev Med. 1986; 15(1):1–17. [PubMed: 3714655]
6. Carleton RA, Lasater TM, Assaf AR, Feldman HA, McKinlay S. The Pawtucket Heart Health Program. Am J Public Health. 1995; 85(6):777–785. [PubMed: 7762709]
7. Farquhar JW, Fortmann SP, Maccoby N, et al. The Stanford Five-City Project. Am J Epidemiol. 1985; 122(2):323–334. [PubMed: 4014215]
8. Schooler C, Farquhar J, Fortman S, Flora J. Synthesis of findings and issues from community prevention trials. Ann Epidemiol. 1997; 7(7S):S54–S68.
9. Weinehall L, Hellsten G, Boman K, Hallmans G. Prevention of cardiovascular disease in Sweden. Scand J Public Health Suppl. 2001; 56:13–20. [PubMed: 11681559]
10. Nafziger AN, Erb TA, Jenkins PL, Lewis C, Pearson TA. The Otsego-Schoharie healthy heart program. Scand J Public Health Suppl. 2001; 56:21–32. [PubMed: 11681560]
11. Cossman JS, James WL, Cosby AG, Cossman RE. Underlying causes of the emerging nonmetropolitan mortality penalty. Am J Public Health. 2010; 100(8):1417–1419. [PubMed: 20558803]
12. Ezzati M, Friedman AB, Kulkarni SC, Murray CJ. The reversal of fortunes. PLoS Med. 2008; 5(4):e66. [PubMed: 18433290]
13. Dixon DC. Franklin County up to date. J Maine Med Assoc. 1971; 62(11):278–279. [PubMed: 5171238]
14. Onion DK, Conant CA, Dixon DC, Judkins PA Jr. Rural health care. Med Group Manage. 1980; 27(4):17–25. [PubMed: 10247674]
15. Record NB, Harris DE, Record SS, Gilbert-Arcari J, DeSisto M, Bunnell S. Mortality impact of an integrated community cardiovascular health program. Am J Prev Med. 2000; 19(1):30–38. [PubMed: 10865161]
16. Ades PA, Kottke TE, Miller NH, McGrath JC, Record NB, Record SS. Task force #3: getting results. J Am Coll Cardiol. 2002; 40(4):615–630. [PubMed: 12204491]
17. Record NB Jr. High blood pressure control… the Maine thing. J Maine Med Assoc. 1979; 70(4): 141–144. [PubMed: 438647]
18. Miller FS III, Record NB Jr. Hypertension control in rural Maine. J Maine Med Assoc. 1976; 67(9):280–283. [PubMed: 978056]
19. Ghorob A. Health coaching. Fam Pract Manag. 2013; 20(3):40–42. [PubMed: 23939739]
20. Mauksch L, Safford BH. Engaging patients in collaborative care plans. Fam Pract Manag. 2013; 20(3):35–39. [PubMed: 23939738]
21. Lenfant C, Roccella EJ. Trendsin hypertension control in the United States. Chest. 1984; 86(3): 459–462. [PubMed: 6468007]
22. Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Arch Intern Med. 1988; 148(1):36–69. [PubMed: 3422148]
23. Summary of the second report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). JAMA. 1993; 269(23):3015–3023. [PubMed: 8501844]
24. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA. 2001; 285(19):2486–2497. [PubMed: 11368702]
25. US Census Bureau; USA counties data file downloads. http://www.census.gov/support/USACdataDownloads.html. [Accessed March 20, 2014]
26. Centers for Disease Control and Prevention; Compressed mortality file. http://www.cdc.gov/nchs/data_access/cmf.htm. [Accessed March 20, 2014]
27. Maine Center for Disease Control and Prevention; BRFSS (Behavioral Risk Factor Surveillance System) query page. https://data.mainepublichealth.gov/brfss/. [Accessed March 20, 2014]
28. Maine Health Data Organization; Hospital encounters: restricted hospital discharge inpatient data [1994–2011]: data purchased by Franklin Memorial Hospital and made available from Franklin's

data ware house. http://mhdo.maine.gov/data_hospital_discharge_restricted.htm. [Accessed March 20, 2014]

29. Institute for Healthcare Improvement; Counties of interest: achieving better- or worse-than-expected health outcomes. http://www.ihi.org /resources/Pages/Publications/CountiesofInterestHealthOutcomesIHI90Day RDProject.aspx. [Accessed March 20, 2014]
30. Maine rankings data: county health rankings and road maps county data download. Robert Wood Johnson Foundation and University of Wisconsin Population Health. http://www.countyhealthrankings.org/sites/default/files/state/downloads/2010%20County%20Health%20Ranking%20Maine%20Data%20-%20v2.xls.
31. Goff DC Jr, Brass L, Braun LT, et al. American Heart Association Council on Epidemiology and Prevention; American Heart Association Council on Stroke; American Heart Association Council on Cardiovascular Nursing; American Heart Association Working Group on Quality of Care and Outcomes Research; American Heart Association Working Group on Atherosclerotic Peripheral Vascular Disease. Essential features of a surveillance system to support the prevention and management of heart disease and stroke. Circulation. 2007; 115(1):127–155. [PubMed: 17179025]
32. Pearson TA. The prevention of cardiovascular disease. Health Aff (Millwood). 2007; 26(1):49–60. [PubMed: 17211013]
33. Sommers BD, Long SK, Baicker K. Changes in mortality after Massachusetts health care reform. Ann Intern Med. 2014; 160(9):585–593. [PubMed: 24798521]
34. The Victoria Declaration on Heart Health. Health and Welfare Canada. http://www.med.mun.ca/chhdbc/pdf/victr_e.pdf.
35. Worldwide Efforts to Improve Heart Health. Barcelona, Spain: Autonomous Government of Catalonia; 1997.
36. Marmot MG, McDowall ME. Mortality decline and widening social inequalities. Lancet. 1986; 2(8501):274–276. [PubMed: 2874291]
37. Pappas G, Queen S, Hadden W, Fisher G. The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. N Engl J Med. 1993; 329(2):103–109. [PubMed: 8510686]
38. Kaplan GA, Keil JE. Socioeconomic factors and cardiovascular disease. Circulation. 1993; 88(4 pt 1):1973–1998. [PubMed: 8403348]
39. Rogers, E.; Shoemaker, F. Communication of Innovations: a Cross-Cultural Approach. New York, NY: Free Press; 1971.
40. Pearson TA, Lewis C, Wall S, Jenkins PL, Nafziger A, Weinehall L. Dissecting the “black box” of community intervention. Scand J Public Health Suppl. 2001; 56:5–12. [PubMed: 11681564]
41. Schneider, J. Building Healthy Communities. Baltimore, MD: Annie E. Casey Foundation; 2004. The role of social capital.
42. Farquhar JW, Fortmann SP, Flora JA, et al. Effects of communitywide education on cardiovascular disease risk factors. JAMA. 1990; 264(3):359–365. [PubMed: 2362332]
43. Winkleby MA, Taylor CB, Jatulis D, Fortmann SP. The long-term effects of a cardiovascular disease prevention trial. Am J Public Health. 1996; 86(12):1773–1779. [PubMed: 9003136]
44. Luepker RV, Murray DM, Jacobs DR Jr, et al. Community education for cardiovascular disease prevention. Am J Public Health. 1994; 84(9):1383–1393. [PubMed: 8092360]
45. Mittelmark MB, Hunt MK, Heath GW, Schmid TL. Realistic outcomes. J Public Health Policy. 1993; 14(4):437–462. [PubMed: 8163634]
46. Winkleby MA, Feldman HA, Murray DM. Joint analysis of three US community intervention trials for reduction of cardiovascular disease risk. J Clin Epidemiol. 1997; 50(6):645–658. [PubMed: 9250263]
47. Puska, P.; Tuomilehto, J.; Nissinen, A.; Vartiainen, E., editors. The North Karelia Project: 20 Year Results and Experiences. Helsinki, Finland: National Public Health Institute, KTL; 1995.
48. Tuomilehto J, Geboers J, Salonen JT, Nissinen A, Kuulasmaa K, Puska P. Decline in cardiovascular mortality in North Karelia and other parts of Finland. Br Med J (Clin Res Ed). 1986; 293(6554):1068–1071.
49. Salonen JT. Did the North Karelia project reduce coronary mortality? Lancet. 1987; 2(8553):269. [PubMed: 2886730]

50. Sox HC. Resolving the tension between population health and individual health care. JAMA. 2013; 310(18):1933–1934. [PubMed: 24219944]

51. Yach D, Calitz C. New opportunities in the changing landscape of prevention. JAMA. 2014; 312(8):791–792. [PubMed: 25032720]

52. Rosenbaum S, Margulies R. Tax-exempt hospitals and the Patient Protection and Affordable Care Act. Public Health Rep. 2011; 126(2):283–286. [PubMed: 21387959]

53. Young GJ, Chou C-H, Alexander J, Lee SY, Raver E. Provision of community benefits by tax-exempt US hospitals. N Engl J Med. 2013; 368(16):1519–1527. [PubMed: 23594004]

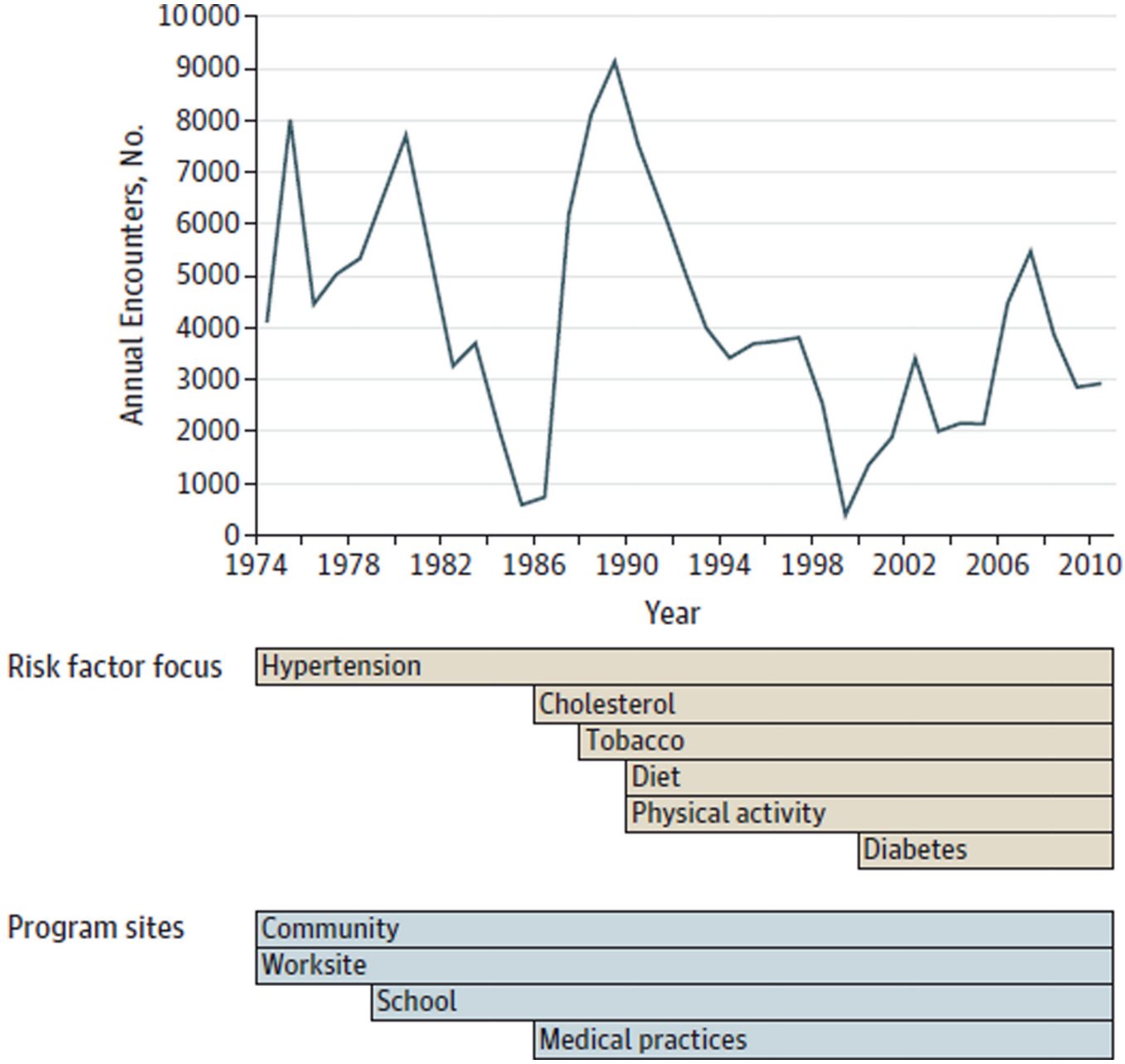

Figure 1. Franklin Cardiovascular Health Program Annual Encounters, Risk Factor Focus, and Locations: 1974–2010

Encounters were in-person contacts between program staff and individuals in the community. The beginning of each bar under the graph indicates the year in which the component was introduced.

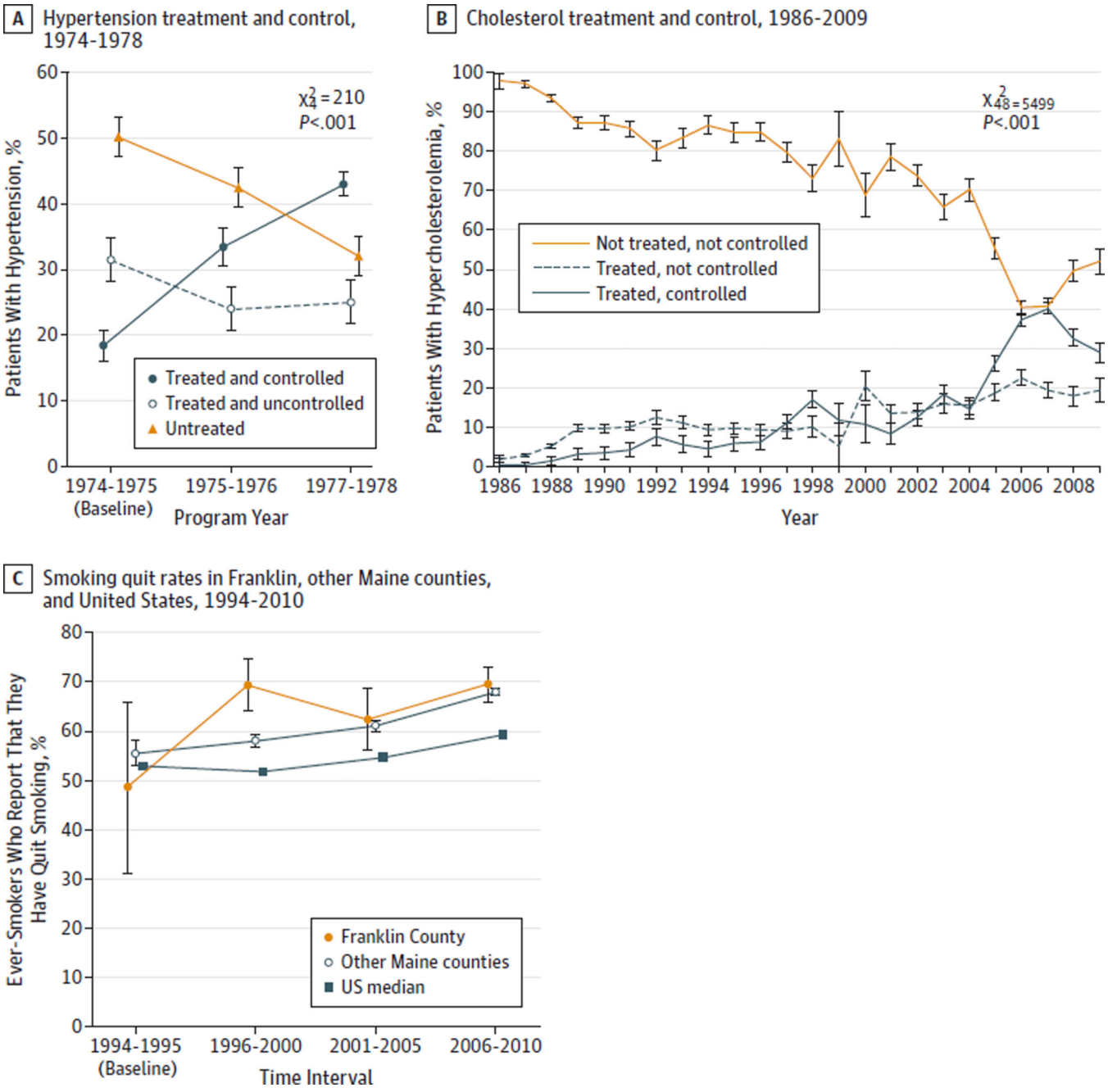

Figure 2. Cardiovascular Risk Factor Reduction

A, Status of the screened population who were found to have hypertension as of the last encounter of the year. Data for 1975 and 1976 taken from Miller and Record.[18] Data for 1978 taken from Record[17] and reanalyzed to allow comparability with 1975–1976 data. χ^2 calculated on change of hypertension treatment and control over time. B, Study population each year is the group of patients with a high cholesterol level at initial screening who had at least 1 encounter at which cholesterol control was measured; control was stated as of the last encounter of the year; and control definitions of cholesterol were based on “at-goal” criteria of contemporaneous Adult Treatment Panel (ATP): ATP I, 1988–1992[22]; ATP II, 1993–

2001[23]; and ATP III, 2002, updated 2004–2013.[24] C, Data are from the Behavioral Risk Factor Surveillance System for 1994–2011, questions “SmokeNow” and “SmokeDay.” Error bars indicate 95% 2-tailed confidence intervals.

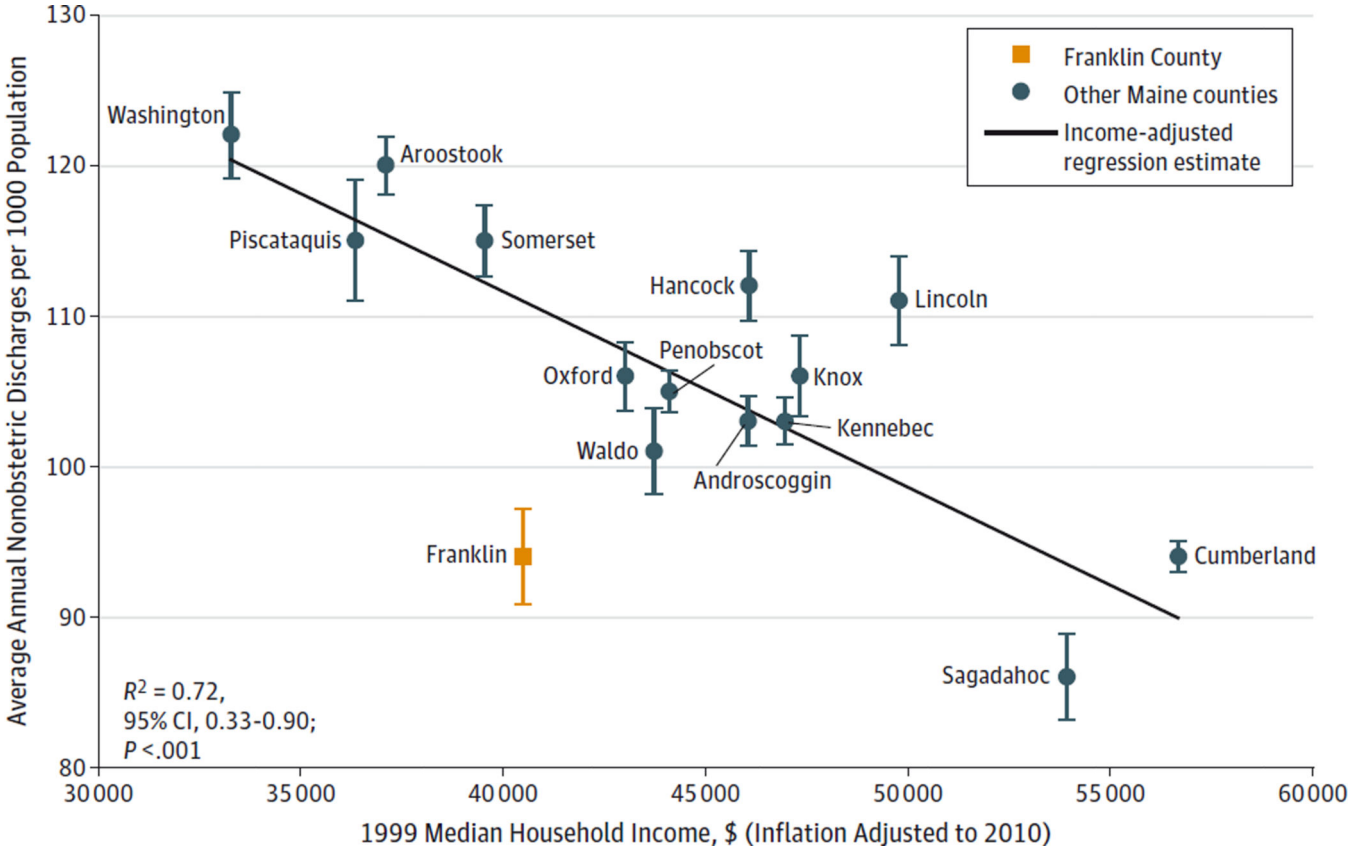

Figure 3. Maine County Hospitalization Rates vs Income, 1994–2006

County-level hospital inpatient discharge rates from the Maine Health Data Organization Inpatient Hospital Discharge Data Set, 1994–2006, assigning cases to the county of residence and excluding obstetric and newborn cases. York County is excluded from this analysis. Error bars indicate non–income-adjusted 95% confidence intervals. Regression estimate performed on Maine county-level data excluding Franklin County. Franklin County observed vs income-adjusted expected discharge rate: −17/1000 residents (95%CI, −20.1 to −13.9; $P < .001$).

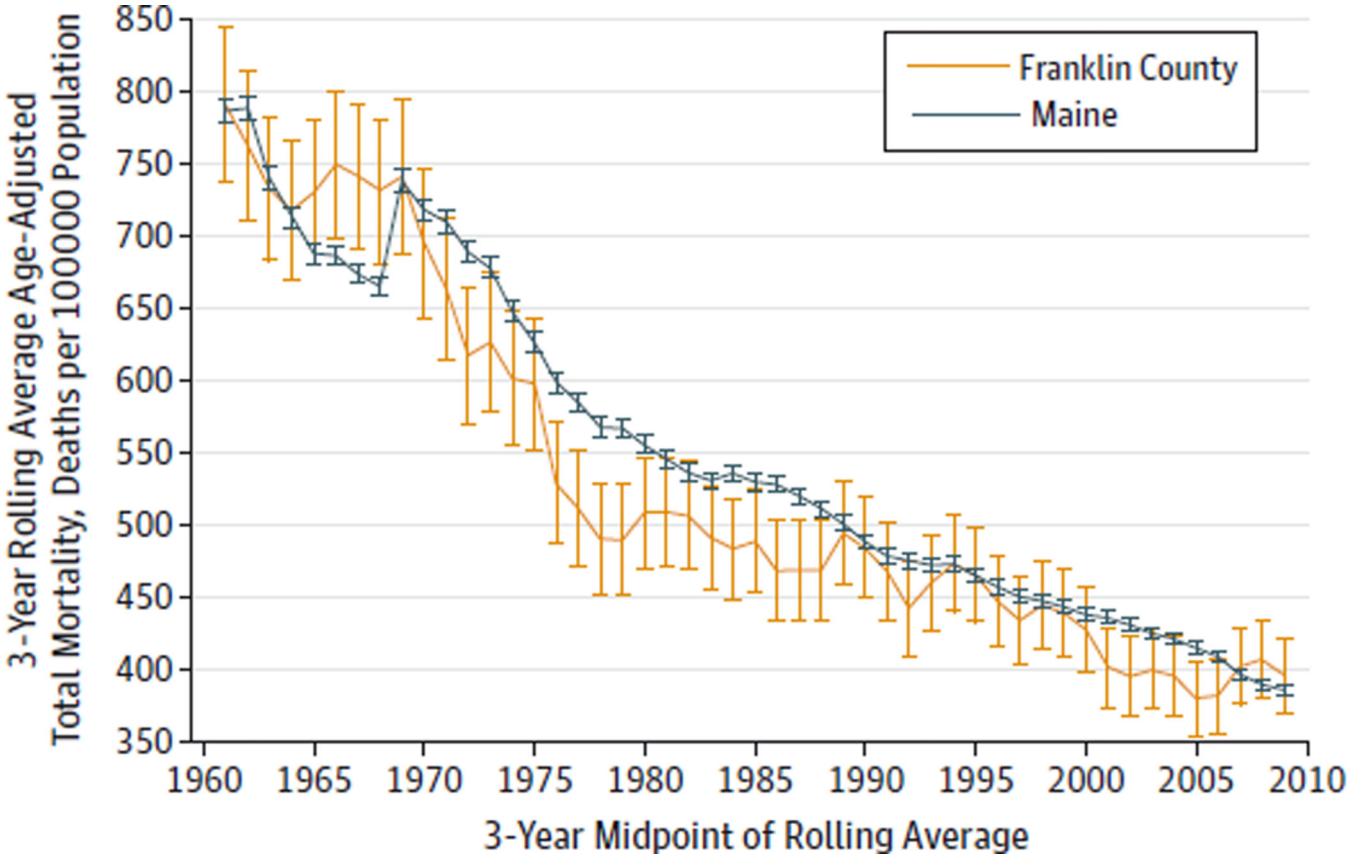

Figure 4. Mortality Rates for Franklin County and Maine, 1960–2010

Age-adjusted total mortality rates. Data was summed to 3-year rolling averages. Age adjustment performed using 1940 standard US population. Error bars indicate 95% confidence intervals.

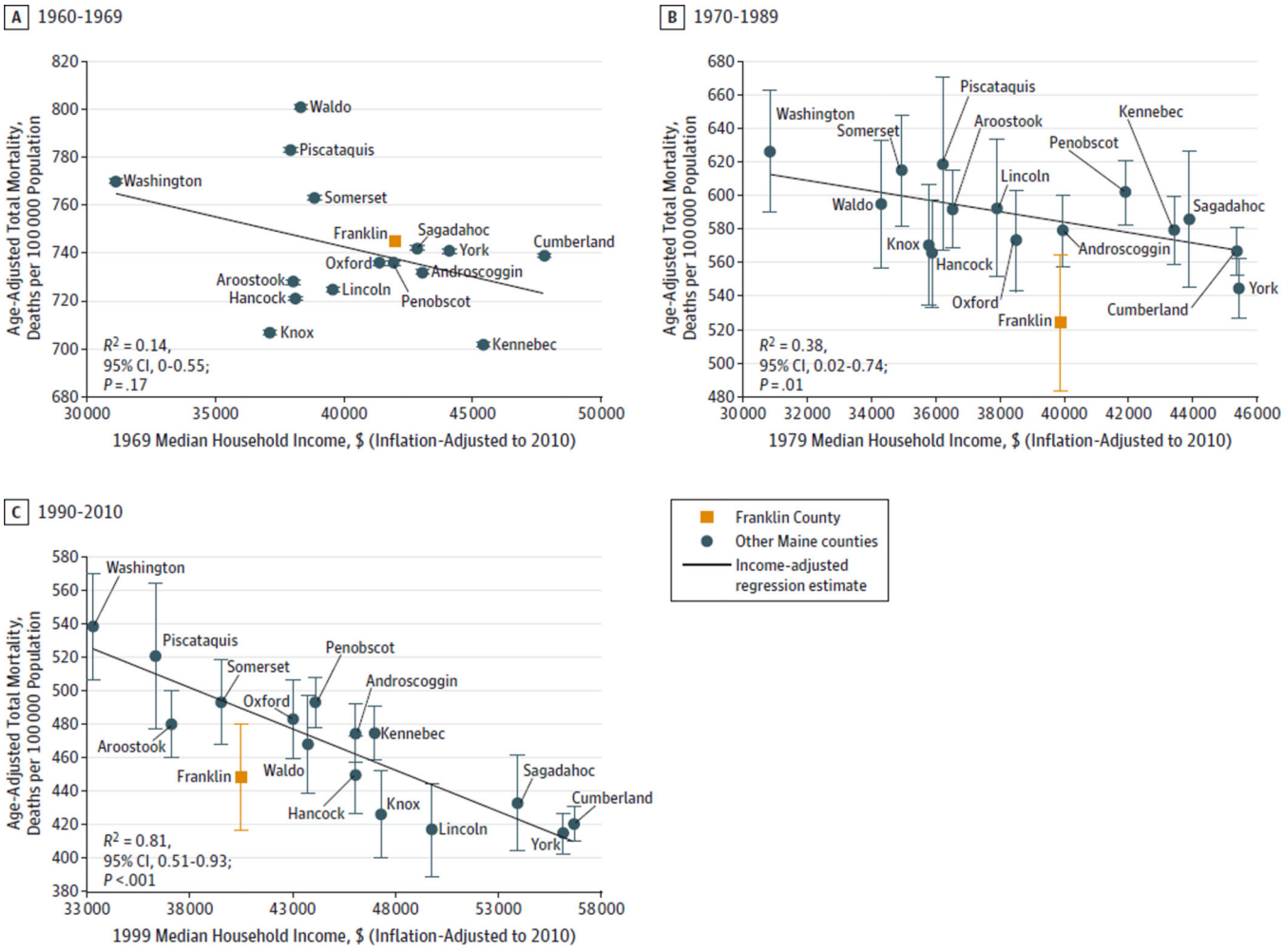

Figure 5. Age-Adjusted Total Mortality Rates vs Household Income for 3 Time Periods: 1960–1969, 1970–1989, and 1990–2010

Maine county age-adjusted mortality rates vs income over 3 time periods. Error bars indicate non–income-adjusted 95% confidence intervals. County death data were not available for 1960–1969 to calculate confidence intervals. Regression was performed on Maine county-level data excluding Franklin County. Franklin County external *t* test values: 1960–1969: 0.27 ($P = .36$); 1970–1989: 3.15 ($P < .001$); 1990–2010:2.28 ($P = .005$). The observed − expected mortality in Franklin County for each period: 1960–1969: 7.9 deaths/100 000 (95% CI, −22.0 to 37.9); 1970–1989: −60.4 deaths/100 000 (95% CI, −97.9 to −22.8); 1990–2010: −41.6 deaths/100 000 (95% CI, −77.3 to −5.8).

Table 1

Key Elements of Franklin Program Interventions[a]

Focus	Start	Intervention Characteristics
Health System		
Infrastructure	1970	Integration of current and new clinical and community resources. Health promotion projects later combined into a hospital-supported healthy community coalition, which served as the policy, coordinating, and goal-setting body for the area's health education, promotion, and prevention activities.
Access	1966	Trained indigenous outreach workers became regular fixtures in the community and many collaborating primary care offices and helped overcome barriers to health and care. A regional health care organization, created through collaboration among local physicians and community action program leaders, included the following: a multispecialty group practice; a comprehensive health insurance plan for low-income residents and local employee groups; and research, development, and education. Health van screening, education, and coaching services in schools, worksites, and health care and other community settings. Overcame barriers to care: geographic (with 1 central and 3 satellite clinics) and financial (capitated health insurance plans for indigent and employed).
Quality	1970	Continuous quality improvement became standard operating procedures for regional risk factor identification and management, starting with medical practice self-audit of hypertension. Adherence to national blood pressure and cholesterol guidelines fostered collaboration between patients, physicians, and health coaches. Guideline-based information systems facilitated risk assessment, coaching, longitudinal tracking, and outreach for multiple risk factors and program management oversight for analysis, reporting, and continuous quality improvement at individual, population, and program levels.
Risk Factors		
Hypertension	1974	Multidisciplinary health coaches and nurses provided multifactorial, integrated cardiovascular risk factor education, screening, referral, and follow-up to all age groups in diverse settings: community, school, worksite, and medical practices, starting with hypertension and in collaboration with community physicians. Simple yes/no algorithm to guide consistent, professional-level care by >200 volunteer nurses. Active follow-up with patients and primary care clinicians by mail, telephone, and even home visits to improve tracking and control. Participation in the National High Blood Pressure Education Program and subsequent risk-focused national programs for cholesterol, tobacco, and diabetes led to continually updating standards and practices and sharing outcomes with national peers.
Cholesterol	1986	Applied the same community outreach "hypertension model" to cholesterol when new scientific evidence and national guidelines were developed (and later to tobacco, diet, and physical activity) using effective efficient 3-person teams of activated patient, clinician, and nurse. National nursing and medical consultants helped develop local competence and establish credibility for local screening and management of lipid disorders. Nurses used new finger-stick technology for point-of-care lipid screening and follow-up. Media advocacy endorsed the "Franklin Health Model" to the population at large.
Diabetes	2000	Collaborative nurse care management facilitated care for complex patients with lipid disorders, diabetes, and/or heart failure, eventually integrated within all hospital-affiliated primary care physician practices.
Health Behaviors		
Tobacco	1988	Teachers and clinicians collaborated in developing and delivering in-class tobacco-related curriculum for county K-12 students. Local adoption/adaptation of statewide/national tobacco guidelines and initiatives for adult, youth, and clinician education, community organization and advocacy, public policy change, and individual and group intervention. Conducted effective tobacco sales "sting" interventions by program staff and motivated high school students, with parental and law-enforcement approval, along with education and follow-up of all regional tobacco product sources.
Diet	1990	Volunteer citizen and professional task forces initiated, promoted, and staffed diverse projects, including community-wide heart healthy menu campaigns involving restaurants, schools, and grocery stores; nutritionist-guided healthy grocery tours; and consultations with school food services to serve heart-healthy meals.
Physical activity	1990	Local university added a community health education department and major; it also built, aided by a community fund drive, a health and fitness center, with area's only indoor pool, open to students and community residents. Program staff helped open school facilities for indoor adult walking; make outdoor recreation areas smoke-free; produce and distribute brochures on local, year-round fitness opportunities; and map safe walking routes in most towns.

[a] Refer to the eMethods in the Supplement for details.

Table 2

Franklin County and Maine Demographics: 1970–2010

	1970		1990–1992[a]		2010	
Demographics	**Franklin County**	**Maine**	**Franklin County**	**Maine**	**Franklin County**	**Maine**
Population	22 444	992 048	29 008	1 227 928	30 768	1 328 361
Per square mile, mean	11.7	31.3	14.7	38.7	18.1	43.1
White, %	99.9	99.3	99.2	98.4	97.2	95.2
Age						
Median age, years	26.8	29.1	32.9	33.9	43.4	40.7
Population <18 y, %	35.3	34.9	26.2	25.2	19.7	20.7
Population >65 y, %	10.8	11.6	12.3	13.3	16.8	15.9
Education						
Age ≥25 y with at least a high school degree, %	57.2	54.7	79.7	78.8	87.9	89.7
Income						
Living below the poverty level, %	9	10.3	12.5	10.8	16.8	12.8
Median income, $	7993	8217	24 432	27 587	39 628	46 541
Physician access						
Ratio of population to primary care physicians	1870	NA	1250	1250	853	952

Abbreviation: NA, not available.

[a]Some data available for one year and not the other, hence the 2-year span.