SPECIAL ARTICLE

Progress in Cancer Screening Over a Decade: Results of Cancer Screening From the 1987, 1992, and 1998 National Health Interview Surveys

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Background: **Screening to detect cancer early, an increasingly important cancer control activity, cannot be effective unless it is widely used.** ***Methods:*** **Use of Pap smears, mammography, fecal occult blood tests (FOBTs), sigmoidoscopy, and digital rectal examination (DRE) was evaluated in the 1987, 1992, and 1998 National Health Interview Surveys. Levels and trends in screening use were examined by sex, age, and racial/ethnic group. The effects of income, educational level, and health care coverage were examined within age groups. Logistic regression analyses of 1998 data were used to develop a parsimonious, policy-relevant model.** ***Results:*** **Use of all screening modalities increased over the period examined; for mammography and DRE, the increase was more rapid in the first half of the decade; for the Pap test and sigmoidoscopy, the increase was more rapid in the second half of the decade. Levels of colorectal cancer screening (both sigmoidoscopy and FOBTs) in 1998 were less than the level that prevailed a decade earlier for mammography. Patterns of change for all screening modalities differed between age, sex, and racial/ethnic groups, but prevalence of use during the study, within recommended time intervals, was consistently lower among groups with lower income and less education. Logistic regression analyses indicated that insurance coverage and, to a greater extent, usual source of care had strong independent associations with screening usage when age, sex, racial/ethnic group, and educational level were taken into account.** ***Conclusions:*** **While cancer screening is generally increasing in the United States, usage is relatively low for colorectal cancer screening and among groups that lack health insurance or a usual source of care. [J Natl Cancer Inst 2001;93:1704–13]**

Screening to detect cancer early is an increasingly important activity to control cancer. Unless widely and regularly used, screening cannot be optimally effective in a population. Therefore, monitoring of cancer screening is a critical aspect in the ongoing evaluation of national cancer control efforts. Before analyzing the use of cancer screening in the U.S. population in 1998, the main purpose of this special article, we provide some context by examining trends in screening during the last decade. We then examine cancer-screening data from the recently released 1998 National Health Interview Survey (NHIS). Finally, we utilize several parsimonious, policy-relevant models to elucidate further what factors influence the most recent use of screening as reflected in the 1998 data.

The NHIS is a continuous national interview survey of households in the United States. The first NHIS cancer module, administered in 1987, was designed to monitor cancer-screening objectives established in that same year *(1,2)*. The 1998 survey provides the final results for Healthy People 2000 (HP2000) objectives for cancer screening and also establishes the benchmarks for the new Healthy People 2010 objectives *(3)*. We analyze data on cancer screening from the 1998 NHIS prevention module in light of trends since 1987. We then analyze the 1998 data with regard to covariates that have been shown to be associated with differential use of cancer screening and, on the basis of clinical evidence, can be expected to be linked to differentials in cancer-related health outcomes.

This special article examines trends in, and determinants of, major cancer-screening practices. We do not attempt to evaluate whether the HP2000 cancer-screening objectives were met for several reasons. First, the 2000 objectives will be systematically evaluated in official reports. Second, new scientific evidence, reflected in important changes in national thinking in the decade since the objectives were originally published, has led to debates about and modifications in screening guidelines. Also, reimbursement for cancer screening, especially by Medicare, has expanded. We have chosen the screening modalities that, because of these debates and changes, are most likely to require analysis and interpretation. This special article examines Pap smear (cervical cancer screening), mammography (breast cancer screening), fecal occult blood test (FOBT) and sigmoidoscopy (colorectal cancer screening), and digital rectal examination (DRE) (rectal and prostate cancer screening) as reported in the 1987, 1992, and 1998 NHIS. In this article, we use the contemporary term “endoscopy” to refer to screening procedures that may have consisted of either rigid procto-sigmoidoscopy, flexible sigmoidoscopy, or colonoscopy. The term that was actually used on the NHIS questionnaires to refer to this group of procedures was “proctoscopy.”

Studies have consistently found that levels of income and education as well as the presence or absence of health insurance and a usual source of health care are all factors that are associ-

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See “Note” following “References.”

ated with individual use of health services and are especially strong predictors of preventive service use *(4–12).* Health insurance coverage and having a usual source of health care are the routinely used measures of access to services. Using regression analysis, we estimate how much screening would increase if health insurance and a usual source of care were extended to the entire U.S. population. We also examine screening prevalence over the recommended time periods by the three major racial/ethnic groups in the Unites States: non-Hispanic whites (“whites”), Hispanics, and non-Hispanic blacks (“blacks”).

Subjects and Methods

National Health Interview Survey

The NHIS is a multipurpose health survey conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC), and is the principal source of information on the health of the civilian, noninstitutionalized, household population of the United States. The NHIS has been conducted continuously since its beginning in 1957. Data are released on an annual basis.

The NHIS core questionnaire items are revised every 10–15 years; the last major revision occurred in 1997. The NHIS that was fielded from 1982 through 1996 consisted of two parts: 1) a set of basic health and demographic items (known as the core questionnaire) and 2) one or more sets of questions (called supplements) on current health topics.

The NHIS uses in-person household interviews to obtain demographic characteristics and health-related information on everyone living in the household. The survey was approved by the U.S. Office of Management and Budget under the Privacy Act, and informed consent was provided by the participants upon administration of the survey instrument.

NHIS data in this article were collected in the 1987, 1992, and 1998 surveys. In 1987 and 1992, the National Cancer Institute (NCI), National Institutes of Health, sponsored special topic supplements. One adult in each household was randomly selected to respond to questions addressing a number of issues related to cancer, including utilization of cancer-screening modalities *(13).* In 1998, a Health Prevention Supplement, sponsored by the U.S. Department of Health and Human Services, also included questions regarding the utilization of cancer screening. Questions changed slightly between the surveys; however, in all years, respondents were asked whether they had ever had the screening examination and, if so, how long ago. The 1987 and 1992 surveys allowed open-ended responses to screening time. Respondents to the 1998 survey were asked to choose between a limited number of response categories characterized in terms of years. Precoded responses for questions for all the screening modalities have an outer range of 3 years. While not perfect, individual self-report has been found to be a satisfactory measure of the usage of screening tests for the purposes of monitoring national level and trends in usage *(14,15).*

Test Intervals

For the five screening tests under study (mammography, Pap test, FOBT, sigmoidoscopy, and DRE), dichotomous variables were constructed to indicate whether the respondent reported a test within a specified period of time. Definitions of recency are derived from evidence-based clinical guidelines and attempt to capture adherence to the recommendations they contain. This special article uses the U.S. Preventive Services Task Force recommendations *(16)* as the reference for screening test intervals, with the exception of endoscopy. The time periods were 3 years for Pap tests and endoscopy and 2 years for mammography, FOBT, and DRE.

The NCI and the American Cancer Society’s recommended interval for screening mammography for women 40 years old or older changed from every 1 to every 2 years (http://cancernet.nci.nih.gov/wyntk_pubs/breast.htm#5). For purposes of documenting trends in use over the period of 1987 through 1998, we use mammography received within the last 2 years. This measure obviously results in higher reported use than would a measure of women who currently receive regular screening mammography on an annual basis; however, it provides a consistent measure over this period of changing recommendations.

The U.S. Preventive Services Task Force does not recommend a specific screening interval for sigmoidoscopy *(16).* Recent guidelines from the American Gastroenterological Association (AGA) suggest an interval of 5 years *(17).* Since the longest time interval from last screening available in the NHIS is 3 years, we used this interval for endoscopy.

Screening Versus Diagnostic Tests

In NHIS, a test can be categorized as screening or diagnostic on the basis of the respondent selecting the item “Part of a routine physical examination/As a screening” as the reason for the test. As tests become more widely used for screening, their use for diagnostic follow-up constitutes a smaller proportion of overall use. For example, less than 10% of mammography and Pap smear tests were identified as done for diagnosis. Use of colorectal cancer tests for screening of asymptomatic individuals is still relatively low. This article focuses on colorectal cancer tests used for screening purposes. However, information is also discussed for total usage, i.e., for diagnostic, screening, and combinations of diagnostic and screening tests for colorectal cancer. For colorectal cancer, the prevalence of test use reported for screening purposes was analyzed in the regression models.

Age Groups

For purposes of analysis, three age groups were defined: 25–49 years, 50–64 years, and 65 years or older. Age groups were selected to allow for a clearer understanding of how various factors that are known to influence prevalence of screening across age groups, such as insurance coverage and age-specific screening guidelines, might vary by these age groups. For insurance coverage, age 65 years was selected because this is the age at which the Medicare benefit begins—a benefit that covers the population 65 years old and older almost universally (97%). In contrast, 15%–25% of the 25- to 65-year-old population was uninsured from 1987 through 1998 *(18).* Age-specific clinical guidelines for cancer screening influenced the decision to use the age group 50–64 years. Prevalence of Pap smear usage is reported separately for women 25–49 years old, because women in this age range tend to obtain Pap smears routinely as part of their reproductive health care. In NHIS, questions regarding the Pap test were asked of women 18 years old and older. Most Americans are assumed to have completed their lifetime educational attainment by age 25 years. Because we used educational attainment in some of the analyses, only women 25 years old and older were included throughout this article.

Response Rate and Missing Data

NHIS uses a nested sample design. Therefore, adults eligible to receive the Health Prevention Supplement consist of those living in family units who agreed to respond to the core NHIS questionnaire (90%) and who, themselves, responded to the general adult questionnaire (83.8%). In this subset, 98.3% of adults asked to respond to the Health Prevention Supplement did so, resulting in a final response rate of 72.6% from all individuals from the original household sample. Final response rates for the 1987 NHIS and the 1992 NHIS supplements were 82% and 87%, respectively.

Respondents who indicated that they had never heard of the test or who reported a test within an unknown period since their last test—making it unclear whether or not to include their response within the targeted time period—were considered to be missing. The proportion of missing responses ranged from 0.87% ($n = 14$) for men 50 years old and older responding to FOBT in 1992 to 8.5% ($n = 272$) for men 50 years old and older responding to FOBT in 1987. The number of respondents for all population groups and screening tests are shown in Table 1.

Analysis

All statistics were weighted by the NHIS sample weights to the U.S. total population. All statistical tests were two-sided. The Survey Data Analysis statistical computer package (SUDAAN) *(19)* was used to take into account the complex sampling scheme of NHIS for the estimation of standard errors. The patterns in Fig. 1 did not differ noticeably when usage prevalence was age-adjusted, so unadjusted prevalences are shown.

Trends for the two different periods, 1987 through 1992 and 1992 through 1998, as well as for the entire decade under study, 1987 through 1998, were tested for statistical significance with the use of the t statistic for testing equality of two proportions. Any t statistic greater than 2 in absolute value would indicate statistical significance at the 5% level. The results of the tests are not shown; however, all differences noted in the text are statistically significant. Since trend tests were carried out by groups defined by age, race/ethnicity, and sex (when applicable), a more conservative approach would be to use a higher threshold of

Table 1, A. Proportion who reported recent use of Pap smear by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
1987		*No.*	*10 539*	*8228*	*1496*	*620*
	⩾25	*10 539*	**74.4 (73.3 to 75.4)**	**74.4 (73.2 to 75.6)**	**80.6 (78.3 to 82.9)**	**68.5 (63.9 to 73.1)**
	25–49	*5867*	85.0 (83.9 to 86.1)	85.1 (83.9 to 86.4)	91.7 (89.5 to 93.9)	78.7 (74.0 to 83.3)
	50–64	*2127*	68.2 (65.8 to 70.7)	70.1 (67.5 to 72.8)	70.9 (65.5 to 76.3)	50.7 (40.9 to 60.4)
	⩾65	*2545*	50.8 (48.7 to 52.9)	51.8 (49.6 to 54.0)	44.8 (38.2 to 51.4)	41.7 (27.5 to 56.0)
1992		*No.*	*6018*	*4420*	*847*	*588*
	⩾25	*6018*	**76.4 (75.0 to 77.7)**	**75.7 (74.2 to 77.3)**	**80.1 (76.6 to 83.6)**	**81.5 (77.1 to 85.8)**
	25–49	*3439*	86.0 (84.6 to 87.5)	86.2 (84.4 to 87.9)	88.2 (84.9 to 91.6)	86.8 (82.7 to 90.9)
	50–64	*1200*	72.2 (69.0 to 75.4)	72.3 (68.5 to 76.0)	76.0 (68.2 to 83.8)	76.4 (67.0 to 85.8)
	⩾65	*1379*	53.3 (50.2 to 56.5)	53.2 (49.9 to 56.5)	51.9 (42.1 to 61.8)	57.5 (43.1 to 71.8)
1998		*No.*	*15 704*	*10 661*	*2221*	*2367*
	⩾25	*15 704*	**79.9 (79.2 to 80.7)**	**79.9 (79.0 to 80.8)**	**84.5 (82.6 to 86.3)**	**77.4 (75.5 to 79.3)**
	25–49	*8699*	87.0 (86.2 to 87.8)	87.9 (87.0 to 88.9)	90.6 (88.7 to 92.4)	80.6 (78.3 to 82.9)
	50–64	*3359*	79.9 (78.4 to 81.4)	80.4 (78.7 to 82.1)	81.6 (77.2 to 85.9)	76.6 (72.3 to 81.0)
	⩾65	*3646*	59.8 (57.9 to 61.6)	59.7 (57.6 to 61.7)	61.7 (57.0 to 66.4)	59.8 (53.1 to 66.5)

Table 1, B. Proportion who reported recent use of mammography by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
1987		*No.*	*6517*	*5277*	*838*	*318*
	⩾40	*6517*	**28.8 (27.4 to 30.2)**	**30.4 (28.7 to 32.0)**	**23.8 (19.9 to 27.7)**	**18.3 (13.2 to 23.3)**
	40–49	*1719*	32.0 (29.4 to 34.6)	34.3 (31.3 to 37.4)	27.8 (19.5 to 36.2)	15.3 (8.9 to 21.8)
	50–64	*2161*	31.7 (29.5 to 33.9)	33.7 (31.0 to 36.3)	26.5 (20.4 to 32.6)	23.0 (13.7 to 32.3)
	⩾65	*2637*	22.8 (21.0 to 24.7)	24.0 (22.1 to 26.0)	14.1 (9.8 to 18.4)	13.7 (5.8 to 21.7)
1992		*No.*	*3719*	*2847*	*485*	*304*
	⩾40	*3719*	**55.8 (53.8 to 57.7)**	**56.6 (54.3 to 58.8)**	**52.5 (47.3 to 57.6)**	**55.6 (48.7 to 62.5)**
	40–49	*1123*	58.1 (54.8 to 61.4)	58.4 (54.6 to 62.3)	52.5 (42.9 to 62.1)	65.0 (53.7 to 76.4)
	50–64	*1190*	61.1 (57.7 to 64.4)	62.6 (58.8 to 66.5)	60.7 (53.1 to 68.3)	52.5 (42.0 to 63.0)
	⩾65	*1406*	48.2 (45.2 to 51.3)	49.3 (46.0 to 52.7)	42.6 (31.7 to 53.6)	44.2 (30.7 to 57.7)
1998		*No.*	*10 374*	*7580*	*1363*	*1178*
	⩾40	*10 374*	**66.9 (65.9 to 68.0)**	**68.0 (66.7 to 69.2)**	**66.0 (62.6 to 69.4)**	**60.2 (57.0 to 63.4)**
	40–49	*3294*	63.4 (61.5 to 65.3)	64.4 (62.1 to 66.6)	65.0 (60.1 to 69.9)	55.2 (49.9 to 60.5)
	50–64	*3375*	73.7 (72.0 to 75.3)	75.3 (73.5 to 77.1)	71.2 (66.2 to 76.2)	67.2 (61.9 to 72.4)
	⩾65	*3705*	63.8 (62.0 to 65.6)	64.3 (62.4 to 66.2)	60.6 (55.6 to 65.7)	59.0 (52.3 to 65.7)

Table 1, C. Proportion who reported recent use of screening endoscopy for women and men by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
				Women		
1987		*No.*	*4728*	*3889*	*584*	*201*
	⩾50	*4728*	**5.8 (5.1 to 6.6)**	**6.4 (5.5 to 7.3)**	**4.0 (1.9 to 6.2)**	—
	50–64	*2144*	5.1 (4.0 to 6.1)	5.6 (4.3 to 6.9)	4.5 (1.3 to 7.7)	—
	⩾65	*2584*	6.6 (5.5 to 7.7)	7.1 (5.9 to 8.4)	3.3 (0.8 to 5.8)	—
1992		*No.*	*2670*	*2087*	*341*	*193*
	⩾50	*2670*	**7.3 (6.2 to 8.5)**	**7.1 (5.9 to 8.3)**	**8.3 (3.9 to 12.7)**	**8.4 (4.1 to 12.7)**
	50–64	*1233*	6.7 (5.1 to 8.3)	6.2 (4.5 to 7.8)	10.6 (4.1 to 17.2)	7.7 (2.0 to 13.3)
	⩾65	*1437*	8.0 (6.4 to 9.7)	8.0 (6.3 to 9.6)	—	9.4 (2.1 to 16.6)
1998		*No.*	*7029*	*5323*	*873*	*675*
	⩾50	*7029*	**9.8 (9.1 to 10.6)**	**10.0 (9.2 to 10.9)**	**10.6 (7.8 to 13.3)**	**6.5 (4.3 to 8.8)**
	50–64	*3356*	8.3 (7.2 to 9.3)	8.3 (7.0 to 9.5)	8.8 (5.8 to 11.9)	7.0 (3.7 to 10.2)
	⩾65	*3673*	11.4 (10.3 to 12.6)	11.8 (10.5 to 13.1)	12.9 (8.5 to 17.4)	6.0 (3.0 to 8.9)
				Men		
1987		*No.*	*2959*	*2455*	*340*	*128*
	⩾50	*2959*	**7.7 (6.6 to 8.7)**	**8.4 (7.3 to 9.5)**	**4.3 (1.3 to 7.4)**	—
	50–64	*1587*	6.9 (5.5 to 8.2)	7.7 (6.2 to 9.2)	—	—
	⩾65	*1372*	8.7 (7.1 to 10.3)	9.2 (7.5 to 10.9)	—	—
1992		*No.*	*1698*	*1373*	*178*	*112*
	⩾50	*1698*	**12.2 (10.7 to 13.8)**	**12.5 (10.8 to 14.1)**	**13.2 (7.7 to 18.7)**	**7.8 (2.6 to 13.0)**
	50–64	*899*	10.8 (8.6 to 12.9)	11.3 (8.9 to 13.8)	9.8 (3.1 to 16.4)	8.4 (2.0 to 14.8)
	⩾65	*799*	14.0 (11.6 to 16.4)	13.8 (11.2 to 16.3)	18.1 (8.7 to 27.5)	—
1998		*No.*	*4896*	*3783*	*509*	*488*
	⩾50	*4896*	**19.0 (17.8 to 20.2)**	**19.5 (18.2 to 20.8)**	**17.8 (13.8 to 21.9)**	**15.1 (11.3 to 18.9)**
	50–64	*2615*	17.6 (15.9 to 19.3)	18.2 (16.3 to 20.1)	14.7 (9.8 to 19.7)	16.2 (11.2 to 21.1)
	⩾65	*2281*	20.9 (19.1 to 22.7)	21.2 (19.2 to 23.2)	22.6 (16.3 to 29.0)	12.9 (7.8 to 18.0)

(Table continues)

Table 1, D. Proportion who reported recent use of screening FOBT for women and men by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
			Women			
1987		*No.*	*4645*	*3835*	*560*	*194*
	⩾50	*4645*	**20.9 (19.4 to 22.3)**	**22.0 (20.4 to 23.6)**	**15.9 (12.3 to 19.5)**	**13.5 (6.2 to 20.7)**
	50–64	*2105*	20.1 (18.1 to 22.1)	21.3 (19.0 to 23.7)	18.3 (13.8 to 22.8)	11.4 (3.5 to 19.3)
	⩾65	*2540*	21.7 (19.9 to 23.5)	22.7 (20.7 to 24.7)	12.4 (7.9 to 17.0)	17.7 (5.9 to 29.6)
1992		*No.*	*2565*	*2006*	*323*	*190*
	⩾50	*2565*	**24.8 (22.8 to 26.8)**	**25.8 (23.5 to 28.0)**	**20.8 (14.7 to 27.0)**	**15.4 (8.3 to 22.4)**
	50–64	*1178*	24.6 (21.7 to 27.5)	25.2 (22.1 to 28.4)	22.9 (13.9 to 32.0)	19.4 (8.2 to 30.6)
	⩾65	*1387*	25.0 (21.9 to 28.1)	26.3 (22.8 to 29.8)	18.2 (9.5 to 27.0)	9.8 (3.1 to 16.6)
1998		*No.*	*6925*	*5236*	*864*	*667*
	⩾50	*6925*	**26.1 (24.9 to 27.4)**	**27.8 (26.4 to 29.2)**	**21.3 (18.1 to 24.5)**	**14.6 (11.5 to 17.7)**
	50–64	*3314*	25.0 (23.3 to 26.7)	26.9 (25.0 to 28.9)	20.6 (16.6 to 24.7)	13.5 (9.7 to 17.2)
	⩾65	*3611*	27.4 (25.7 to 29.1)	28.6 (26.7 to 30.5)	22.2 (17.7 to 26.7)	16.2 (11.2 to 21.1)
			Men			
1987		*No.*	*2886*	*2400*	*328*	*122*
	⩾50	*2886*	**18.2 (16.4 to 19.9)**	**19.5 (17.6 to 21.4)**	**11.5 (7.2 to 15.9)**	**6.8 (2.7 to 10.8)**
	50–64	*1547*	17.4 (15.1 to 19.7)	18.9 (16.4 to 21.4)	11.6 (5.7 to 17.5)	7.7 (2.9 to 12.6)
	⩾65	*1339*	19.1 (16.6 to 21.6)	20.2 (17.6 to 22.9)	11.4 (6.4 to 16.4)	—
1992		*No.*	*1614*	*1307*	*166*	*109*
	⩾50	*1614*	**23.8 (21.0 to 26.6)**	**25.0 (22.0 to 27.9)**	**19.3 (10.0 to 28.6)**	**10.2 (4.2 to 16.3)**
	50–64	*870*	23.1 (19.3 to 26.8)	24.5 (20.1 to 28.8)	18.1 (5.6 to 30.5)	7.4 (2.3 to 12.4)
	⩾65	*744*	24.7 (21.2 to 28.2)	25.5 (21.7 to 29.4)	21.1 (9.6 to 32.6)	—
1998		*No.*	*4794*	*3701*	*505*	*478*
	⩾50	*4794*	**28.5 (26.9 to 30.0)**	**29.9 (28.2 to 31.6)**	**24.3 (19.8 to 28.7)**	**15.9 (12.3 to 19.5)**
	50–64	*2573*	26.0 (24.2 to 27.9)	27.5 (25.3 to 29.6)	23.1 (16.5 to 29.7)	14.4 (9.9 to 18.9)
	⩾65	*2221*	31.8 (29.4 to 34.3)	33.0 (30.2 to 35.8)	26.1 (18.8 to 33.4)	19.1 (13.2 to 24.9)

Table 1, E. Proportion who reported recent use of colorectal cancer screening for women and men by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
			Women			
1987		*No.*	*4550*	*3758*	*549*	*188*
	⩾50	*4550*	**24.2 (22.7 to 25.8)**	**25.7 (24.0 to 27.4)**	**18.2 (14.3 to 22.1)**	**14.6 (7.6 to 21.6)**
	50–64	*2067*	23.1 (21.0 to 25.2)	24.7 (22.2 to 27.2)	20.9 (16.0 to 25.8)	11.7 (3.7 to 19.7)
	⩾65	*2483*	25.5 (23.5 to 27.5)	26.7 (24.5 to 28.9)	14.3 (9.5 to 19.2)	20.7 (8.5 to 32.8)
1992		*No.*	*2556*	*2000*	*320*	*189*
	⩾50	*2556*	**28.2 (26.1 to 30.3)**	**29.0 (26.6 to 31.4)**	**24.3 (18.1 to 30.4)**	**20.1 (12.3 to 28.0)**
	50–64	*1176*	27.3 (24.4 to 30.3)	27.7 (24.4 to 30.9)	27.4 (18.9 to 36.0)	24.5 (13.1 to 35.9)
	⩾65	*1380*	29.1 (25.9 to 32.2)	30.2 (26.7 to 33.8)	20.4 (11.0 to 29.7)	14.1 (5.4 to 22.7)
1998		*No.*	*6895*	*5219*	*855*	*663*
	⩾50	*6895*	**30.2 (29.0 to 31.5)**	**31.9 (30.4 to 33.3)**	**26.0 (22.6 to 29.5)**	**18.3 (14.8 to 21.7)**
	50–64	*3305*	28.6 (26.8 to 30.4)	30.5 (28.3 to 32.6)	24.3 (19.7 to 28.9)	17.9 (13.5 to 22.4)
	⩾65	*3590*	32.0 (30.2 to 33.7)	33.3 (31.3 to 35.2)	28.4 (23.8 to 33.1)	18.7 (13.6 to 23.8)
			Men			
1987		*No.*	*2820*	*2345*	*320*	*121*
	⩾50	*2820*	**22.0 (20.1 to 23.9)**	**23.6 (21.6 to 25.6)**	**14.5 (9.4 to 19.6)**	**7.7 (2.6 to 12.7)**
	50–64	*1515*	20.5 (18.0 to 22.9)	22.3 (19.7 to 24.9)	12.8 (6.5 to 19.1)	8.9 (2.8 to 15.0)
	⩾65	*1305*	24.0 (21.4 to 26.5)	25.2 (22.5 to 28.0)	16.6 (9.1 to 24.1)	—
1992		*No.*	*1622*	*1312*	*167*	*110*
	⩾50	*1622*	**29.4 (26.5 to 32.4)**	**30.4 (27.3 to 33.6)**	**26.7 (17.1 to 36.3)**	**15.7 (7.6 to 23.8)**
	50–64	*870*	27.7 (23.9 to 31.6)	29.3 (24.9 to 33.6)	22.9 (10.0 to 35.9)	12.0 (5.2 to 18.9)
	⩾65	*752*	31.5 (27.8 to 35.2)	31.8 (27.8 to 35.8)	32.2 (20.4 to 44.1)	22.6 (7.6 to 37.7)
1998		*No.*	*4784*	*3690*	*503*	*478*
	⩾50	*4784*	**37.1 (35.5 to 38.6)**	**38.7 (36.9 to 40.5)**	**31.5 (26.7 to 36.3)**	**23.7 (19.5 to 27.9)**
	50–64	*2567*	33.8 (31.8 to 35.8)	35.5 (33.2 to 37.8)	28.3 (21.4 to 35.2)	22.5 (17.1 to 27.9)
	⩾65	*2217*	41.5 (39.0 to 44.0)	42.9 (40.0 to 45.7)	36.5 (29.2 to 43.8)	26.2 (19.9 to 32.5)

(Table continues)

Table 1, F. Proportion who reported recent use of digital rectal examination for women and men by age and race*; 1987, 1992, and 1998†

Year	Age group, y		All races, % (95% CI)	White, % (95% CI)	AA, % (95% CI)	Hisp, % (95% CI)
			Women			
1987		*No.*	*4711*	*3889*	*569*	*198*
	⩾50	*4711*	**37.6 (35.8 to 39.3)**	**39.6 (37.6 to 41.5)**	**29.8 (24.8 to 34.8)**	**27.0 (20.9 to 33.1)**
	50–64	*2121*	39.9 (37.3 to 42.5)	43.0 (40.0 to 46.1)	32.4 (25.6 to 39.2)	25.0 (17.6 to 32.4)
	⩾65	*2590*	35.1 (32.9 to 37.3)	36.2 (33.9 to 38.5)	26.0 (19.2 to 32.7)	30.9 (16.8 to 44.9)
1992		*No.*	*2490*	*1938*	*326*	*181*
	⩾50	*2490*	**40.0 (37.5 to 42.5)**	**41.7 (39.0 to 44.3)**	**35.8 (28.8 to 42.8)**	**28.3 (21.0 to 35.6)**
	50–64	*1132*	45.0 (41.6 to 48.5)	47.0 (43.1 to 50.9)	43.1 (33.2 to 53.0)	30.8 (21.1 to 40.5)
	⩾65	*1358*	35.1 (31.9 to 38.4)	36.8 (33.4 to 40.3)	27.1 (17.7 to 36.5)	24.7 (15.3 to 34.0)
1998		*No.*	*6927*	*5237*	*866*	*671*
	⩾50	*6927*	**41.6 (40.0 to 43.2)**	**43.1 (41.3 to 44.9)**	**37.4 (33.7 to 41.0)**	**31.9 (27.6 to 36.3)**
	50–64	*3325*	43.8 (41.7 to 46.0)	46.3 (43.9 to 48.8)	36.0 (30.9 to 41.0)	33.7 (27.9 to 39.4)
	⩾65	*3602*	39.2 (37.1 to 41.2)	39.9 (37.5 to 42.2)	39.2 (34.4 to 44.0)	29.4 (22.9 to 35.8)
			Men			
1987		*No.*	*2916*	*2427*	*329*	*125*
	⩾50	*2916*	**39.1 (36.9 to 41.3)**	**40.7 (38.4 to 42.9)**	**35.5 (28.9 to 42.1)**	**25.5 (19.0 to 32.0)**
	50–64	*1560*	36.3 (33.4 to 39.3)	38.3 (35.1 to 41.5)	29.7 (21.0 to 38.5)	27.1 (18.7 to 35.4)
	⩾65	*1356*	42.6 (39.5 to 45.7)	43.5 (40.4 to 46.6)	43.1 (34.3 to 51.9)	21.2 (6.6 to 35.8)
1992		*No.*	*1577*	*1273*	*161*	*109*
	⩾50	*1577*	**47.4 (44.5 to 50.3)**	**50.3 (47.3 to 53.2)**	**32.2 (22.2 to 42.2)**	**27.9 (19.4 to 36.5)**
	50–64	*845*	41.9 (38.3 to 45.5)	45.0 (41.1 to 48.9)	26.1 (15.2 to 37.0)	25.2 (16.2 to 34.1)
	⩾65	*732*	54.1 (49.5 to 58.7)	56.4 (51.7 to 61.0)	42.3 (28.9 to 55.6)	32.5 (16.2 to 48.9)
1998		*No.*	*4871*	*3751*	*515*	*492*
	⩾50	*4871*	**50.0 (48.3 to 51.6)**	**52.2 (50.4 to 54.0)**	**42.6 (37.4 to 47.7)**	**35.8 (30.5 to 41.1)**
	50–64	*2609*	44.1 (42.0 to 46.3)	46.7 (44.3 to 49.1)	37.4 (31.0 to 43.8)	31.1 (24.8 to 37.3)
	⩾65	*2262*	58.0 (55.7 to 60.3)	59.3 (56.8 to 61.8)	50.6 (42.3 to 58.8)	45.8 (37.4 to 54.2)

*For Pap test and endoscopy, "recent" is defined as during the 3 years preceding the interview; for mammography, fecal occult blood test (FOBT), and digital rectal examination, "recent" is defined as during the past 2 years preceding the interview; for colorectal cancer screening, "recent" is if the respondent reported FOBT for screening during the past 2 years or endoscopy for screening during the past 3 years.

†*Source:* National Health Interview Survey. Respondent racial/ethnic groups are as follows: Hispanic/Latino, non-Hispanic black/African-American, and non-Hispanic white; Asian/Pacific Islanders and Native American/Alaska Native samples were too few to analyze separately. AA = non-Hispanic black/African-American; Hisp = Hispanic/Latino. Percents not shown have a relative standard error greater than 30%. Numbers of respondents for each race/ethnic category do not add up to number for all races because the category of all races includes all-other-race category. CI = confidence interval.

confidence in order to adjust for multiple comparisons. However, most of the differences that we note would still be statistically significant using a significance level far smaller than 5% because of our large sample size. In addition, the data provided allow any hypothesis to be checked by the reader using any significance level.

For 1998 NHIS data, possible determinants of use of each screening test were explored by entering selected socioeconomic and demographic variables in regression models. The following categorically defined determinants were considered: age (coded as two or three levels, depending on the screening examination); sex; race/ethnicity (coded as three levels); educational level (coded as less than high school graduate, high school graduate, and at least some college); income (family income coded as below the poverty level [poor], 100%–199% of poverty level [near poor], and ⩾200% of poverty level [middle/high]); metropolitan statistical area (MSA) residence (coded as in an MSA or not); health insurance coverage (yes or no); and having a usual source of care (yes or no).

In the logistic regression models, we included independent variables that would provide a parsimonious and policy-relevant analysis. In each model, we included age, race/ethnicity, educational level, usual source of health care, and insurance coverage. We carried out separate logistic regressions by sex when the screening test was appropriate for both sexes. We tested for statistically significant two-factor interactions in the independent variables and included significant ones in the model.

We summarized the logistic regression results by using odds ratios (ORs). For a binary independent variable, the estimated OR gives the ratio of the screening prevalence for that variable, with all other variables being held constant. If there is correlation among the independent variables, one must be cautious in interpreting the OR by itself.

For each screening test, direct standardization was used to estimate the proportion of the population screened out of the total U.S. population of age groups eligible for screening *(20).* Finally, the results of the logistic regression were used in a "what-if" analysis to estimate the gain in screening prevalence that might be expected if policy changes were to improve insurance coverage and access to usual care. To estimate the gain in the proportion of the population screened, the population was stratified by all variables in the model. For each of these strata, the gain in screening for that group was estimated as if they had more favorable characteristics, e.g., insurance coverage versus no insurance coverage and a usual source of care versus no usual source of care. We determined the total population gain by taking a weighted average of the gains of every subgroup strata, where the weights were proportional to the population size of each subgroup.

Results

Fig. 1 shows aggregate national trends in recent test use for men and women at each data point between 1987 and 1998 inclusive. Parts A–F of Table 1 present age-specific recent cancer screening prevalence for the total and for the largest three racial/ethnic groups in the United States, for each of the screening modalities.

Changes Over Time in Pap Smear Use

In 1987, when the first cancer control module was fielded, Pap smears were already used by nearly three quarters of women in the United States (Table 1, A). Use continued to increase, but only by 5 percentage points over the entire period, reaching 80% in 1998. This 5-percentage-point increase in Pap smear utilization is largely attributable to increased use among women aged 50 years and older. The most notable increase in Pap smear use, from 48 percentage points to 69 percentage points, occurred for Hispanic women aged 50 years and older between 1987 and

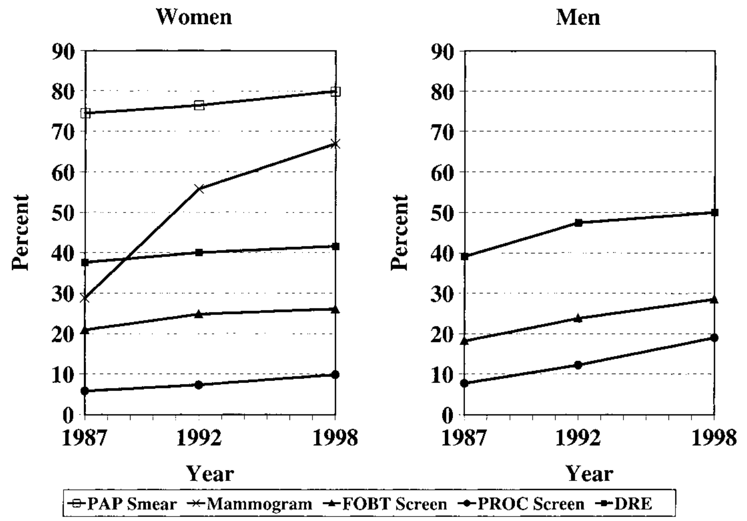

Fig. 1. Recent use of cancer screening tests: 1987, 1992, and 1998. *Source:* National Health Interview Survey. For Pap smear and endoscopy (PROC screen), "recent" is defined as during the 3 years preceding the interview; for mammography, fecal occult blood test (FOBT), and digital rectal examination (DRE), "recent" is defined as during the past 2 years preceding the interview.

1992 inclusive. Use among all women aged 25–49 years, already at 85% in 1987, increased 2 percentage points by 1998; in contrast, among women 50 years old and older, it increased 10 percentage points over the same time period. Throughout the decade, black women used Pap tests at consistently higher rates than white women, except for the oldest age group in 1987 and 1992.

Changes Over Time in Mammography Use

The most dramatic increase in cancer screening has been for mammography. Mammography was first monitored nationally in 1987. In that year, less than 30% of women 40 years old and older reported receiving a recent examination (Table 1, B). Between 1987 and 1992 inclusive, use of mammography almost doubled. It continued to rise, albeit at a slower pace until 1998, when 67% of women 40 years of age and older reported receiving mammography within the last 2 years. Over the decade, women aged 50–64 years emerged as the most frequent users of mammography. During the first half of the decade, all three groups showed about the same increase (25–29 percentage points). The increase in mammography use among younger women, aged 40–49 years, was less (5 percentage points) than in the older groups (13 and 16 percentage points) during the second half of the decade. The racial/ethnic differentials in use of mammography that existed in 1987 disappeared by 1998 for black women. Hispanic women continued to be screened at the lower proportion of 60% compared with 67% of all women.

Changes Over Time in Colorectal Cancer Tests

Endoscopy of the colon is used for both diagnostic/therapeutic and screening purposes. The use of endoscopy for both purposes was more frequent in men in 1987 (15% for men versus 12% for women), rose slowly between 1987 and 1992 for both men and women, and rose at a somewhat higher rate between 1992 and 1998 inclusive. The increase over the decade was greater for men (14 percentage points) than for women (7 percentage points). The total endoscopy usage in 1998 was 25% and 34% for men aged 50–64 years and 65 years and older and 17% and 22% for women in these age groups, respectively. Table 1, C, shows usage proportions as reported for screening endoscopy only.

Over the decade, the proportion of all endoscopies performed for screening increased among men, from 53% to 66% of all tests. However, the proportion among women that was for screening remained at about 50% throughout the decade. Small age differentials in the use of screening endoscopy widened. In 1998, although older men and women were more likely to use the procedure, the proportion used for screening purposes was higher among men aged 50–64 years (70%) than among either men 65 years old and older (60%) or women 50 years old and older (50%). FOBT is also used for diagnostic as well as for screening purposes. Over the decade, total FOBT among men increased about 9 percentage points (from 26% to 35%) and among women about 5 percentage points (from 29% to 34%). All of this increase was due to use of FOBT for screening. The proportion of FOBT tests performed for screening purposes increased more among men, from 70% to 81%, than among women, from 71% to 77% (data on proportion of screening tests not shown in Table 1).

Table 1, D, shows that the period prevalence of screening FOBT increased more among persons aged 65 years and older than among persons aged 50–64 years. White men and white women were more likely to use screening FOBT than black or Hispanic men and women. Among the older population, white women had the smallest increase in FOBT for screening of any group over the decade.

Screening for colorectal cancer with the use of either modality (FOBT or endoscopy) was slightly more common for women than for men in 1987; over the decade, it rose more than twice as much for men (15 percentage points) than for women (6 percentage points) (Table 1, E). White men used screening with either modality less often than white women at the beginning of the decade; by 1998, they were screened for colorectal cancer more frequently than any group of women.

Changes Over Time in DRE Use

DRE also showed a much greater increase among men (11 percentage points) than among women (4 percentage points) during the same period (Table 1, F). Older men were more likely than younger men to use the test, whereas the reverse was true for women throughout the decade. The rate of increase of DRE usage was twice as high among men 65 years old and older compared with younger men and more than three times that among women. Most of the increase for men occurred in the first half of the decade. The racial/ethnic gradient present in 1987 did not change over the decade.

Use of Tests by Socioeconomic Factors

Table 2 shows use of the various screening modalities as reported in the 1998 NHIS by the socioeconomic characteristics of the respondents. The usage prevalences are reported for each socioeconomic factor without adjustments for the influence of other factors. As observed in other studies, average levels of screening usage are substantially lower for groups lacking health insurance coverage or lacking a usual source of care. For insurance coverage, this observation applies across all screening modalities and age groups; virtually all individuals aged 65 years and older are covered by Medicare. Lacking a usual source of care is associated with lower screening proportions across all age groups. A similar pattern occurs for income and educational level, with low-income and low-education groups reporting low prevalence of screening across all age groups. In general, the differences in usage between middle to high income compared with poor were greater than the differences for the educational groups. Place of residence had little effect on usage patterns. Subpopulations living in MSAs were only slightly more likely to use the various cancer-screening tests than those living in non-MSAs. Therefore, residence was not included in the subsequent regression analyses.

Regression Analysis

We used logistic regression analyses to explore further the apparent influence of these factors. Table 3 presents point estimates of the ORs for these factors and their 95% confidence intervals. For all the screening examinations, the direction of the coefficients for educational level, usual source of care, and insurance coverage was as anticipated from the descriptive results of Table 2, with ORs higher for those with more education and for those having a usual source of care or insurance coverage. Screening was more strongly related to usual source of care than to insurance coverage. The ORs for those having more than a high school education were about double those having less than a high school education. The only statistically significant OR for race/ethnicity status was a twofold increase in the OR for Pap smear for black women compared with white women. However, a statistically significant interaction term between insurance coverage and black race of .614 (not shown in Table 3) suggests a more complex interpretation. The difference between blacks and whites in Pap smear utilization (controlling for all other factors) is larger for those without insurance than for those with insurance, suggesting that lack of insurance coverage was less of a deterrent to receiving a Pap smear for black women than for white and Hispanic women (a statistically nonsignificant interaction coefficient of 1.045).

We included income categories in a second regression model (not shown). As expected, the effect of introducing income into the model was to reduce modestly the estimated ORs for insurance coverage and educational level, from 0% to 30%, depending on the screening test, and to a much lesser extent for usual source of care.

Table 2. Proportion who reported recent* use of cancer screening tests by socioeconomic factors and age, 1998†

	% Pap test, age, y				% mammography, age, y			% colorectal cancer screening, sex and age, y				% digital rectal examination, sex and age, y			
Socioeconomic variable	25–39	40–49	50–64	≥65	40–49	50–64	≥65	Males: 50–64	Males: ≥65	Females: 50–64	Females: ≥65	Males: 50–64	Males: ≥65	Females: 50–64	Females: ≥65
Education															
Less than high school graduate	77.2	76.2	66.8	52.4	47.3	58.8	54.7	20.5	33.2	19.8	24.8	30.9	47.5	33.0	33.8
High school graduate	85.8	80.7	80.2	60.7	59.1	73.3	66.8	29.8	38.6	25.9	32.7	39.5	58.6	42.6	38.4
Some college	92.1	88.4	84.8	67.9	68.3	79.8	71.3	40.0	50.7	34.2	39.9	50.6	66.6	49.4	47.1
Income‡															
Poor	79.5	74.1	64.1	47.9	44.2	54.2	52.2	18.8	21.9	14.1	21.4	26.6	44.4	32.4	28.9
Near poor	84.0	70.4	72.0	55.0	43.5	62.1	58.0	25.6	34.1	25.3	27.4	35.8	50.2	38.6	38.0
Middle or high income	91.3	88.6	84.5	66.7	68.4	79.2	71.3	37.3	47.5	32.4	38.3	47.8	65.7	48.6	45.5
Metropolitan Statistical Area (MSA)															
MSA	88.7	85.8	81.2	60.3	65.4	74.4	65.6	36.3	45.1	29.7	33.6	45.7	60.5	45.0	40.6
Non-MSA	87.5	81.2	75.7	58.1	54.8	71.4	57.8	25.4	30.2	25.1	26.9	39.0	50.0	40.1	34.6
Usual source of care															
Yes	90.7	88.2	83.0	61.4	66.8	77.4	65.4	37.4	42.9	30.2	33.0	49.0	59.6	46.1	40.3
No	71.7	49.8	46.4	20.9	27.8	32.6	23.1	8.6	9.4	11.1	7.8	10.1	20.6	20.0	10.5
Insurance coverage§															
Yes	91.2	87.6	82.8	—	67.3	77.6	—	36.4	—	30.6	—	47.4	—	46.8	—
No	75.7	63.9	59.1	—	34.5	45.7	—	9.9	—	14.9	—	14.3	—	23.1	—

*For Pap smear and endoscopy, "recent" is defined as during the 3 years preceding the interview; for mammography, fecal occult blood test (FOBT), and digital rectal examination, "recent" is defined as during the past 2 years preceding the interview; for colorectal cancer screening, "recent" is if the respondent reported FOBT for screening during the past 2 years or endoscopy for screening during the past 3 years.

†*Source:* National Health Interview Survey.

‡Poor is family income below the Federal poverty level; near poor is 100%–199% of the Federal poverty level; middle or high income is 200% or more of the Federal poverty level.

§Fewer than 20 respondents aged 65 years or older were without insurance coverage.

Table 3. Policy and socioeconomic factors affecting recent* use of cancer test, 1998†

	Pap smear, OR (95% CI)	Mammogram, OR (95% CI)	CRC, male, OR (95% CI)	CRC, female, OR (95% CI)	DRE, male, OR (95% CI)	DRE, female, OR (95% CI)
Intercept	0.7 (0.55 to 0.85)	0.1 (0.07 to 0.14)	0.0 (0.02 to 0.07)	0.1 (0.04 to 0.12)	0.1 (0.03 to 0.10)	0.1 (0.04 to 0.12)
Age, y						
⩾65	0.2 (0.17 to 0.22)	1.1 (0.93 to 1.20)	0.8 (0.65 to 0.88)	0.8 (0.74 to 0.96)	0.6 (0.54 to 0.72)	1.3 (1.13 to 1.45)
50–64	0.6 (0.52 to 0.64)	1.9 (1.68 to 2.15)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
<50‡	1.0 (referent)	1.0 (referent)				
Race§						
Non-Hispanic black	2.3 (1.54 to 3.36)	1.4 (0.91 to 2.07)	1.3 (0.42 to 4.33)	0.9 (0.40 to 2.11)	1.1 (0.37 to 3.23)	1.4 (0.67 to 3.10)
Hispanic	1.1 (0.87 to 1.48)	1.3 (0.88 to 1.92)	0.6 (0.19 to 1.87)	0.5 (0.21 to 1.16)	0.7 (0.26 to 2.12)	1.0 (0.47 to 1.99)
Non-Hispanic white	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Education						
Some college	2.3 (1.97 to 2.58)	2.1 (1.83 to 2.46)	2.0 (1.67 to 2.39)	1.8 (1.54 to 2.18)	2.0 (1.67 to 2.40)	1.6 (1.40 to 1.94)
High school graduate	1.5 (1.30 to 1.66)	1.6 (1.39 to 1.86)	1.3 (1.07 to 1.57)	1.3 (1.11 to 1.58)	1.4 (1.16 to 1.66)	1.2 (1.03 to 1.45)
Less than high school graduate	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Usual source of care						
Yes	3.9 (3.31 to 4.56)	4.7 (3.79 to 5.73)	5.2 (3.38 to 7.91)	3.5 (2.43 to 5.17)	6.6 (4.56 to 9.68)	3.4 (2.45 to 4.58)
No	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Insurance coverage						
Yes	2.0 (1.68 to 2.50)	2.7 (2.10 to 3.45)	2.9 (1.71 to 4.81)	1.6 (1.06 to 2.47)	3.0 (1.88 to 4.68)	2.3 (1.57 to 3.35)
No	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)

*For Pap smear, "recent" is defined as during the 3 years preceding the interview; for mammography and digital rectal examination, "recent" is defined as during the past 2 years preceding the interview; for colorectal cancer screening, "recent" is if the respondent reported fecal occult blood test for screening during the past 2 years or endoscopy (sigmoidoscopy, colonoscopy, proctosigmoidoscopy) for screening during the past 3 years.

†CRC = colorectal cancer screening; DRE = digital rectal examination; OR = odds ratio; CI = confidence interval. *Source:* National Health Interview Survey.

‡<50 refers to ages 25–49 years for Pap smear and ages 40–49 years for mammograms.

§Respondent racial/ethnic groups are as follows: Hispanic/Latino, non-Hispanic black/African-American, and Non-Hispanic white; Asian/Pacific Islanders and Native American/Alaska Native were too few to analyze separately.

Policy Implications of Health System Changes for Screening

We also performed a "what-if" modeling exercise for each race/ethnicity group, within the age group 50–64 years, for each of the screening modalities to examine the potential benefit of improved health care access. This approach uses the regression model to predict what the average usage proportion of screening would be for a population group if that group had the characteristics of another group in the sample, instead of its own characteristics. For white women, we estimated that the percentage of women receiving Pap smear screening every 3 years would increase from its current value of 81% to 84% if all women had both insurance and a regular source of care. Although the 3% potential gain is comparatively small, larger gains would be expected for the two minority racial/ethnic groups because they currently have less insurance coverage and less commonly have a usual source of care. For instance, for Hispanic women, we estimate that the percentage of women receiving mammography screening every 2 years would rise from its current value of 66% to 77%, if all Hispanic women had both insurance and a usual source of care. For black men, we estimate that the percentage of individuals receiving colorectal screening every 2 years would rise from its current value of 26% to 31% if all black men had both insurance and a regular source of care. Although relatively modest in terms of the total percentage increase in screening utilization across the population, the predicted gains in screening usage would represent a substantial public health advance for the subgroups who currently underuse screening services.

Discussion

Data from the 1998 NHIS demonstrate that some of the disparities observed in previous reports of cancer screening, such as race/ethnicity differences for mammography, diminished or disappeared by 1998. Important differences in use persist for groups distinguished by factors such as educational level, income, health insurance coverage, and usual source of care. The strongest predictor of use of every screening test is having a usual source of medical care. This finding is consistent with results obtained in several studies of screening mammography *(21–23)* that have shown that recommendation to the patient and/or referral to screening by primary care physicians is a crucial step in the screening process. Although universal health insurance coverage has been emphasized in recent policy debates, our data suggest that people also must have a usual source of care. Achieving this should be a complementary goal of health care policy. As a first step, if Medicare promoted regular use of a usual provider, this finding suggests that screening rates would rise. Several reports *(4,21–23)* have found that access, in concert with physician recommendation for screening in accordance with recommended guidelines, increases screening usage. We also found that other socioeconomic factors, specifically health insurance and educational status, that are related to general access to health care services continue to be associated with important differences in the use of screening.

The prevalence of Pap smear use and mammography in the United States is generally high. Proportions of women using mammography continue to increase, although the rates of increase are slowing. Past race/ethnicity gradients for mammography use have, by and large, disappeared, although the prevalence for younger Hispanic women is still somewhat lower than that for other groups. Even for these modalities, however, substantial gaps remain when groups are characterized by socioeconomic and health system factors. Our finding that access to health insurance and a usual source of medical care are particularly important factors confirms other research *(4,21–23)*.

Various initiatives promoted and facilitated mammography and Pap smear use during the period under study, including state laws requiring that insurance companies cover screening mammography *(24),* Health Plan Employer Data and Information Set (HEDIS) standards for breast and cervical cancer screening in managed care organizations (http://www.ncqa.org/index.htm), less restrictive Medicare coverage for mammography and publicity campaigns to inform Medicare enrollees that Pap and mammography screening are covered services, and programs across the nation that provide free or low-cost mammography (http://www.hcfa.gov/medicare/prevent/pap.htm; http://www.hcfa.gov/news/pr1997/ncireq.htm). Programs to promote early detection of breast and cervical cancers, such as those co-sponsored by the CDC and state health departments, also have contributed to improved access to screening among low-income and uninsured women. But after 10 years of operation, this CDC program reaches only 15% of the eligible population *(25).*

Additional increases in Pap screening, associated with readily available follow-up services when cervical abnormalities are detected, could result in further decreases in mortality from this disease. Maps of cancer mortality in the United States *(26)* show pockets of high cervical cancer mortality in the United States throughout Appalachia, in the Southeast, and along the United States–Mexico border. Focusing interventions on the geographic areas where rates are high seems to be the most promising approach to controlling invasive cervical cancer *(27).* Our descriptive and regression results suggest that targeted interventions to promote the use of Pap tests are especially needed among women 65 years old and older or those with low educational attainment. Behavioral research indicates that specific interventions designed for groups with low educational attainment and access-enhancing strategies, such as information and help with appointments, transportation, cost, and dependent care, may be more effective than general promotional efforts *(28).*

Use of colorectal cancer screening increased over the decade, but it still lags behind mammography and Pap smear use. There is an emerging differential in the use of screening endoscopy between men and women, and differentials in use by race/ethnicity persist for these modalities. The more rapid increase in use among persons 65 years old and older means that, relative to risk of colorectal cancer, the distribution of colorectal cancer screening in the population was more appropriate in 1998 than it was in 1987. However, the growing differential in use over the decade between men and women may reflect misunderstandings about the importance of colorectal cancer screening for women. This trend should be monitored, especially because use of endoscopy compared with FOBT is lower for nonwhite than for white women. Survey items on the year 2000 NHIS have been designed to provide more specific and detailed information about colorectal cancer-screening modalities and diagnostic follow-up than has been available in the past.

Two other recent studies *(29,30)* report prevalence of usage for colorectal cancer screening. Erban et al. *(29)* conducted a random-digit telephone survey of 1119 respondents 50 years old and older (63% response rate) in Massachusetts in 1998. In that study, 51% of the respondents reported adherence to AGA guidelines; 13% reported a screening FOBT alone within the last year, while 19% received a screening sigmoidoscopy, with or without FOBT, within the last 5 years. Additional screening modalities used, with or without annual FOBT, were screening barium enema within the last 5 years (5%) and screening colonoscopy within the last 10 years (8%). Thirty-three percent of respondents reported receiving at least an FOBT within the last year. Almost 7% of the respondents reported having had a recent diagnostic sigmoidoscopy, colonoscopy, or barium enema. The Behavioral Risk Factor Surveillance System (BRFSS), a system of state telephone surveys co-sponsored by the CDC and state health departments, has reported on levels of colorectal cancer screening in 1997 and 1999 *(30).* BRFSS found that, in 1997, 20% of all respondents reported receiving a FOBT within the last year and 30% reported receiving endoscopy within the last 5 years. By 1999, these proportions increased slightly to 21% and 34%, respectively. The levels of colorectal cancer-screening procedures reported in the Massachusetts survey appear to be substantially higher than those reported in the 1998 NHIS. This finding is not surprising, however, because other screening rates for Massachusetts are also higher than those for the nation. In the 1999 BRFSS, the prevalence of FOBT was 29% for Massachusetts compared with 21% for all states, and the prevalence of endoscopy was 35% compared with 34% for all states. The 1997–1999 BRFSS proportions are reported for all procedures, regardless of whether they were used for screening or diagnostic purposes.

Because of the different screening intervals reported, it is difficult to compare proportions for endoscopy between BRFSS and the 1998 NHIS. For annual FOBT, in the 1998 NHIS, about 26% of respondents reported having had an FOBT within the last year, a proportion somewhat higher than, but in the same general range as, that reported by BRFSS. While BRFSS has a large sample size, it had a response rate in 1999 of only 56%, compared with the 1998 NHIS response rate of 73%. Given these respective response rates, it is likely that BRFSS estimates are more prone to bias due to the nonresponse *(31).*

Evidence for the benefit of and recommendations for use of DRE as a screening modality for colorectal cancer became less definitive over the decade covered by this article. A likely explanation for the rapid increase in the use of DRE in older men is the increase in use of clinical examinations because of the rapid increase in use of prostate-specific antigen (PSA) tests for prostate cancer detection *(32).*

A decade of data from NHIS reflects some notable public health advances in cancer screening in the United States, especially in regard to the Pap smear and mammography. Although the use of screening modalities for colorectal cancer has also increased, the overall pattern of screening for this cancer resembles levels achieved a decade ago for breast cancer. But even for breast and cervical cancer screening, persistent patterns of underuse remain for groups with lower income and educational status, without access to health insurance coverage, or lacking the relationship with a medical professional that comes with having a usual source of care. These are remaining public health challenges that must be addressed if utilization of screening is to achieve levels required to reduce cancer mortality, its ultimate goal.

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Note

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