Breast Cancer Detection Demonstration Project: Five-Year Summary Report

Larry H. Baker

CA Cancer J Clin 1982;32;194-225
DOI: 10.3322/canjclin.32.4.194

Breast Cancer Detection Demonstration Project: Five-Year Summary Report

Larry H. Baker, M.D.

This article is the result of work undertaken by the Breast Cancer Detection Demonstration Project Data Management Advisory Group (BCDDP DMAG), which consists of the following members: Larry H. Baker, M.D., Chairman, University of Kansas Medical Center, Kansas City, Kansas; Thomas Carlile, M.D., Virginia Mason Research Center, Seattle, Washington; John R. Milbrath, M.D., Medical College of Wisconsin, Milwaukee, Wisconsin; Barbara Threatt, M.D., University of Michigan, Ann Arbor, Michigan; Fred I. Gilbert, Jr., M.D., Pacific Health Research Institute, Honolulu, Hawaii; Robert N. Hoover, M.D., National Cancer Institute, National Institutes of Health, Bethesda, Maryland; Philip C. Prorok, Ph.D., National Cancer Institute, National Institutes of Health, Bethesda, Maryland; Louise A. Brinton, Ph.D., National Cancer Institute, National Institutes of Health, Bethesda, Maryland; Jan Howard, Ph.D., National Cancer Institute, National Institutes of Health, Silver Spring, Maryland; Benjamin F. Byrd, Jr., M.D., Vanderbilt University School of Medicine, Nashville, Tennessee; Herbert Seidman, American Cancer Society, New York, New York; Lawrence Garfinkel, American Cancer Society, New York, New York; and Robert V. P. Hutter, M.D., Saint Barnabas Medical Center, Livingston, New Jersey. Ex-Officio participants include: Peter Greenwald, M.D., National Cancer Institute, Bethesda, Maryland; Richard D. Costlow, Ph.D., National Cancer Institute, Bethesda, Maryland; Victoria C. Goforth, National Cancer Institute, Bethesda, Maryland; George T. Foradori, Ph.D., Data Management Center, Philadelphia, Pennsylvania; and Robert G. Burnight, Ph.D., National Cancer Institute, Bethesda, Maryland.

Dr. Baker is Associate Professor in the Department of Community Health at the University of Kansas Medical Center in Kansas City, Kansas.

The author and the members of the BCDDP DMAG wish to acknowledge the project directors of the BCDDP who were invaluable in making this project a success, and the more than 280,000 women who participated, without whom the BCDDP would not have been possible.

The author and DMAG committee members also wish to thank Ms. Najma Khalid of the Data Management Center in Philadelphia for her invaluable assistance accessing the computerized data base; and Ms. Judi Silverman of the Data Management Center in Philadelphia and Ms. Kay Wagner of the Department of Community Health, University of Kansas Medical Center, for their technical assistance.

Supported by contract No 1-CN-65376 from the National Cancer Institute.

The Breast Cancer Detection Demonstration Project (BCDDP) was implemented to disseminate the techniques of early detection of breast cancer to both the public and the medical profession. The project,

which was jointly funded by the American Cancer Society (ACS) and the National Cancer Institute (NCI), became operational in 1973. By 1975, there were 29 BCDDP centers at 27 widely distributed locations throughout the United States, and more than 280,000 women had enrolled in the program.

Most centers recruited approximately 10,000 women over a two-year period with a mandate to screen each woman for five years and to follow them for an additional five-year period. Participants were screened for breast cancer on an annual basis using a combination of medical history, physical examination, mammography, and thermography* to detect breast cancer in its earliest stages. Breast self-examination (BSE) was also taught at the screenings, and participants were encouraged to practice BSE on a monthly basis.

Since the BCDDP was not originally designed as a research or investigational project, no provision was made for the systematic collection of data from the centers. It became apparent, however, that data collected on the BCDDP population might provide valuable information about breast disease, and a few months after the program began, a Data Management Center (DMC) was added. A uniform set of data collection forms was developed, and the DMC attempted to acquire and add to the files all extant data from the operational centers.

Screening was completed in March 1981 and a Data Management Advisory Group (DMAG) was appointed by the NCI to begin a descriptive analysis of the BCDDP data base. The files will continue to be edited and updated through June 1983, but it is expected that the basic distribution of the data as it is summarized below will not change significantly.

The BCDDP Population

Recruitment

At the beginning of the program, there was some question about the feasibility of recruiting 280,000 women to participate in a large-scale screening program for breast cancer and motivating them to return for five annual screenings. ACS volunteers compiled lists of women to be contacted, spoke on radio and television, made presentations at meetings, and carried out a variety of other activities aimed at informing the public about the BCDDP and encouraging women to participate.

According to a 10 percent sample of the BCDDP participants, the most effective methods of recruitment were information about the program from informed friends and announcements in newspapers and on television (Table 1). These ACS efforts were highly successful, and more than 280,000 women joined the program. As of September 1981, the DMC had at least one screening document on file for 283,222 women.**

Age At Entry

Although most centers accepted any woman who wanted to be screened for breast cancer, 99.4 percent of the participants were between the ages of 35 and 74 when they entered the program. The median age of all BCDDP participants was 49.5 years.

Age at entry of the BCDDP population at each annual screening is shown in Table 2. At the first annual screening, the population is almost evenly divided between women under 50 and those at or over 50 years of age. At subsequent screenings, there is a slight decrease in the percent of

*Thermography was discontinued as a routine procedure in 1977 on the recommendation of a special Working Group that was asked to review the BCDDP. *Journal of the National Cancer Institute* 62:708, 1979.

**Each BCDDP participant was assigned a unique accession number, and all forms pertaining to that participant were coded with this number. When a woman transferred between centers, she was assigned a new accession number. Therefore, some women have Final Screening Recommendations filed under more than one accession number. At the time of this analysis, the DMC had 1,074,019 Final Screening Recommendation Forms from annual exams and 276,593 Initial Patient History Records on file.

TABLE 1
SOURCE OF INFORMATION ABOUT THE
BREAST CANCER DETECTION DEMONSTRATION PROJECT

Source of Information	Number of Responses*	Percent of Respondents**
Friend	11,682	43.7
Newspaper	7,713	28.8
Television	3,108	11.6
Physician	2,459	9.2
Contact by American Cancer Society Worker	1,545	5.8
Meeting	1,428	5.3
Radio	924	3.5
Church	372	1.4
Poster	194	0.7
Other	2,825	10.6

*These figures are based on a 10 percent sample of Initial Patient History Records, where participants may have listed more than one response.

**Percents are based on the percentage of respondents (N = 26,756) who listed that response as a source of information. It totals more than 100.0 percent, since some women listed more than one response.

women under 50 at entry and a slight increase in women at or over 50. By the fifth annual exam, women under 50 constitute 45.6 percent of the population, and women at or over 50 years of age, 49.5 percent.*

Analysis of the attendance patterns also reveals a slight age trend (Table 3). A higher percentage of women under 50 dropped out of the program after attending only one or two annual exams, while a higher percentage of women over 50 attended all five annual screenings. It is also remarkable that regardless of age, more than half the women who entered the program attended all five screenings.

Race

The majority of the BCDDP participants were white (88.3 percent). Only a small percentage of the population was black

*These percentages do not add up to 100.0 percent, because data on age at entry is not available for 4.4 percent to 5.0 percent of the population over the five annual screenings.

VOL. 32. NO. 4 JULY/AUGUST 1982

TABLE 2
AGE AT ENTRY OF WOMEN PARTICIPATING IN THE BREAST CANCER DETECTION DEMONSTRATION PROJECT

Age at Entry	Annual Screening									
	1		2		3		4		5	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
< 35	1,568	0.6	961	0.4	684	0.3	544	0.3	470	0.3
35-39	36,752	13.3	30,370	12.8	25,241	12.2	21,753	11.8	20,113	11.7
40-44	44,770	16.3	38,204	16.1	32,389	15.7	28,481	15.5	26,482	15.4
45-49	48,701	17.7	42,292	17.9	36,940	17.9	33,223	18.1	31,255	18.2
50-54	47,410	17.2	41,850	17.7	37,247	18.1	33,632	18.3	31,631	18.4
55-59	36,104	13.1	31,782	13.4	28,030	13.6	25,332	13.8	23,814	13.9
60-64	24,172	8.8	21,005	8.9	18,474	9.0	16,581	9.0	15,503	9.0
65-69	15,793	5.7	13,504	5.7	11,715	5.7	10,436	5.7	9,698	5.6
70-74	7,207	2.6	5,918	2.5	5,053	2.5	4,393	2.4	3,914	2.3
75-79	756	0.3	542	0.2	384	0.2	322	0.2	258	0.2
> 79	125	0.05	66	0.03	34	0.02	28	0.02	22	0.01
Data N.A.	12,043	4.4	10,405	4.4	9,876	4.8	9,210	5.0	8,557	5.0
Total	275,401	100.0	236,899	100.0	206,067	100.0	183,935	100.0	171,717	100.0

TABLE 3
DEMOGRAPHIC PROFILE OF THE BCDDP
POPULATION ORGANIZED BY ATTENDANCE PATTERNS*

Demographic Profile	Attendance Patterns (Number of Annual Screenings Completed)				
	1 or 2	3 or 4	5	Total	
	Percent	Percent	Percent	Number	Percent
Age at Entry					
< 50	26.3	23.5	50.2	134,129	100.0
≥ 50	22.2	22.2	55.6	134,012	100.0
Race					
White, Non-Hispanic	23.9	23.1	53.0	240,351	100.0
White, Hispanic	27.8	24.0	48.2	7,702	100.0
Black	32.6	24.4	43.1	14,864	100.0
Oriental	17.6	18.5	63.9	8,188	100.0
Education					
< 12 Years	26.5	23.0	50.4	157,255	100.0
≥ 12 Years	22.5	22.7	54.8	117,728	100.0
Household Income (1973–1975)					
< $15,000	25.9	23.4	50.7	132,348	100.0
≥ $15,000	22.2	22.5	55.2	129,462	100.0
Marital Status at Entry					
Married	23.4	22.8	53.8	219,205	100.0
Not Married	28.5	23.9	47.6	54,885	100.0

*Data available on attendance patterns differ slightly from data available on annual screenings. Data-not-available categories are omitted.

TABLE 4
RACIAL DISTRIBUTION OF THE BCDDP POPULATION

Race	Annual Screening									
	1		2		3		4		5	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
White, Non-Hispanic	235,648	85.6	203,486	85.9	176,973	85.9	157,521	85.6	146,470	85.3
White, Hispanic	7,555	2.7	6,210	2.6	5,352	2.6	4,694	2.6	4,396	2.6
Black, Non-Hispanic	13,977	5.1	11,264	4.8	9,106	4.4	7,783	4.2	7,490	4.4
Black, Hispanic	618	0.2	529	0.2	436	0.2	381	0.2	355	0.2
American Indian-Eskimo	491	0.2	363	0.2	292	0.2	252	0.1	274	0.2
Japanese	5,179	1.9	4,754	2.0	4,339	2.1	4,149	2.3	4,050	2.4
Chinese	2,097	0.8	1,817	0.8	1,589	0.8	1,510	0.8	1,471	0.9
Other Oriental	320	0.1	259	0.1	211	0.1	190	0.1	192	0.1
Other	2,746	1.0	2,240	0.9	1,923	0.9	1,761	1.0	1,655	1.0
Uncertain/No Response	6,770	2.5	5,977	2.5	5,846	2.8	5,694	3.1	5,364	3.1
Total*	275,401	100.0	236,899	100.0	206,067	100.0	183,935	100.0	171,717	100.0

*Information on race is taken from the Initial Patient History Records and totals are based on the number of Final Screening Recommendation Forms on file at the DMC as of May 1981.

TABLE 5
DEMOGRAPHIC DISTRIBUTION OF THE BCDDP POPULATION*

Demographic Distribution	Number of Participants	Percent
Household Income (1973–1975)		
< $5,000	23,322	8.4
$5,000–$10,000	43,845	15.9
$10,000–$15,000	65,360	23.6
$15,000–$30,000	98,791	35.7
$30,000–$100,000	29,967	10.8
≥ $100,000	860	0.3
Uncertain/No Response	14,448	5.2
Total	276,593	100.0
Education		
1–8 Years School	15,535	5.6
9–12 Years School	142,755	51.6
1–3 Years College	64,087	23.2
4 Years College	30,616	11.1
5+ Years College	21,998	8.0
Uncertain/No Response	1,602	0.6
Total	276,593	100.0
Marital Status		
Married	219,624	79.4
Single	11,617	4.2
Divorced	15,990	5.8
Separated	3,618	1.3
Widowed	23,778	8.6
No Response	1,966	0.7
Total	276,593	100.0

*These figures are based on Initial Patient History Records.

TABLE 6
RELEVANT MEDICAL HISTORY OF THE BCDDP POPULATION PRIOR TO SCREENING*

Medical History	Response	Percent
Number of Breast Examinations by a Physician	None	3.2
	One	3.5
	Two	3.9
	Three or More	85.8
	Uncertain/No Response	3.6
Number of Mammograms	None	80.5
	One	12.4
	Two	3.1
	Three or More	3.5
	Uncertain/No Response	0.6
Breast Mass at Entry	No	91.4
	Yes	5.6
	Uncertain/No Response	3.0
Number of Breast Surgeries	None	82.0
	One	12.9
	Two or More	4.7
	Uncertain/No Response	0.4
Previous History of Breast Cancer**	None	98.7
	Once	1.1
	Twice or More	0.2
	Uncertain/No Response	0.01
Previous History of Cancer***	None	91.7
	Once or More	6.5
	Uncertain/No Response	1.7
Number of Relatives with History of Breast Cancer (Includes Grandmothers, Mothers, Sisters, Half Sisters, Daughters, or Aunts)	None	74.2
	One	17.6
	Two	3.8
	Three or More	2.4
	Uncertain/No Response	2.1
Breast Self-Examination	No	18.3
	Yes, Few Times	44.6
	Yes, Regularly	35.9
	Uncertain/No Response	1.3

*These figures are based on a 10 percent sample of Initial Patient History Records.

**These figures are based on the number of breast surgeries where a cancer was found.

***Includes breast cancer.

(5.3 percent) or Oriental (3.0 percent).* Race was specified as "other" for 1.0 percent, while for 0.7 percent, race was recorded as uncertain, and 1.7 percent did not answer the question. A more detailed breakdown of participation by race is included in Table 4. The numbers of women in many of these groups are very small compared with the size of the non-Hispanic white population.

The data on attendance patterns by race (Table 3) show that a higher percentage of black women dropped out of the program after only one or two annual screenings (32.6 percent) than women of any other racial group. Oriental women had the largest percentage of attendance at all five annual exams (63.9 percent). The attendance patterns of non-Hispanic white and Hispanic white women were similar, although a slightly higher percentage of Hispanic whites dropped out after only one or two exams, and a greater percentage of non-Hispanic whites attended all five annual screenings.

Regardless of age, more than half the women who entered the program attended all five screenings.

Income

Data on the household income of BCDDP participants were collected from 1973 to 1975, when the median household income in the United States was approximately $11,000.** The BCDDP population was almost evenly distributed between women with household incomes less than $15,000 per year (47.9 percent) and women with household incomes $15,000 or more (46.8 percent), and more than one third of the women (35.7 percent) came from households that earned $15,000 to $30,000 per year (Table 5).

When attendance patterns are looked at by household income (Table 3), a greater percentage of women whose incomes were less than $15,000 dropped out after only one or two screenings, while a greater percentage of women with household incomes above $15,000 attended all five annual exams.

Education

Data available on the education of participants are presented in Table 5. More than 40 percent of the women attended college, and all but 5.6 percent attended high school. As might be expected, there is a slight trend toward increased attendance among women with more education.

Marital Status

The great majority of the BCDDP population were married at the time of entry into the program. Divorced, separated, and widowed women totaled 15.7 percent of the population, while 4.2 percent said they were single (Table 5).

Data available for the population based on attendance patterns showed a slight trend toward increased attendance by married women (Table 3).

Medical History Prior to Screening

Although the program was designed to screen asymptomatic women, the protocol detailed no strict selection criteria for participation. Women who were concerned about breast cancer, or who were at high risk for breast cancer, were encouraged to participate.

An indication of the degree of self-selection of BCDDP participants can be obtained from the Initial Patient History Records, which contain questions about the

*Information on race is taken from the Initial Patient History Records, and percentages are based on the number of women completing the first annual screening.

**This figure is based on the 1974 U.S. median household income from: Money income in 1977 of households in the United States, in *Current Population Reports*, series P-60, No 117. US Dept of Commerce, Bureau of the Census, 1978.

medical history of participants prior to joining the program. A 10 percent sample (26,923) of these records was analyzed, and a brief summary is given in Table 6.

In 93.2 percent of the sample, BCDDP participants indicated that they had received one or more breast examinations by a physician. Of the women sampled, 80.5 percent reported that they had never received a mammogram, and only 6.6 percent had received a mammogram more than once. The BCDDP appeared to be an appropriate population in which to introduce and demonstrate annual screening with mammography.

In terms of pre-existing breast disease, 5.6 percent of the women sampled reported an awareness of a breast lump at entry, and 17.6 percent indicated previous breast surgery. Of the sample, 6.5 percent reported having some form of cancer prior to entry, and 1.1 percent of the sample gave a history of previous breast cancer. Family history of breast cancer was reported in 17.6 percent of the sample. Family history was defined in the Initial Patient History Record as breast cancer occurring in "grandmothers, mothers, sisters, half sisters, daughters, or aunts;" however, the Record did not always indicate the specific relationship.

The teaching of BSE was an important part of the BCDDP. The Initial Patient History Record also documented whether women had practiced BSE prior to participation in the program. The results indicated that 80.5 percent of the women sampled had practiced BSE prior to entry; 35.9 percent of the sample practiced BSE on a regular basis. This figure is consistent with the findings of a Gallup poll published in 1977,* in which 35 percent of American women reported performing BSE on a monthly basis.

Longer duration prevalent cancers seemed to be mainly detected in a screened population after age 45.

Cancer Detection in the BCDDP

A final total of 4,443** breast cancers was recorded by the DMC as of September 1981. Of these, 3,557 cancers were detected by the BCDDP centers following 1,074,019 annual screening observations, and 886 cancers were detected outside the project.

Cancers have been classified as "project-detected" if they were detected as a result of compliance with a surgical recommendation made during an annual screening or early recall exam (3,293 cancers), or if a cancer was detected when a woman who had been asked to come in for an early recall exam*** due to an abnormal modality finding chose to see a surgeon before the scheduled exam (264 cancers).

Cancers detected outside the project have been classified into two groups: those detected within one year after an annual screening at which no surgical recommendation was made (744 interval cancers); and those detected during the program more than a year after a woman's last annual exam (142 postscreening cancers).

*From: *A Survey Concerning: Cigarette Smoking, Health Checkups, and Cancer Detection Tests* conducted for the American Cancer Society in January 1977 by the Gallup Organization Inc, Princeton, NJ.

**Since initial BCDDP screening recommendation forms did not specify breast side, this analysis selected the "worst case" for disease detected in both breasts following the same examination (i.e., breast cancer was selected over benign disease). If a woman had cancer detected in both breasts following the same annual exam, only the more invasive carcinoma was selected. Synchronous bilateral breast cancer occurred within the same year in 149 women, or 3.4 percent of all cases. If a cancer was found in the same woman at two different annual screening examinations, the finding was recorded as two separate cancers. Successive bilateral breast cancer occurred following different annual screenings in 58 women or 1.4 percent of all women with unilateral disease.

***Early recall was defined as a scheduled follow-up mammogram and/or physical examination within six months of an annual screening exam at which an abnormal modality finding was noted.

All BCDDP cancers have been categorized into four types of lesions: noninfiltrating; infiltrating, less than one cm; infiltrating, equal to or greater than one cm; and size unspecified. To simplify the presentation of data, lesions that were reported as noninfiltrating or infiltrating less than one cm will be referred to as "minimal" cancers.

Within the BCDDP, recommendation for surgery did not always specify a particular surgical procedure. The recommendation may have been for a surgical consultation, for an aspiration, or for a biopsy. Thus the surgical recommendation rates derived from this program are nonspecific and tend to be higher than the rates for a given surgical procedure.

The lower proportion of positive nodes in the BCDDP is due in part to earlier detection of breast cancer as a result of periodic screening with mammography and physical examination.

The nonspecific surgical recommendation rate for all women regardless of race or age in the first year of screening is almost twice that for years two through five (Table 7). This is probably due to the presence of breast disease of long duration or prevalent breast disease in the population prior to the first year of screening.

It is interesting that the surgical recommendation rate for women 50 years of age and older at entry during year one of the program (60.1 surgeries recommended per 1,000 annual screenings) is higher than that for women younger than 50 at entry (52.7 surgeries recommended per 1,000 annual screenings). It is possible that this difference reflects the higher prevalence of cancer in the older age group.

After the first annual screening, the surgical recommendation rates for women 50 years of age and older at entry remain lower than those for women under 50 years of age at entry. This is most likely due to the increased prevalence of fibrocystic disease in the younger age group, and the consequent increase in the number of recommendations for aspiration. The surgical recommendation rates are not directly comparable to the biopsy rates and/or cancer detection rates, since they include recommendations for biopsy, aspiration, or surgical consultation and do not include recommendations for early recall.

Figure 1 and Table 8 compare the biopsy rates,* cancer detection rates, minimal cancer detection rates, and the interval cancer rates for years one through five of the program. The cancer detection rates for year one are much higher than for years two through five and reflect the difference between prevalent and incident cancer rates. The cancer detection rates are relatively stable in years two, three, and four, and drop off slightly in year five. Both the cancer detection rates and minimal cancer detection rates closely parallel the biopsy rates in years one, two, and three, but the biopsy rates decrease disproportionately in years four and five.

The decline in the minimal cancer detection rates appears slightly greater than the decline in the overall cancer detection rates. This decline in the minimal rates is due to a substantial decrease in the rates for the under 50 age group (see age-specific rates in Table 12). This is the age group that had restricted access to mammography during the last 2½ years of screening.

The interval cancer rates in Figure 1 and Table 8 are depicted at midyear, since these cancers occurred between annual screenings. A fifth-year rate was not determined for interval cancers, since there was no mandate to continue collecting data on interval cancers after the fifth year of the screening program. An initial sample of 20,000 "normal"** BCDDP screenees

*Includes biopsies that were performed following a surgical recommendation made at an annual or early recall screening, and those that were performed when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding.

**"Normal" participants refers to women who did not have a recommendation for a biopsy.

TABLE 7
SURGICAL RECOMMENDATION RATES
FOR WOMEN < 50 AND ≥ 50*

Year	Surgeries Recommended			
	Age at Entry < 50		Age at Entry ≥ 50	
	Number	Rate**	Number	Rate**
1	6,944	52.7	7,907	60.1
2	3,898	34.9	3,419	29.8
3	3,118	32.7	2,513	24.9
4	2,875	34.2	2,184	24.1
5	2,661	34.0	1,859	21.9

*These rates are not directly comparable to the cancer detection rates and biopsy rates, since they include recommendations for biopsy, aspiration, or surgical consultation, and they do not include recommendations for early recall examination.

**Rates are per 1,000 annual screenings.

matched to biopsied participants that were surveyed after the completion of the program turned up no unknown cases of interval or postscreening cancers that occurred during the screening program prior to year five. Thus, despite the absence of an intensive follow-up of participants who missed an annual screening during the program, data collected for the "Long-term Follow-up of BCDDP Participants" indicate that the BCDDP centers were informed about the vast majority of the cancers detected outside the project, and that these data are included in the BCDDP data base. It is notable that the interval cancers occurred at approximately the same rate throughout the program. This is a finding that deserves further analysis.

Age- and Race-Specific Cancer Detection Rates

Tables 9 through 13 and Figure 2 are restricted to data for women aged 35 to 74 at entry. Table 9 shows the age-specific cancer detection rates of this cohort for years one through five and for all years combined. There is a marked increase in the prevalent, or first-year, cancers detected by the BCDDP with increasing age, ranging from 1.0 cancers detected per 1,000 annual screenings in women aged 35 to 39, to a rate of 12.9 cancers detected per 1,000 annual screenings in women aged 70 to 74. There is a less dramatic rate increase with age among the incident cancers in years two through five, and within

TABLE 8
COMPARISON OF CRUDE CANCER DETECTION RATES, BIOPSY PERFORMANCE RATES, MINIMAL CANCER DETECTION RATES, AND INTERVAL CANCER RATES FOR YEARS ONE TO FIVE

Rates*	Year 1	1.5	2	2.5	3	3.5	4	4.5	5
Biopsy Performance Rates	358.1		187.6		173.4		145.9		117.8
Cancer Detection Rates	55.8		26.5		25.2		25.4		23.6
Minimal Cancer Detection Rates**	18.4		8.5		8.6		8.0		7.0
Interval Cancer Rates***		8.0		7.7		8.0		7.5	

*Rates are per 10,000 annual screenings.

**Minimal cancers are defined as noninfiltrating cancers, or infiltrating cancers, less than one cm in diameter.

*** Includes those cancers detected outside the Project within one year after an annual screening.

each age group the rates remain remarkably constant over this time period.

Although there is an increase in first-year cancer detection rates with increasing age, there is very little difference between the prevalent and incident cancer detection rates among women in the 35-to-44 age group at entry. This implies that longer duration prevalent cancers are mainly detected in a screened population after age 45.

Table 10 presents age-adjusted cancer detection rates by race for women aged 35 to 74. Since the majority of the BCDDP participants were non-Hispanic whites, and the number of cancers detected in women of other ethnic categories was relatively small, information about cancer detection in these groups may be difficult to interpret. Although the numbers are relatively small, the cancer detection rates in

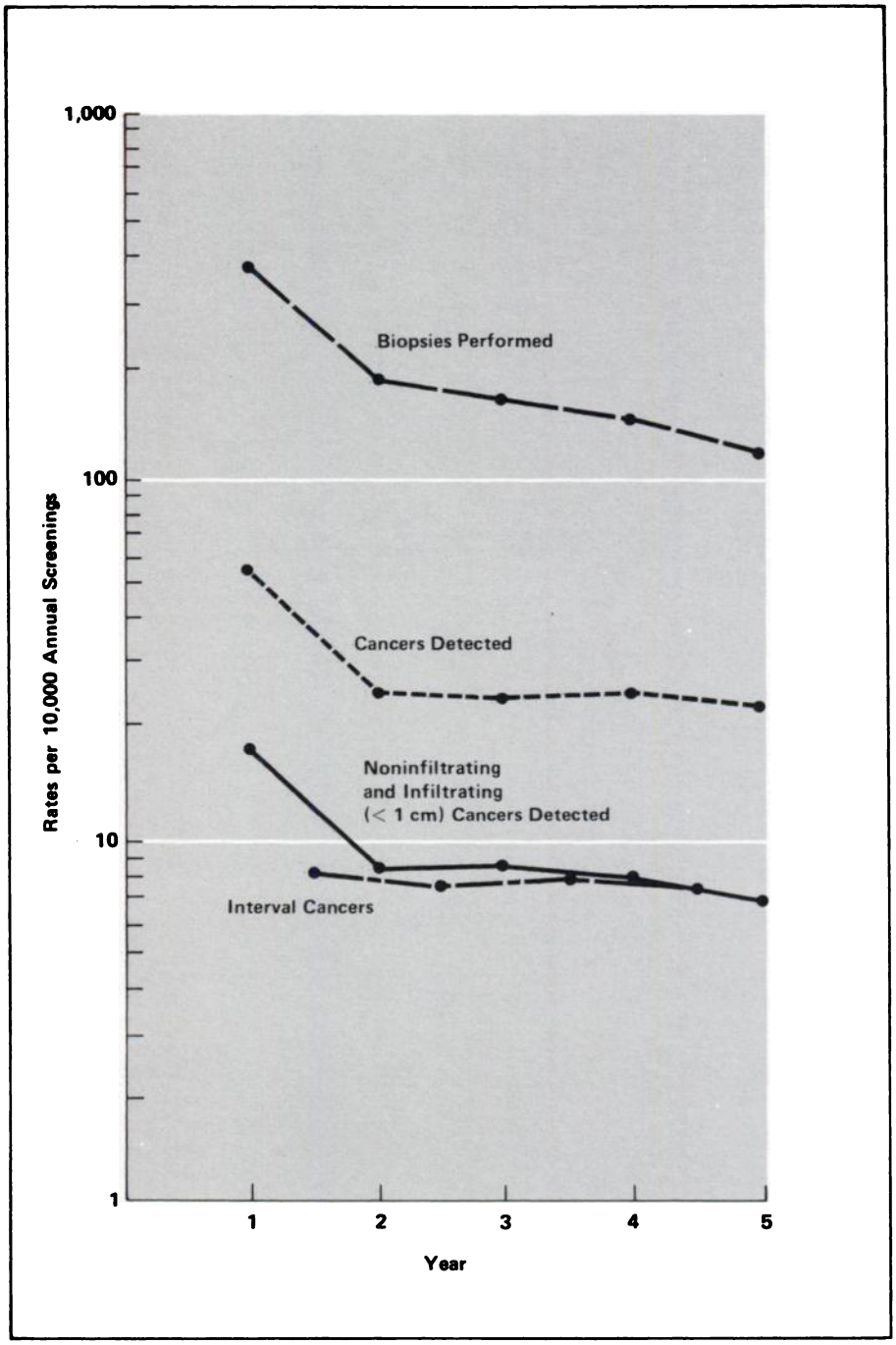

Fig. 1. Comparison of crude cancer detection rates, biopsy performance rates, minimal cancer detection rates, and interval cancer rates for years one to five.

TABLE 9
AGE-SPECIFIC CANCER DETECTION RATES* (YEARS ONE TO FIVE).

Age at Entry	Breast Cancers Detected per 1,000 Annual Screenings											
	Year 1		Year 2		Year 3		Year 4		Year 5		All Years Combined	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
35–39	38	1.0	25	0.8	23	0.9	21	1.0	16	0.8	123	0.9
40–44	106	2.4	82	2.1	58	1.8	46	1.6	53	2.0	345	2.0
45–49	247	5.1	115	2.7	99	2.7	93	2.8	65	2.1	619	3.2
50–54	313	6.6	127	3.0	102	2.7	91	2.7	75	2.4	708	3.7
55–59	284	7.9	115	3.6	91	3.2	88	3.5	77	3.2	655	4.5
60–64	228	9.4	78	3.7	66	3.6	59	3.6	59	3.8	490	5.1
65–69	151	9.6	56	4.1	44	3.8	39	3.7	40	4.1	330	5.4
70–74	93	12.9	20	3.4	23	4.6	22	5.0	17	4.3	175	6.6

*These figures are based on Project-detected cancers, which include those cancers detected for which a surgical recommendation was made at an annual or early recall screening, and those detected when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding.

VOL. 32, NO. 4 JULY/AUGUST 1982

TABLE 10
RACE-SPECIFIC CANCER DETECTION RATES (YEARS ONE TO FIVE)

Race	Breast Cancers Detected per 1,000 Annual Screenings*									
	Year 1		Year 2		Year 3		Year 4		Year 5	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
White, Non-Hispanic	1,294	5.4	547	2.8	452	2.6	421	2.7	361	2.5
White, Hispanic	28	4.2	13	2.3	9	1.8	8	1.8	6	1.5
Black, Non-Hispanic	71	5.9	31	2.9	19	2.2	10	1.4	18	2.6
Black, Hispanic	4	6.4	0	0.0	1	3.2	0	0.0	0	0.0
American Indian-Eskimo	4	9.1	2	5.6	1	5.7	0	0.0	1	3.6
Japanese	26	4.9	14	3.1	14	3.0	8	1.7	4	0.9
Chinese	9	4.7	6	3.1	3	2.1	5	3.8	2	1.4
Other Oriental	2	6.7	1	2.7	1	3.6	2	10.8	2	8.1
Other	13	5.1	3	1.4	5	2.8	3	1.9	7	4.2
Uncertain	9	44.3	1	23.5	1	28.5	2	62.9	1	20.0

*These rates have been age-adjusted and standardized on the total BCDDP population. They are based on the age-specific rates for ages 35–74 only.

TABLE 11
AGE-SPECIFIC NONMALIGNANT TO MALIGNANT BIOPSY RATIOS*

Age at Entry	Nonmalignant to Malignant Biopsy Ratio
35-39	16.4
40-44	9.5
45-49	6.5
50-54	5.2
55-59	3.8
60-64	3.4
65-69	3.2
70-74	2.7
Total	5.4

*Includes biopsies performed for which a surgical recommendation was made at an annual or early recall screening, and those performed when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding.

Orientals, a characteristically low-risk population, are similar to the rates for non-Hispanic whites. This may reflect a unique group of Oriental screenees self-selected into the screening program.

Biopsies Performed

Age is an important factor in examining biopsy rates, since younger women have a higher incidence of benign breast disease, while older women have an increasingly higher incidence of breast cancer. This trend is clearly demonstrated in Figure 2. The nonmalignant biopsy rates are higher in younger women, tending to level with increasing age. These higher biopsy rates in younger women, especially those in the 40-to-49 age groups, probably reflect the high incidence of fibrocystic disease in women of this age.

Since cancer detection rates increase with age, there is greater disparity in the nonmalignant to malignant biopsy ratio in younger women than in older women (Table 11). In the 35-to-39 age group, the ratio of nonmalignant to malignant biopsy results is 16.4 to 1. The ratio falls to 2.7 to

1 in the 70-to-74 age group, reflecting the increasing incidence of cancer in older women.

Detection of Minimal Cancers

Minimal cancers, which have been defined as noninfiltrating and infiltrating (less than one cm), constitute 32.4 percent of all cancers detected in the BCDDP. Table 12 shows the age-specific minimal cancer detection rates for years one through five and for all years combined. There is a definite increase in the rate of minimal cancers detected with increasing age for prevalent, or year-one cancers, similar to that of the overall cancer detection rates shown in Table 9. The minimal cancer detection rates over the next four years also increase with age. More striking is the decrease in the minimal cancer detection rates in younger women during years four and five. This may be a result of the change in mammography guidelines, instituted in the BCDDP in 1977, that excluded many women who had not yet reached 50 years of age from routine screening with mammography.

Of the 4,443 cancers recorded in the BCDDP population, more than 80 percent were detected by the 29 centers.

Interval Cancers

The interval cancer data include only those cancers diagnosed outside the project within one year after screening. As can be seen in Table 8, the crude interval cancer rates remain relatively stable over the four-year period analyzed, from midpoint in the first year of screening through midpoint in the fourth year of screening (8.0, 7.7, 8.0, and 7.5 interval cancers detected per 10,000 annual screenings).

The age-specific interval cancer rates shown in Table 13 also tend to be relatively stable over the four years. In contrast to the cancer detection rates (Table 9), the interval cancer rates do not increase markedly with age. Although there is an initial increase from ages 35 to 45, the rates among postmenopausal age groups remain remarkably flat.

How Cancer Was Detected in the BCDDP

The Screening Modalities

At the outset of the program, the combined modalities of medical history, physical examination, mammography, and thermography were used to screen participants. Two policy changes in the BCDDP occurred in 1977 that affected the data from the third to the fifth annual screening. Thermography was dropped as a screening modality, and restrictions were placed on the utilization of mammography for women younger than 50 years of age at the time of examination. While all women 50 years and older were still candidates for routine screening with mammography, only women under 50 years of age who were at high risk of breast cancer were eligible.*

The absence of these two screening modalities made the program less attractive to women under 50 years of age, since now only BSE training and physical examination were routinely available to them. Concern about radiation exposure further decreased the number of eligible women electing mammography for screening. Since, after the guidelines changed, most mammography in women under 50 years of age was performed on the basis of an abnormal physical exam, the dependence between modalities increased, and opportunity for diagnosis by mammography alone was reduced.

*High-risk women, less than 50 years of age at the time of examination, were defined as follows: 1) Women aged 35 to 39 were considered to be at high risk if they had a personal history of breast cancer or an abnormal physical exam; 2) Women aged 40 to 49 were considered to be at high risk if they had an abnormal physical finding, had a personal history of breast cancer, or had a mother or sister who had a history of breast cancer.

TABLE 12
AGE-SPECIFIC MINIMAL CANCER DETECTION RATES (YEARS ONE TO FIVE)

Age at Entry	Minimal Breast Cancers Detected per 10,000 Annual Screenings*											
	Year 1		Year 2		Year 3		Year 4		Year 5		All Years Combined	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
35–39	12	3.3	6	2.0	10	4.0	6	2.8	4	2.0	38	2.8
40–44	43	9.6	25	6.5	21	6.5	8	2.8	13	4.9	110	6.5
45–49	82	16.8	40	9.5	39	10.6	33	9.9	18	5.8	212	11.0
50–54	123	25.9	33	7.9	34	9.1	26	7.7	22	7.0	238	12.4
55–59	81	22.4	39	12.3	27	9.6	30	11.8	28	11.8	205	14.1
60–64	62	25.7	28	13.3	25	13.5	19	11.5	20	12.9	154	16.1
65–69	49	31.0	18	13.3	8	6.8	15	14.4	11	11.3	101	16.5
70–74	31	43.0	7	11.8	5	9.9	7	15.9	4	10.2	54	20.4

*Includes those minimal cancers detected for which a surgical recommendation was made at an annual or early recall screening, and those detected when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding.

VOL. 32, NO. 4 JULY/AUGUST 1982

TABLE 13
AGE-SPECIFIC INTERVAL CANCER RATES (YEARS ONE TO FIVE)*

Age at Entry	Interval Breast Cancers per 10,000 Annual Screenings*									
	Year 1.5		Year 2.5		Year 3.5		Year 4.5		All Years Combined	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
35-39	18	4.9	18	5.9	12	4.8	12	5.5	60	5.3
40-44	24	5.4	28	7.3	28	8.6	25	8.8	105	7.3
45-49	40	8.2	36	8.5	29	7.9	28	8.4	133	8.3
50-54	47	9.9	35	8.4	33	8.9	31	9.2	146	9.1
55-59	31	8.6	34	10.7	22	7.8	19	7.5	106	8.7
60-64	28	11.6	19	9.0	23	12.4	11	6.6	81	10.1
65-69	16	10.1	7	5.2	13	11.1	8	7.7	44	8.6
70-74	6	8.3	4	6.8	4	7.9	1	2.3	15	6.6

*Includes those cancers detected outside the Project within one year after an annual screening.

The distribution of suspicious modality findings for the BCDDP is presented in Table 14 and is compared with the results of the Health Insurance Plan (HIP) of Greater New York Screening Program, a clinical trial conducted in the 1960s. The purpose of the HIP study was to determine whether periodic screening played a significant role in reducing mortality from breast cancer. As demonstration projects, the 29 BCDDP centers were not designed to address research issues on the effectiveness of screening to reduce mortality. However, the program did stimulate considerable interest about the contribution of mammography in the detection of early-stage breast cancer.

A high proportion of cancers detected within the BCDDP are localized, and according to tumor registry data, these patients should have an excellent prognosis.

The HIP study maintained strict independence of observations between mammography and physical examination.* In the BCDDP, the degree of independence of observations at both the examination and reporting stages varied between the 29 centers. Independence of modalities was decreased when a mammogram was performed solely on the basis of an abnormal physical finding in women under 50, or when a screenee was recalled to a center for follow-up of an abnormal finding on the physical exam or mammogram. As a result of this dependence between modalities in the BCDDP, the percentage of cancers detected by mammography alone, or physical exam alone, tends to be reduced, while the percentage detected by both modalities is inflated. Despite this fact, mammography alone was responsible for the biopsy recommendation in 41.6 percent (1,481 of 3,557) of the cancers detected in the BCDDP, compared with 33.3 percent in the HIP study.

The HIP study demonstrated significantly reduced mortality from breast cancer in screened women aged 50 to 59,** where mammography alone was responsible for the biopsy recommendation in 41.5 percent of the cancers detected. Among this age group in the BCDDP, 42.1 percent of the cancers were detected by mammography alone (Table 14). In the HIP study, mammography was positive (whether or not physical examination was positive) in 60.0 percent of all cancers detected in the 50-to-59 age group. In contrast, mammography was positive in 91.8 percent of the BCDDP cancers detected in the same age group. Physical exam alone was responsible for the biopsy recommendation in 40.0 percent of the HIP cancers and in only 6.7 percent of the BCDDP cancers for women in the 50-to-59 age group.

Among the 40-to-49 age group, the HIP study detected low numbers of cancers, and mammography alone was responsible for the biopsy recommendation in only 19.4 percent (6 of 31). In the BCDDP, larger numbers of cancers were detected in this age group, and mammography alone was responsible for 35.4 percent (270 of 762) of cancers detected. Mammography was positive (whether or not physical examination was positive) in only 38.8 percent of the cancers detected in women aged 40 to 49 in the HIP study; the same was true for 85.4 percent of the cancers detected among this age group in the BCDDP. Physical exam alone accounted for the biopsy recommendation in 61.3 percent of the HIP cancers and in 13.1 percent of the BCDDP cancers in women aged 40 to 49.

It is apparent from these data that mammography played a significantly greater role in the diagnosis of breast cancer in the BCDDP than in the HIP study among both

*Shapiro S, Strax P, Venet L: Periodic breast cancer screening, in *Presymptomatic Detection and Early Diagnosis*. London, Pitman Medical Publishing Co Limited, 1968, pp 203–236.

**Shapiro S: Evidence on screening for breast cancer from a randomized trial. *Cancer* 39 (suppl):2772–2782, 1977.

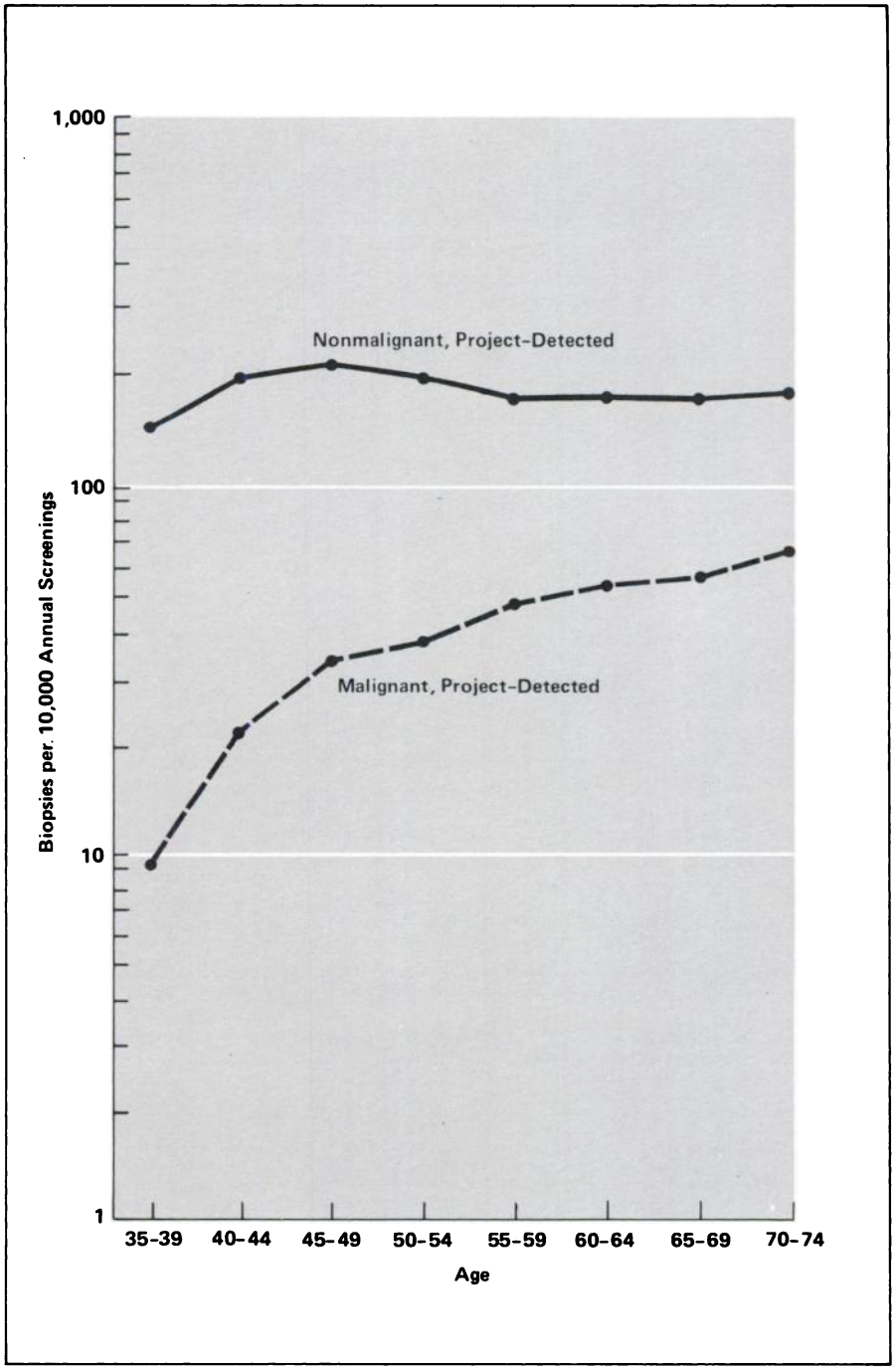

Fig. 2. Age-specific nonmalignant and malignant biopsy rates for years one to five.

TABLE 14
BREAST CANCERS DETECTED DURING THE FIVE-YEAR BREAST CANCER DETECTION DEMONSTRATION PROJECT COMPARED WITH THE FOUR-YEAR HEALTH INSURANCE PLAN OF GREATER NEW YORK SCREENING PROGRAM

Suspicious Modality*	BCDDP**				HIP***			
	Ages 40–49 at Surgery		Ages 50–59 at Surgery		Ages 40–49 at Surgery		Ages 50–59 at Surgery	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Mammography Only	270	35.4	540	42.1	6	19.4	27	41.5
Mammography & Physical Examination	381	50.0	638	49.7	6	19.4	12	18.5
Physical Examination Only	100	13.1	86	6.7	19	61.3	26	40.0
Unknown	11	1.4	19	1.5	0	0.0	0	0.0
Total	762†	100.0	1,283††	100.0	31	100.0	65	100.0

*Includes modalities that have findings with one or more features interpreted as suspicious of malignant or benign breast disease.

**BCDDP cancers shown in this table include only those cancers detected following a surgical recommendation made at an annual or early recall screening.

***From: Shapiro S: Evidence on screening for breast cancer from a randomized trial. *Cancer* 39 (suppl): 2772–2782, 1977.

†Includes 30 breast cancer cases in which a mammogram was not performed for any reason, such as exam refused, exam not recommended for a woman under 50 years of age, or exam technically not satisfactory. Exclusion of these cases changes the distribution of suspicious modalities to: Mammography Only, 36.9 percent; Mammography and Physical Exam, 52.0 percent; Physical Exam Only, 9.6 percent; and Unknown, 1.5 percent.

††Includes 17 breast cancer cases in which a mammogram was not performed for any reason, such as exam refused or exam technically not satisfactory. Exclusion of these cases changes the distribution of suspicious modalities to: Mammography Only, 42.7 percent; Mammography and Physical Exam, 50.4 percent; Physical Exam Only, 5.5 percent; and Unknown, 1.5 percent.

TABLE 15
BREAST CANCERS STRATIFIED BY LESION SIZE AND MODALITY FINDINGS

Suspicious Modality*	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥ 1 cm		Breast Cancer Size Not Specified**		Total Number of Breast Cancers***	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Mammography Only	461	59.0	195	52.6	631	33.7	194	36.4	1,481	41.6
Mammography & Physical Examination	258	33.0	135	36.4	1,038	55.5	252	47.3	1,683	47.3
Physical Examination Only	43	5.5	31	8.4	161	8.6	73	13.7	308	8.7
Unknown	20	2.6	10	2.7	41	2.2	14	2.6	85	2.4
Total	782	100.0	371	100.0	1,871	100.0	533	100.0	3,557	100.0

*Includes modalities that have findings with one or more features interpreted as suspicious of malignant or benign breast disease.

**Breast cancer size not specified includes cancers for which the Hospital Pathology Report did not give the specific lesion size and/or for which a project pathologist did not carry out a slide review.

***Includes cancers detected following a surgical recommendation at an annual or early recall screening, or when a woman saw a surgeon prior to a scheduled early recall screening.

TABLE 16
BREAST CANCERS STRATIFIED BY LESION SIZE AND NODAL STATUS AT SURGERY

Nodal Status at Surgery	Lesion Size									
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥ 1 cm		Breast Cancer Size Not Specified		Total Number of Breast Cancers*	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive**	15	1.9	53	14.3	547	29.2	84	15.8	699	19.7
Negative**	422	54.0	268	72.2	1,183	63.2	193	36.2	2,066	58.1
No Nodes Examined***	319	40.8	50	13.5	141	7.5	66	12.4	576	16.2
Data Not Available	26	3.3	0	0.0	0	0.0	190	35.6	216	6.1
Total	782	100.0	371	100.0	1,871	100.0	533	100.0	3,557	100.0

*Includes cancers detected following a surgical recommendation made at an annual or early recall screening, or when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding.

**Positive and negative nodes have been confirmed by histologic examination.

***Includes cases where nodal dissection was not carried out.

TABLE 17
INTERVAL BREAST CANCERS STRATIFIED BY LESION SIZE AND NODAL STATUS AT SURGERY

Nodal Status at Surgery	Lesion Size									
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥ 1 cm		Breast Cancer Size Not Specified		Total Number of Breast Cancers*	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive**	1	1.2	19	21.6	139	31.5	21	16.2	180	24.2
Negative**	45	52.9	58	65.9	261	59.2	31	23.8	395	53.1
No Nodes Examined***	35	41.2	11	12.5	41	9.3	23	17.7	110	14.8
Data Not Available	4	4.7	0	0.0	0	0.0	55	42.3	59	7.9
Total	85	100.0	88	100.0	441	100.0	130	100.0	744	100.0

*Includes those cancers detected outside the Project within one year after an annual screening for all age categories, years one through five.

**Positive and negative nodes have been confirmed by histologic examination.

***Includes cases where nodal dissection was not carried out.

TABLE 18
DETECTED BREAST CANCERS CATEGORIZED
BY MODALITY, LESION SIZE, AND NODAL STATUS AT SURGERY*

Suspicious Modality: Mammography Only

Nodal Status at Surgery	Lesion Size							
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers < 1 cm		Infiltrating Breast Cancers ≥ 1 cm		Breast Cancer Size Not Specified	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive	6	1.3	15	7.7	148	23.5	22	11.3
Negative	270	58.6	155	79.5	437	69.3	87	44.8
No Nodes Examined**	172	37.3	25	12.8	46	7.3	24	12.4
Data Not Available	13	2.8	0	0.0	0	0.0	61	31.4
Total	461	100.0	195	100.0	631	100.0	194	100.0

Suspicious Modality: Mammography and Physical Exam								
Nodal Status at Surgery	Lesion Size							
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥ 1 cm		Breast Cancer Size Not Specified	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive	6	2.3	33	24.4	354	34.1	50	19.8
Negative	125	48.4	86	63.7	615	59.2	87	34.5
No Nodes Examined**	115	44.6	16	11.9	69	6.6	30	11.9
Data Not Available	12	4.7	0	0.0	0	0.0	85	33.7
Total	258	100.0	135	100.0	1,038	100.0	252	100.0

*Includes cancers detected following a surgical recommendation made at an annual or early recall screening, or when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding. Includes modalities that have findings with one or more features interpreted as suspicious of malignant or benign breast disease.

**Includes cases where nodal dissection was not carried out.

TABLE 18 (continued)
DETECTED BREAST CANCERS CATEGORIZED
BY MODALITY, LESION SIZE, AND NODAL STATUS AT SURGERY*

Suspicious Modality: Physical Exam Only

Nodal Status at Surgery	Lesion Size							
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥1 cm		Breast Cancer Size Not Specified	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive	1	2.3	4	12.9	40	24.8	10	13.7
Negative	16	37.2	21	67.7	105	65.2	18	24.7
No Nodes Examined**	25	58.1	6	19.4	16	9.9	8	11.0
Data Not Available	1	2.3	0	0.0	0	0.0	37	50.7
Total	43	100.0	31	100.0	161	100.0	73	100.0

Suspicious Modality: Unknown								
Nodal Status at Surgery	Lesion Size							
	Noninfiltrating Breast Cancers		Infiltrating Breast Cancers <1 cm		Infiltrating Breast Cancers ≥1 cm		Breast Cancer Size Not Specified	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Positive	2	10.0	1	10.0	5	12.2	2	14.3
Negative	11	55.0	6	60.0	26	63.4	1	7.1
No Nodes Examined**	7	35.0	3	30.0	10	24.4	4	28.6
Data Not Available	0	0.0	0	0.0	0	0.0	7	50.0
Total	20	100.0	10	100.0	41	100.0	14	100.0

*Includes cancers detected following a surgical recommendation made at an annual or early recall screening, or when a woman saw a surgeon prior to a scheduled early recall screening to follow up an abnormal modality finding. Includes modalities that have findings with one or more features interpreted as suspicious of malignant or benign breast disease.

**Includes cases where nodal dissection was not carried out.

age groups. This is most likely due to technological changes in the quality of mammography between the HIP study of the 1960s and the BCDDP of the 1970s.

Analysis of suspicious modality findings by breast cancer lesion size (Table 15) highlights the importance of mammography in detecting noninfiltrating and infiltrating cancers (<1 cm). Mammography alone was responsible for recommending a biopsy in 59.0 percent (461 of 782) of the noninfiltrating cancers, and it was responsible for the biopsy recommendation in 52.6 percent (195 of 371) of the infiltrating cancers (<1 cm). Due to the greater role of physical exam in diagnosing larger cancers, mammography alone was positive in 33.7 percent of the infiltrating cancers (≥1 cm).

In the 40-to-49 age group, the HIP study detected low numbers of cancers, and mammography alone was responsible for the biopsy recommendation in only 19.4 percent; in the BCDDP, larger numbers of cancers were detected, and mammography alone was responsible for 35.4 percent.

Breast cancers detected by the BCDDP are stratified by lesion size and nodal status at surgery in Table 16. As expected, noninfiltrating breast cancers either did not have findings warranting nodal dissection, or had nodes that were negative on histologic examination. Only 14.3 percent of infiltrating cancers (<1 cm), and 29.2 percent of infiltrating cancers (≥1 cm) had positive nodes.

Overall, less than 20 percent of all cancers detected within the BCDDP had positive nodes at surgery. This is considerably less than reports from outside screening programs where 53 percent of all breast cancer cases have positive nodes.*

Table 17 presents the distribution by lesion size and nodal status at surgery for the interval cancers diagnosed outside the BCDDP. A comparison between this table and Table 16 shows that a higher proportion of interval cancers have positive nodes (24.2 percent), but that this is also substantially lower than might be expected from tumor registry data or other reports outside screening programs. It is interesting that the greatest difference in nodal status is among infiltrating cancers (<1 cm), where 21.6 percent of smaller invasive interval cancers had positive nodes, compared with 14.3 percent of all such cancers detected by the projects. Since interval cancers were diagnosed outside the program within one year of screening, it is suggestive that they are more aggressive tumors, rapidly metastasizing to nodes. A lower percentage of the interval cancers were noninfiltrating, but the distribution of infiltrating cancers by lesion size is similar to cancers detected within the projects.

The lower proportion of positive nodes in the BCDDP is due in part to earlier detection of breast cancer as a result of periodic screening with mammography and physical examination. The nodal status of cancers detected according to suspicious modality findings and lesion size is shown in Table 18. The lowest percentage of positive nodes for all lesion sizes is found in cancers detected by mammography alone. Interestingly, both the physical examination only and mammography only categories have a lower percentage of positive nodes than the cancers detected when mammogram and physical exam are both positive, a finding that deserves further analysis.

Summary

It is apparent that the BCDDP data base is unique because of the amount of information available about screening large numbers of women and about the nature of breast disease detected under screening conditions. Large numbers of women were

*Axtell LM, Asire AJ, Myers MH (eds): *Cancer Patient Survival: Report Number 5*. DHEW Publication No (NIH) 77-992. Bethesda, Md, National Cancer Institute, 1976.

successfully recruited into the screening program through the ACS volunteer network, and these women enthusiastically returned to the program for periodic screening and education over the five-year period. A majority of the participants came to all five annual screenings (51.7 percent). This high compliance to screening signified the importance with which women viewed the program.

Of the 4,443 cancers recorded in the BCDDP population, more than 80 percent were detected by the 29 centers. Approximately one third (32.4 percent) of the 3,557 cancers detected by the centers were smaller cancers, either noninfiltrating or infiltrating cancers (<1 cm). More than 80 percent of all cancers detected showed no evidence of nodal involvement. Although there is no preselected comparison group, it is clear that a high proportion of cancers detected within the BCDDP are localized, and according to tumor registry data, these patients should have an excellent prognosis.*

*Axtell LM, Asire AJ, Myers MH (eds): *Cancer Patient Survival: Report Number 5*. DHEW Publication No (NIH) 77-992. Bethesda, Md, National Cancer Institute, 1976.

Physical examination and mammography both contributed cases not detected by the other, but the contribution of mammography was substantially greater. The relative contribution of mammography alone (in the absence of positive physical findings) was 41.6 percent compared with 8.7 percent for physical examinations (in the absence of positive mammogram findings). This relative contribution of mammography was impressively high in the detection of smaller cancers—59 percent for noninfiltrating cancers and 52.6 percent for infiltrating cancers (<1 cm).

The relative contribution of mammography was also impressively higher than had been shown in previous reports (the HIP study) for breast cancer detection in younger women. When mammography was removed as a routine screening modality for women under 50 years of age, the minimal cancer detection rates in this age group decreased.

The information in this article represents only a part of the BCDDP data base. It is hoped that researchers from a multiplicity of disciplines will be able to use the data base to provide new insights into the detection of breast cancer and the natural history of this disease.