



Breast Cancer Facts & Figures 2009-2010

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What is breast cancer?

Cancer is a group of diseases that cause cells in the body to change and grow out of control. Most types of cancer cells eventually form a lump or mass called a tumor, and are named after the part of the body where the tumor originates.

Breast cancer begins in breast tissue, which is made up of glands for milk production, called lobules, and the ducts that connect lobules to the nipple. The remainder of the breast is made up of fatty, connective, and lymphatic tissue.

- Most masses are benign; that is, they are not cancerous, do not grow uncontrollably or spread, and are not life-threatening.
- Some breast cancers are called in situ because they are confined within the ducts (ductal carcinoma in situ) or lobules (lobular carcinoma in situ) of the breast. Nearly all cancers at this stage can be cured. Many oncologists believe that lobular carcinoma in situ (also known as lobular neoplasia) is not a true cancer, but an indicator of increased risk for developing invasive cancer in either breast.
- Most cancerous breast tumors are invasive, or infiltrating. These cancers start in the lobules or ducts of the breast but have broken through the duct or glandular walls to invade the surrounding tissue of the breast.

The seriousness of invasive breast cancer is strongly influenced by the stage of the disease; that is, the extent or spread of the cancer when it is first diagnosed. There are two main staging systems for cancer. The American Joint Committee on Cancer (AJCC) classification of tumors uses information on tumor size and how far it has spread within the breast and nearby organs (T), lymph node involvement (N), and the presence or absence of distant metastases (spread to distant organs) (M).¹ Once the T, N, and M are determined, a stage of I, II, III, or IV is assigned, with stage I being an early stage and stage IV being the most advanced. The AJCC staging system is commonly used in clinical settings.

A simpler system used for staging of cancers is known as the SEER Summary Stage system and is more commonly used in reporting to cancer registries and for public health research and planning.² According to this system:

- Local-stage tumors are cancers confined to the breast.
- Regional-stage tumors have spread to surrounding tissue or nearby lymph nodes.
- Distant-stage cancers have metastasized (spread) to distant organs.

Who gets breast cancer?

Sex

- Excluding cancers of the skin, breast cancer is the most common cancer among women, accounting for nearly 1 in 4 cancers diagnosed in US women.
- Men are generally at low risk for developing breast cancer; however, they should report any change in their breasts to a physician.

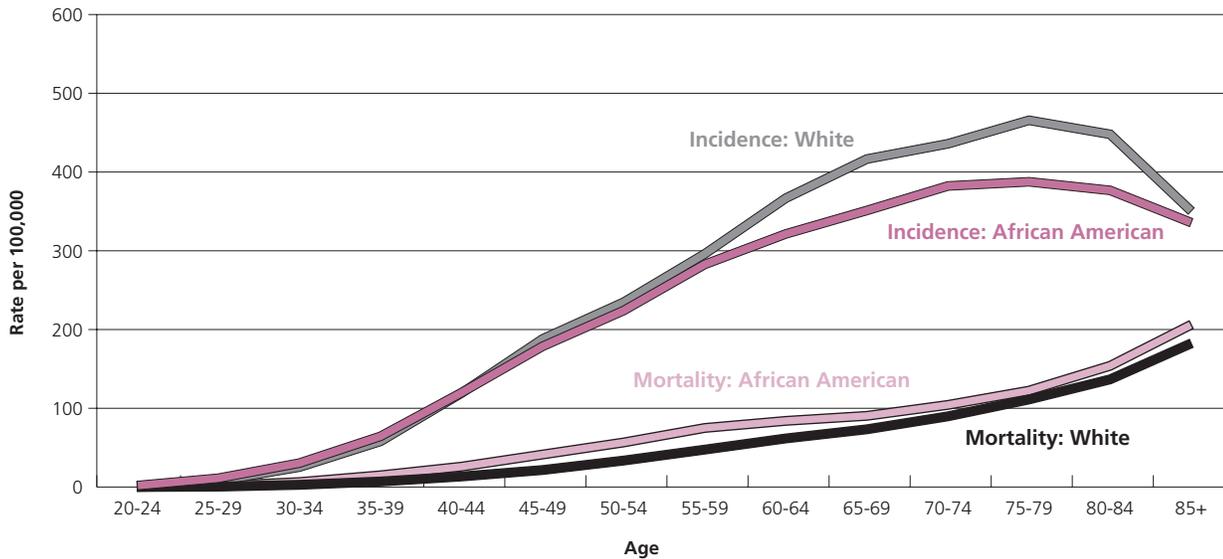
Age

- Breast cancer incidence and death rates generally increase with age (Figure 1, page 2). During 2002-2006, 95% of new cases and 97% of breast cancer deaths occurred in women aged 40 and older.
- During 2002-2006, women aged 20-24 had the lowest incidence rate, 1.4 cases per 100,000 women; women aged 75-79 had the highest incidence rate, 441.9 cases per 100,000.³ The decrease in incidence rates that occurs in women ages 80 and older may reflect lower rates of screening, the detection of cancers by mammography before age 80, and/or incomplete detection.
- During 2002-2006, the median age at the time of breast cancer diagnosis was 61 years.³ This means that 50% of women who developed breast cancer were age 61 or younger at the time of diagnosis.

Race/Ethnicity

- White women have a higher incidence of breast cancer than African American women beginning at age 45. In contrast, African American women have a higher incidence rate before age 45 and are more likely to die from breast cancer at every age (Figure 1, page 2).
- Table 1 (page 3) shows breast cancer incidence and death rates per 100,000 women for white and African American women by state. Among white women, breast cancer incidence rates range from 111.5 in

Figure 1. Female Breast Cancer – Incidence and Mortality Rates by Age and Race, US, 2002-2006



Data sources: Incidence – North American Association of Central Cancer Registries, 2009. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

Utah to 139.1 in Hawaii.⁴ Breast cancer incidence rates among African American women range from 60.9 in New Mexico to 127.3 in Kentucky.⁴ Incidence rates reflect how completely the population is screened, as well as disease occurrence.

- Despite higher incidence rates, breast cancer death rates are lower among white women than among African American women. Breast cancer death rates among white women range from 21.7 in Hawaii to 27.3 in New Jersey. In contrast, breast cancer death rates among African American women range from 20.9 in Rhode Island to 40.0 in Louisiana.
- Incidence and death rates for breast cancer are lower among women of other racial and ethnic groups than among white and African American women (Figure 2, page 4).

How many cases and deaths are estimated to occur in 2009?

- In 2009, an estimated 192,370 new cases of invasive breast cancer will be diagnosed among women, as well as an estimated 62,280 additional cases of in situ breast cancer (Table 2, page 4).

- In 2009, approximately 40,170 women are expected to die from breast cancer (Table 2, page 4). Only lung cancer accounts for more cancer deaths in women.
- In 2009, about 1,910 cases of breast cancer are expected to occur among men, accounting for about 1% of all breast cancers. In addition, approximately 440 men will die from breast cancer.

How many women alive today have ever had breast cancer?

The National Cancer Institute estimates that approximately 2.5 million women with a history of breast cancer were alive in January 2006.³ Most of these individuals were cancer-free, while others still had evidence of cancer and may have been undergoing treatment.

How has the occurrence of breast cancer changed over time?

Incidence trends – women

Invasive breast cancer

Incidence rates of invasive female breast cancer for all races combined show five distinct phases since 1975, when population-based surveillance of cancer began:

- Between 1975 and 1980, incidence was essentially constant.
- Between 1980 and 1987, incidence increased by 4.0% per year.
- Between 1987 and 1994, incidence was essentially constant.
- Between 1994 and 1999, incidence rates increased by 1.6% per year.
- Between 1999 and 2006, incidence rates decreased by 2.0% per year.³

Much of the long-term underlying increase in incidence may be attributed to changes in reproductive patterns, such as delayed childbearing and having fewer children, which are recognized risk factors for breast cancer. The

rapid increase between 1980 and 1987 is due largely to greater use of mammography screening and increased detection of breast cancers too small to be felt. Detecting these tumors earlier has the effect of inflating the incidence rate because tumors are being detected 1 to 3 years before they would have been diagnosed if they continued to grow until symptoms developed. During the uptake of mammography, from 1980 to 1987, incidence rates of smaller tumors (≤ 2.0 cm) more than doubled, while rates of larger tumors (3.0 cm or more) decreased 27%.⁵

The slight increase in overall breast cancer incidence during the later half of the 1990s may reflect increases in the prevalence of mammography screening, rising rates of obesity, and menopausal hormone use. The recent decline in breast cancer incidence is likely due to

Table 1. Female Breast Cancer Incidence and Mortality Rates* by Race and State, 2002-2006

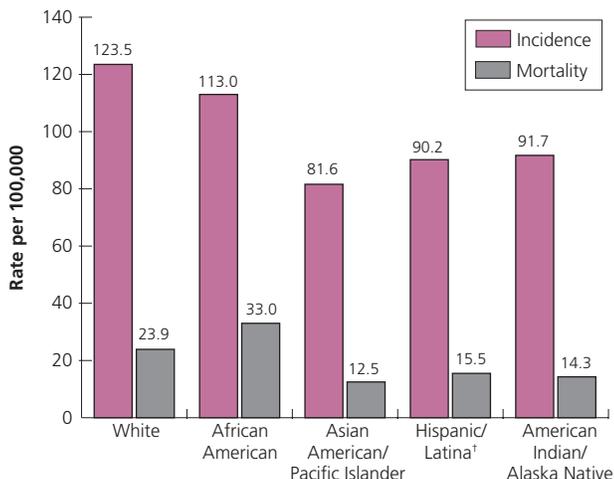
State	White		African American		State	White		African American	
	Incidence	Mortality	Incidence	Mortality		Incidence	Mortality	Incidence	Mortality
Alabama [†]	114.9	23.2	109.3	31.5	Montana	118.8	23.0	§	‡
Alaska	128.9	22.0	83.4	‡	Nebraska	127.3	22.7	108.9	30.8
Arizona	§	22.0	§	30.2	Nevada	115.1	24.9	99.9	27.0
Arkansas	113.9	22.8	103.1	34.9	New Hampshire	131.1	23.4	75.3	‡
California	128.0	23.9	118.2	33.1	New Jersey	132.6	27.3	108.8	33.5
Colorado	123.7	22.6	93.6	21.4	New Mexico	115.6	23.4	60.9	23.9
Connecticut	137.5	24.3	113.9	26.7	New York	129.5	24.7	102.4	28.3
Delaware	123.8	23.5	123.3	27.9	North Carolina	121.0	23.1	117.3	33.5
District of Columbia	§	23.1	§	32.4	North Dakota	121.5	22.9	§	‡
Florida	115.9	21.8	99.5	30.0	Ohio	§	26.4	§	35.0
Georgia	120.7	22.5	114.6	30.9	Oklahoma	127.6	25.0	125.7	34.4
Hawaii	139.1	21.7	71.1	‡	Oregon	130.5	24.2	101.2	22.3
Idaho	118.7	22.5	§	‡	Pennsylvania	124.1	25.9	122.5	34.2
Illinois	124.1	24.2	119.6	37.6	Rhode Island	129.6	23.5	94.2	20.9
Indiana	115.1	24.2	110.5	34.7	South Carolina	121.2	22.8	110.6	31.5
Iowa	124.3	22.8	114.6	32.8	South Dakota	119.3	23.0	§	‡
Kansas	125.2	24.2	125.7	36.5	Tennessee	§	24.1	§	37.3
Kentucky	118.8	24.4	127.3	33.6	Texas [†]	114.6	22.5	117.4	35.1
Louisiana [†]	119.0	24.6	122.4	40.0	Utah	111.5	24.0	86.1	‡
Maine	128.0	23.4	§	‡	Vermont	§	23.1	§	‡
Maryland	§	25.2	§	32.5	Virginia	121.4	24.4	118.7	35.1
Massachusetts	134.6	24.4	103.7	28.2	Washington	134.7	23.9	119.8	26.2
Michigan	124.3	23.8	121.0	34.6	West Virginia	115.3	24.2	99.7	33.9
Minnesota	126.4	22.3	98.2	28.3	Wisconsin	§	23.3	§	26.1
Mississippi	§	22.4	§	35.8	Wyoming	118.2	22.9	§	‡
Missouri	122.2	25.3	121.1	36.8					

*All rates are per 100,000 and age-adjusted to 2000 US standard population.

[†] Case ascertainment not complete for all years. [‡] Fewer than 16 deaths; statistic could not be calculated. [§] Statistic could not be calculated for one of the following reasons: state did not submit data to NAACCR, data failed to meet NAACCR quality standards, or 16 or fewer cases were reported.

Data sources: Incidence – *Cancer in North America, 2002-2006. Volume One: Combined Incidence*, NAACCR, 2009. Data are collected by cancer registries participating in the National Cancer Institute's SEER Program and the Centers for Disease Control and Prevention's National Program of Cancer Registries. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

Figure 2. Female Breast Cancer Incidence and Mortality Rates* by Race and Ethnicity, US, 2002-2006



*Rates are age-adjusted to the 2000 US standard population. †Persons of Hispanic origin may be any race.

Data sources: Incidence – North American Association of Central Cancer Registries, 2009. Incidence data for American Indian/Alaska Natives only includes individuals from Contract Health Service Delivery Areas (CHSDA). Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2009. For Hispanics, information is included for all states except Minnesota, New Hampshire, North Dakota, and the District of Columbia.

American Cancer Society, Surveillance Research, 2009

decreased use of menopausal hormones following the publication of the results of the Women’s Health Initiative randomized trial in 2002, as well as a decrease in mammography screening (thus, detecting fewer cancers earlier).⁶⁻¹⁰ National studies on the prevalence of mammography suggest that since 2000, the percentage of women aged 40 and older who reported having a mammogram within the past 2 years has either decreased slightly or stabilized.^{8,11,12} The decrease in breast cancer incidence rates due to the lower prevalence of mammography use gives the appearance of a decline in the rate of disease, but in fact reflects underdiagnosis or delayed diagnosis and not a true decrease in disease occurrence.

A sharp decrease in breast cancer incidence rates in the US occurred between 2002 and 2003, particularly among women aged 50-69 years in whom menopausal hormone use is most common. This decrease is likely a result of the rapid drop in hormone use that began in 2002. Similar reversals in breast cancer trends have been observed internationally as well.¹³⁻¹⁵ However, breast cancer incidence rates have remained relatively stable since 2003 (Figure 3a).

Age: During the early 1980s, incidence rates of invasive breast cancer increased among both women aged 50 and older and those younger than 50 (5.3% per year and 2.8% per year, respectively) (Figure 3a).³ Among women aged 50 and older, incidence rates remained constant from 1987-1993, increased at a slow rate during 1993-1999 (1.9% per year), and have since been declining (2.5% per year). Among women younger than age 50, incidence rates have remained stable since 1986.

Race/Ethnicity: Figure 4a (page 6) presents trends in invasive female breast cancer incidence rates by race and ethnicity. Incidence data are available for African American and white women since the early 1970s. Among white women, breast cancer incidence rates increased rapidly through 1987 (largely due to the introduction of mammography screening), stabilized from 1987-1994, and then continued to increase at a slower rate until 1999. During 1999-2006, breast cancer incidence rates among white women declined at an average rate of 2.2% per year. The recent decline is likely due to lower rates of mammography screening as well as decreased use of menopausal hormones.⁷⁻⁹ Incidence rates also increased for African American women until 1992; however, they have since remained relatively stable. The lack of a decline in incidence among African American women may be due to the lack of a significant decrease in mammography screening rates, as well as historically lower rates of menopausal hormone use.^{8,9,16}

Incidence data are available for women of other races and ethnicities only since 1992. During 1997-2006, incidence rates decreased 0.8% per year among Asian Americans/

Table 2. Estimated New Female Breast Cancer Cases and Deaths by Age, US, 2009*

Age	In Situ Cases	Invasive Cases	Deaths
Younger than 45	6,460	18,640	2,820
45 and older	55,820	173,730	37,350
Younger than 55	24,450	62,520	8,890
55 and older	37,830	129,850	31,280
Younger than 65	40,940	120,540	17,200
65 and older	21,340	71,830	22,970
All ages	62,280	192,370	40,170

*Rounded to the nearest 10.

Data source: Estimated cases are based on 1995-2005 incidence rates from 41 states as reported by NAACCR, representing about 85% of the US population. Estimated deaths are based on data from US Mortality Data, 1969-2006, National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

American Cancer Society, Surveillance Research, 2009

Pacific Islanders and did not change significantly among Hispanics/Latinas or American Indian/Alaska Natives.³

Tumor size: Figure 5a (page 7) presents incidence trends by race and tumor size for the most recent time period. From 1988 to 2000, the incidence rate of smaller tumors (≤ 2.0 cm) among women of all races combined increased by 2.0% per year. Since 2000, the incidence rate has declined by 3.3% per year. In contrast, the incidence rate of larger tumors (>5.0 cm) has increased since 1992 by 2.0% per year. The increase in prevalence of some underlying risk factors such as postmenopausal obesity, menopausal hormone use, or both may have contributed to this pattern. Incidence rates of breast cancer by tumor size differed between white and African American women: African American women were less likely to be diagnosed with smaller tumors (≤ 2.0 cm) and more likely to be diagnosed with larger tumors (2.1-5.0 and >5.0 cm) than white women.

Stage: Figure 5b (page 7) presents incidence trends by race and stage at diagnosis. Among women of all races combined, incidence rates of localized breast cancer increased through most of the 1980s and 1990s, but began to decline by 2.3% per year in 1999. The incidence of regional-stage disease increased during 1994-2001 and has since decreased on average by 2.8% per year. Incidence rates of distant-stage disease have remained stable.

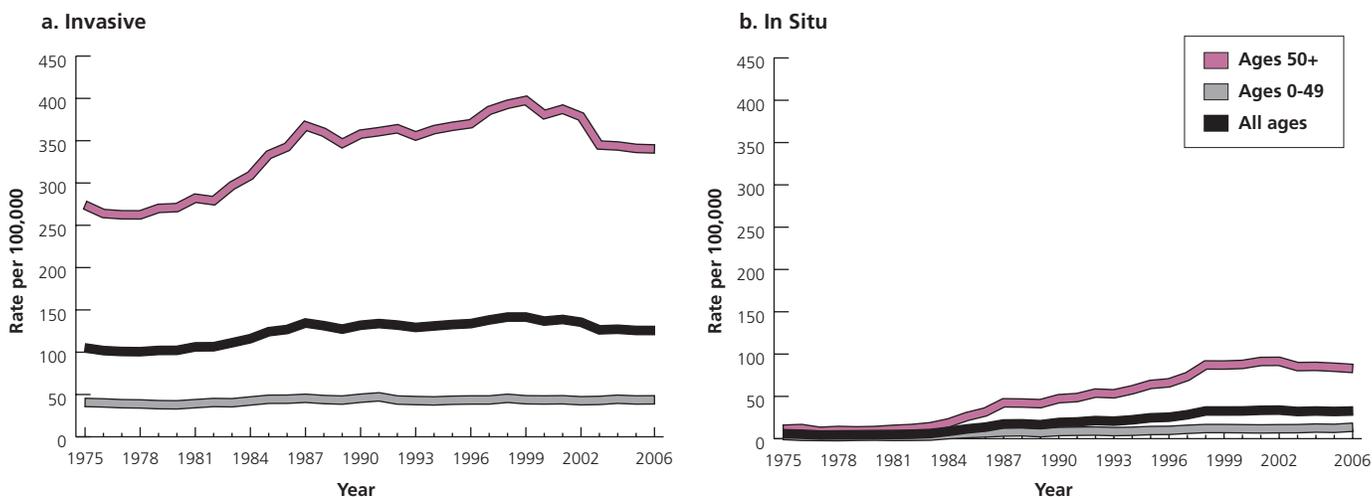
African American women have higher rates of distant-stage breast cancer compared to white women. Rates of distant-stage breast cancer among African American women have increased by 0.5% per year since 1975, whereas rates among white women have remained stable.

In situ breast cancer

Incidence rates of in situ breast cancer increased rapidly during the 1980s and 1990s, largely because of increased diagnosis as a result of mammography screening (Figure 3b). The increase was observed in all age groups, although it was greatest in women aged 50 and older.¹⁷ Since 1999, incidence rates of in situ breast cancer have decreased among women aged 50 and older, but continued to increase in younger women.³ The decrease in incidence among women aged 50 and older may reflect the reduction in mammography screening since 2000.

There are two main types of in situ breast cancer: ductal carcinoma in situ (DCIS) and lobular carcinoma in situ (LCIS). The majority of in situ breast cancers are DCIS, which accounted for about 80% of cases diagnosed from 2002-2006. DCIS is detected by mammography, and the historically large increase in DCIS incidence was a direct result of mammography's ability to detect cancers that cannot be felt.

Figure 3. Incidence Rates* of Invasive and In Situ Female Breast Cancer by Age, Adjusted for Delayed Reporting, US, 1975-2006

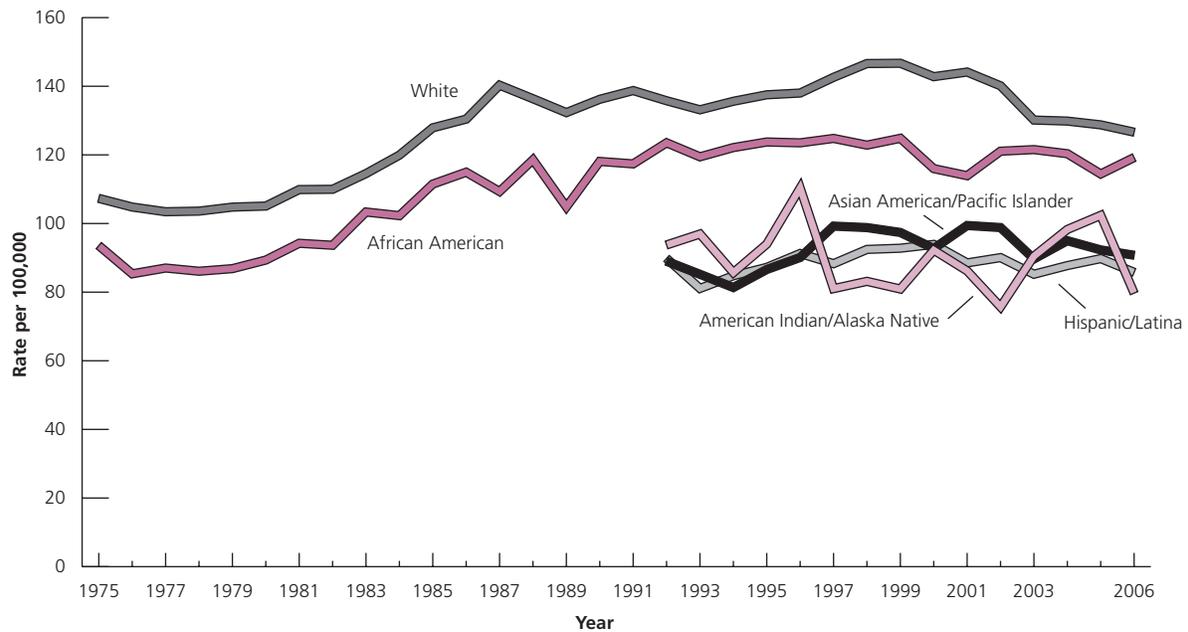


*Rates are age-adjusted to the 2000 US standard population within each age group.

Data source: Surveillance, Epidemiology, and End Results (SEER) Program, SEER 9 Registries, 1973-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

American Cancer Society, Surveillance Research, 2009

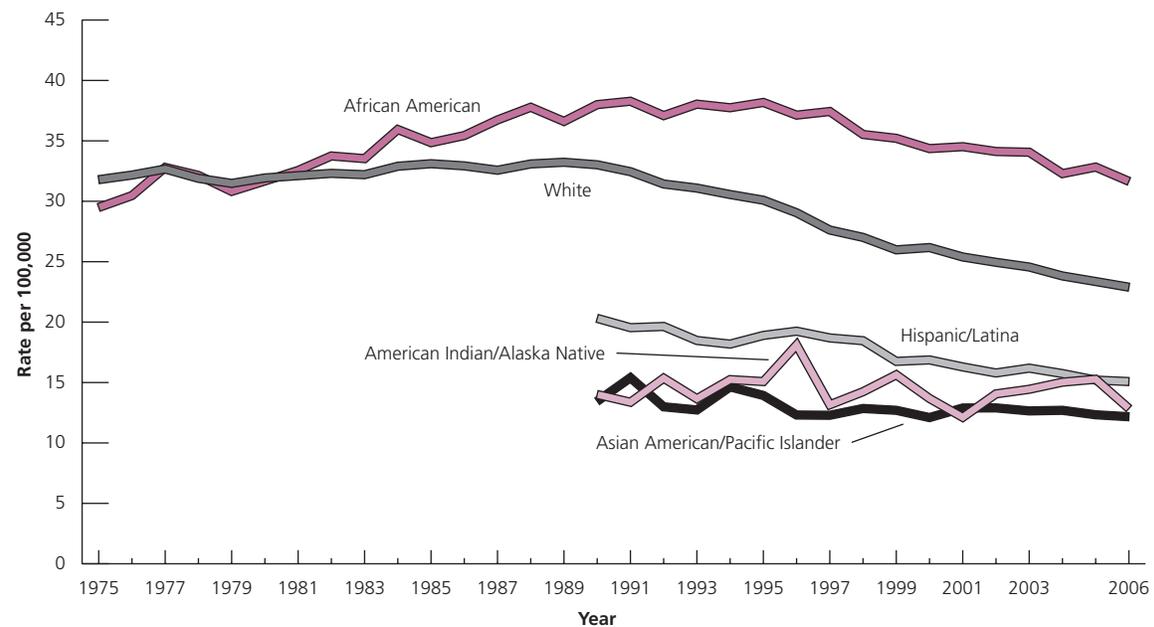
Figure 4a. Trends in Female Breast Cancer Incidence Rates* by Race and Ethnicity, US, 1975-2006



*Rates are age-adjusted to the 2000 US standard population.

Data source: Surveillance, Epidemiology, and End Results (SEER) Program, 1973-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009. Data for whites and African Americans are from the SEER 9 registries. Data for other races/ethnicities are from the SEER 13 registries. For Hispanics, incidence data do not include cases from the Alaska Native Registry. Incidence data for American Indians/Alaska Natives are based on Contract Health Service Delivery Area (CHSDA) counties.

Figure 4b. Trends in Female Breast Cancer Death Rates* by Race and Ethnicity, US, 1975-2006



*Rates are age-adjusted to the 2000 US standard population.

Data source: National Center for Health Statistics, Centers for Disease Control and Prevention, 2009. For Hispanics, information is included for all states except Connecticut, Louisiana, Maine, Maryland, Minnesota, New Hampshire, New York, North Dakota, Oklahoma, Vermont, and Virginia and the District of Columbia.

LCIS is much less common than DCIS, accounting for about 12% of female in situ breast cancers diagnosed from 2002-2006. Similar to DCIS, the overall incidence rate of LCIS increased more rapidly than the incidence rate of invasive breast cancer. This increase was limited to

women over the age of 40 and largely to postmenopausal women.¹⁷ Other in situ breast cancers have characteristics of both ductal and lobular carcinomas or have unspecified origins.

Figure 5a. Trends in Female Breast Cancer Incidence Rates* by Tumor Size and Race, US, 1988-1989 to 2005-2006

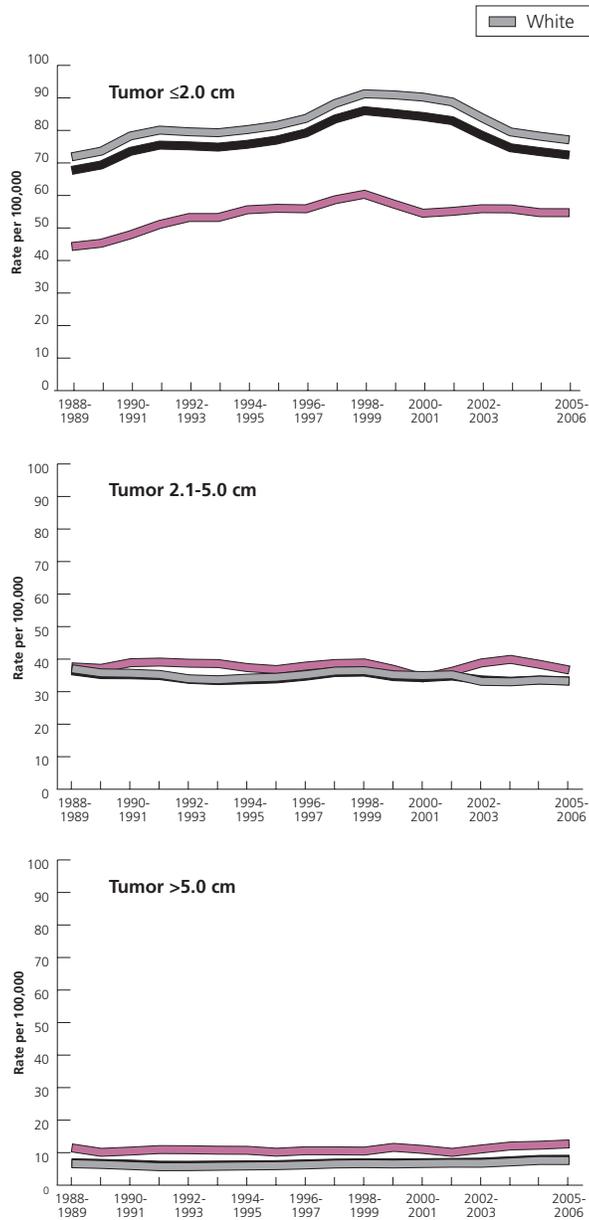
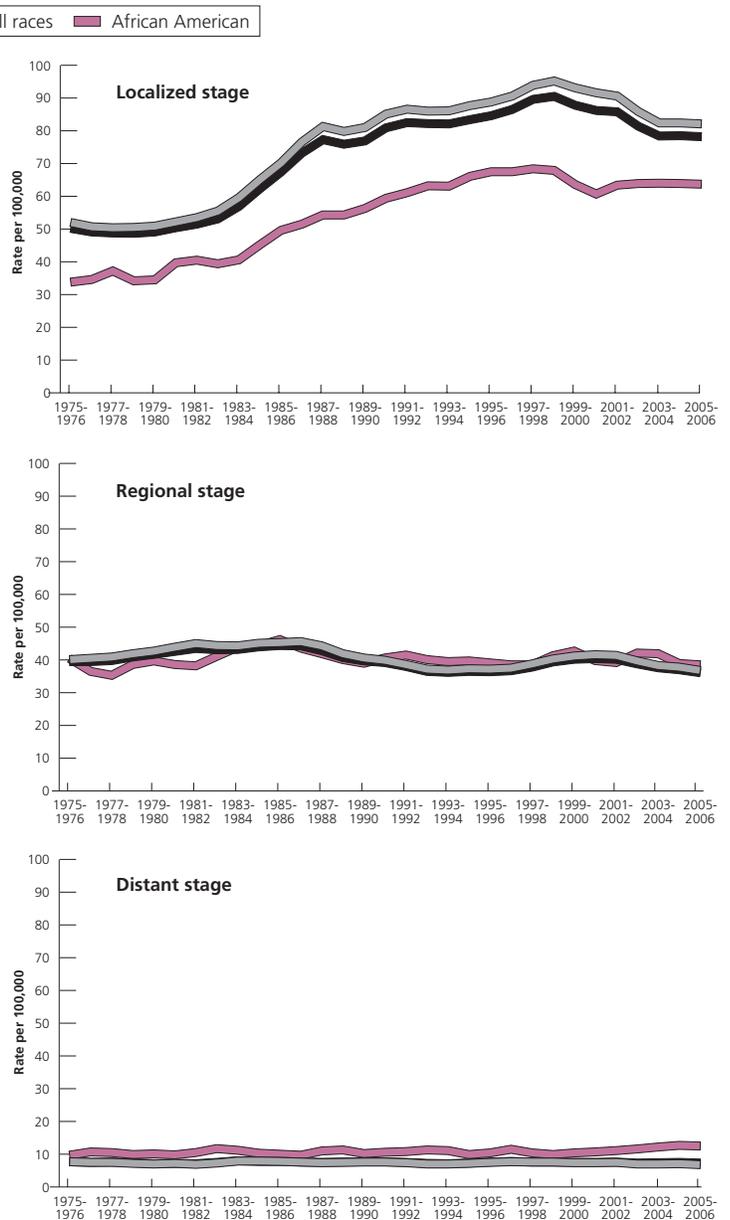


Figure 5b. Trends in Female Breast Cancer Incidence Rates* by Stage and Race, US, 1975-1976 to 2005-2006

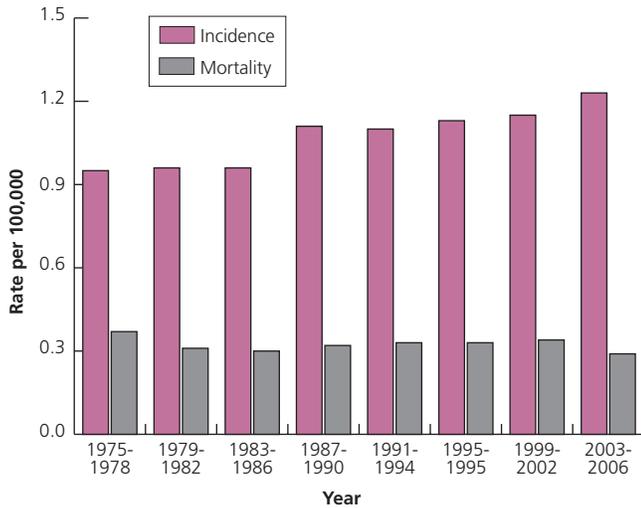


*Rates are two-year moving averages and age-adjusted to the 2000 US standard population.

Data source: Surveillance, Epidemiology, and End Results (SEER) Program, SEER 9 Registries, 1973-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

American Cancer Society, Surveillance Research, 2009

Figure 6. Trends in Male Breast Cancer Incidence and Mortality Rates*, US, 1975-2006



*Rates are age-adjusted to the 2000 US standard population.

Data sources: Incidence – Surveillance, Epidemiology, and End Results (SEER) Program, SEER 9 Registries, 1973-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009. Mortality – National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

Mortality trends – women

The death rate for breast cancer in women has decreased since 1990.

- Between 1975 and 1990, the death rate for all races combined increased by 0.4% annually.
- Between 1990 and 1995, the rate decreased by 1.8% annually.
- Between 1995 and 1998, the rate decreased by 3.3% annually.
- Between 1998 and 2006, the rate decreased by 1.9% annually.³

The percentage decline was larger among younger age groups. From 1990-2006, death rates decreased by 3.2% per year among women younger than 50, and by 2.0% per year among women 50 and older.³ The decline in breast cancer mortality has been attributed to both improvements in breast cancer treatment and early detection.¹⁸ Generally, African American women and women of other racial and ethnic groups have benefited less than white women from these advances. From 1997-2006, female breast cancer death rates declined by 1.9% per year in non-Hispanic whites and Hispanics/Latinas, 1.6% in African Americans, 0.6% per year

in Asian Americans/Pacific Islanders, and remained unchanged among American Indian/Alaska Natives.³ A striking divergence in long-term breast cancer mortality trends between African American and white women began in the early 1980s; by 2006, death rates were 38% higher in African American than white women (Figure 4b, page 6).

Incidence and mortality trends – men

Although breast cancer in men is a rare disease (accounting for approximately 1% of breast cancer cases in the US), between 1975-2006 the incidence rate increased 0.9% annually (Figure 6). The reasons for the increase are unknown and are not attributable to increased detection. Similar to female breast cancer, the incidence of male breast cancer increases with age; however, unlike female breast cancer, incidence rates are higher in African American men compared to white men.¹⁹ Men are more likely than women to be diagnosed with advanced disease and thus have poorer survival.²⁰ Late-stage diagnoses are more common in men because they may not be aware of, or respond as quickly to, changes in their breasts. Mammography is not recommended for men because of the rarity of the disease. Death rates from male breast cancer have remained essentially constant since 1975 (Figure 6).

Due to the rarity of male breast cancer, much less is known about the disease than female breast cancer. Risk factors include BRCA gene mutations, Klinefelter syndrome, testicular disorders, family history of male or female breast cancer, and obesity.²¹ A recent study also reported an increased risk for male breast cancer among men with bone fractures occurring after the age of 45, which may be related to changes in the relative levels of estrogen and testosterone that occur with age.²²

What factors influence breast cancer survival?

Based on the most recent data, relative survival rates for women diagnosed with breast cancer are:

- 89% at five years after diagnosis
- 82% after 10 years
- 75% after 15 years

Caution should be used when interpreting long-term survival rates since they reflect the experience of women treated using past therapies and do not reflect recent trends in early detection or advances in treatment.

Stage at diagnosis

Five-year relative survival is lower among women with a more advanced stage at diagnosis (Figure 7). Considering all races, 5-year relative survival is 98% for localized disease, 84% for regional disease, and 23% for distant-stage disease.³ Larger tumor size at diagnosis is also associated with decreased survival. For example, among women of all races with regional disease, the 5-year relative survival is 95% for tumors less than or equal to 2.0 cm, 82% for tumors 2.1-5.0 cm, and 66% for tumors greater than 5.0 cm.

Age at diagnosis

The 5-year relative survival rate is slightly lower among women diagnosed with breast cancer before age 40 (83%) compared to women diagnosed at ages 40 or older (90%). This may be due to tumors diagnosed at younger ages being more aggressive and less responsive to treatment.^{23, 24}

Race/ethnicity and socioeconomic factors

African American women with breast cancer are less likely than white women to survive 5 years: 78% vs. 90%, respectively.³ This difference can be attributed to both later stage at detection and poorer stage-specific survival (Figure 7).

Table 3 (page 10) presents 5-year cause-specific breast cancer survival rates by race and ethnicity. Cause-specific survival rates are used instead of relative survival because estimates of normal life expectancy are not available for most racial groups. Cause-specific survival

is the probability of not dying of breast cancer within 5 years of diagnosis. African American women have the lowest cause-specific survival rate of any racial or ethnic group, indicating that they have the greatest probability of dying of breast cancer.

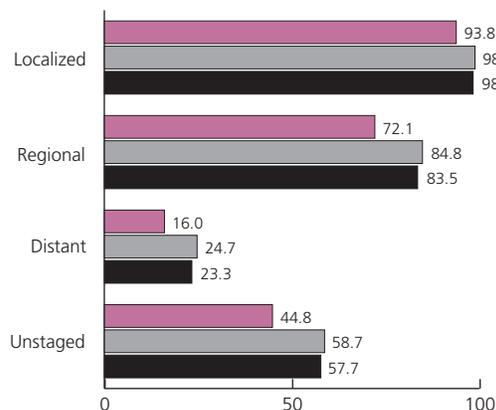
A lack of health insurance is associated with lower survival among breast cancer patients.²⁵ Moreover, breast cancer patients from lower-income areas have lower 5-year relative survival rates than those from higher-income areas at every stage of diagnosis.²⁶ The presence of additional illnesses, unequal access to medical care, and disparities in treatment may contribute to the observed differences in survival between patients living in lower- vs. higher-income areas and between African American and white women.²⁷⁻³² Aggressive tumor characteristics associated with poorer prognosis appear to be more common in African American women and may also contribute to lower survival rates.^{33, 34}

What are the known risk factors for breast cancer?

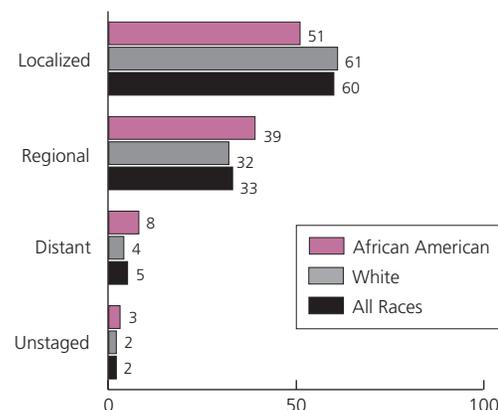
Many of the known breast cancer risk factors, such as age, family history, age at first full-term pregnancy, early menarche, late menopause, and breast density, are not easily modifiable. However, other factors associated with increased breast cancer risk (postmenopausal obesity, use of combined estrogen and progestin menopausal hormones, alcohol consumption, and physical inactivity) are modifiable. Some risk factors directly increase lifetime exposure of breast tissue to circulating

Figure 7. Female Breast Cancer – US, 1999-2005

a. Five-year Relative Survival Rates* (%) by Stage at Diagnosis and Race



b. Stage Distribution (%) by Race



*Survival rates are based on patients diagnosed between 1999-2005 and followed through 2006.

Data source: Horner et al.³

Table 3. Five-year Cause-specific Breast Cancer Survival Rates* by Race/Ethnicity

	Rate (%)
White	88.3
African American	77.3
American Indian/Alaska Native†	84.0
Asian	90.6
Asian Indian, Pakistani	90.5
Chinese	89.9
Filipino	88.1
Japanese	93.1
Korean	90.0
Vietnamese	89.9
Other Asian	93.9
Pacific Islander	85.3
Hawaiian	87.5
Other Pacific Islander	79.6
Hispanic/Latina‡	85.8

*Survival rates are based on patients diagnosed between 1999-2005 and followed through 2006. †Based on Contract Health Service Delivery Areas (CHSDA). ‡Persons of Hispanic origin may be of any race.

Source: Horner et al.³

ovarian hormones (early menarche, late menopause, obesity, and hormone use), whereas others, such as higher socioeconomic status, are only correlates of reproductive behavior or other factors. Established risk factors for breast cancer are listed in Table 4 in order of the strength of their association.

The desire to explain the causes of breast cancer has led to a wide range of proposed explanations from underwire bras to antiperspirants. At present, there is no scientific evidence that shows an association between these products and breast cancer.³⁵ Likewise, no association has been found between breast implants and an increased risk of breast cancer.^{36, 37} There are also persistent claims that women who have had an abortion are at an increased risk for developing breast cancer; however, there is a large body of solid scientific evidence refuting this hypothesis. A review by a panel of experts convened by the National Cancer Institute concluded that there is no association between medical abortion and developing breast cancer.³⁸ Subsequent to that review, results of a study that followed more than 100,000 nurses from 1993 to 2003 also found no link to a previous abortion, either spontaneous or induced.³⁹

Concerns have also been raised among some advocacy groups and survivors that rising breast cancer incidence

in the latter half of the 20th century may be caused by environmental pollutants such as organochlorine pesticides, but studies to date have not found increased concentrations of organochlorines, when measured in adults, to be related to breast cancer risk.^{40, 41} Although animal studies have demonstrated that prolonged high-dose exposure to many industrial chemicals can increase mammary tumors, it is more difficult to determine whether the much lower concentrations of these chemicals that occur – alone or in combination, in air, drinking water, and consumer products – increase the risk of human breast cancer.⁴² In general, epidemiological studies have not found clear relationships between environmental pollutants and breast cancer, but these studies have had limited capability to study effects on subgroups of the population or to quantify exposures at potentially critical periods of life, such as adolescence.

While limited in number, some epidemiologic studies have examined the relationship between occupational exposures and breast cancer after accounting for other important risk factors, such as reproductive history. One such study found that increasing exposure to ethylene oxide, a fumigant used to sterilize surgical instruments that also has been shown to cause breast cancer in experimental animals, was associated with higher breast cancer risk among women employed in commercial sterilization facilities.⁴³ Studies of nurses who work night shifts and flight attendants who experience circadian rhythm disruption through crossing multiple time zones find increased risks of breast cancer associated with long-term employment.⁴⁴ Animal studies suggest that exposure to light at night causes circadian rhythm disruption and increases cancer incidence.⁴⁵ Some researchers suggest that the increased risk of breast cancer may be due to decreases in melatonin levels that occur as a result of exposure to light at night; melatonin may affect estrogen levels as well as act as a tumor suppressor.⁴⁵ Based on the results of studies in humans and experimental animals, the International Agency for Research on Cancer recently concluded that shift work, particularly at night, was probably carcinogenic to humans.⁴⁶ While additional studies are needed to confirm the relationship between shift work and breast cancer, this finding may be important because shift work at night is a common exposure, involving about 15-20% of workers in the US and Europe, and much of the population in industrialized countries is exposed to artificial light at night.

Table 4. Factors That Increase the Relative Risk for Breast Cancer in Women

Relative Risk	Factor
>4.0	Female Age (65+ vs. <65 years, although risk increases across all ages until age 80) Certain inherited genetic mutations for breast cancer (BRCA1 and/or BRCA2) Two or more first-degree relatives with breast cancer diagnosed at an early age Personal history of breast cancer High breast tissue density Biopsy-confirmed atypical hyperplasia
2.1-4.0	One first-degree relative with breast cancer High-dose radiation to chest High bone density (postmenopausal)
1.1-2.0	
Factors that affect circulating hormones	Late age at first full-term pregnancy (>30 years) Early menarche (<12 years) Late menopause (>55 years) No full-term pregnancies Never breastfed a child Recent oral contraceptive use Recent and long-term use of estrogen and progestin Obesity (postmenopausal)
Other factors	Personal history of endometrial or ovarian cancer Alcohol consumption Height (tall) High socioeconomic status Ashkenazi Jewish heritage

Adapted with permission from Hulka et al, 2001.

Increasing age

Besides being female, age is the most important risk factor for breast cancer. Table 5 (page 12) shows a woman's risk of being diagnosed with breast cancer at different ages. These probabilities are averages for the whole population. An individual woman's breast cancer risk may be higher or lower depending on her personal risk factors, experiences, and other factors not yet fully understood.

Currently, a woman living in the US has a 12.1%, or a 1 in 8, lifetime risk of being diagnosed with breast cancer. In the 1970s, the lifetime risk of being diagnosed with breast cancer was 1 in 11. This increase in the likelihood of being diagnosed with breast cancer is due to longer life expectancy, as well as increases in breast cancer incidence due in part to changes in reproductive patterns, long-term menopausal hormone use, the rising prevalence of obesity, and increased detection through screening. Lifetime risk reflects an average woman's risk over an entire lifetime, including the possibility that she may die from another cause before she would have developed breast cancer, and should not be confused with risk over a shorter time period.

Family history of breast cancer and genetic predisposition

Women with a family history of breast cancer, especially in a first-degree relative (mother, sister, or daughter), are at increased risk of developing breast cancer.⁴⁷ The risk is higher if more than one first-degree relative developed breast cancer and increases the younger the relative was at the time of diagnosis. Ovarian cancer is also linked to breast cancer in certain family cancer syndromes. Women with a family history of breast or ovarian cancer in their mothers, sisters, daughters, aunts, or grandmothers on either their mother's or father's side should discuss this history with their physicians.

It is estimated that 5%-10% of breast cancer cases result from inherited mutations or alterations in the breast cancer susceptibility genes, BRCA1 and BRCA2.⁴⁸ These mutations are present in far less than 1% of the general population.⁴⁹ Women with BRCA1 mutations are estimated to have a 57% risk for developing breast cancer by age 70; the corresponding risk for BRCA2 mutations is 49%.⁵⁰

While a family history of breast cancer suggests an inherited influence on disease risk, BRCA1 or BRCA2

Table 5. Age-specific Probabilities of Developing Invasive Female Breast Cancer*

If current age is ...	The probability of developing breast cancer in the next 10 years is: †	or 1 in:
20	0.06%	1,760
30	0.44%	229
40	1.44%	69
50	2.39%	42
60	3.40%	29
70	3.73%	27
Lifetime risk	12.08%	8

*Among those free of cancer at beginning of age interval. Based on cases diagnosed 2004-2006. Percentages and "1 in" numbers may not be numerically equivalent due to rounding.

† Probability derived using NCI DevCan Software, Version 6.4.0.

mutations account for only about 50% of familial breast cancer.⁵¹ Breast cancer can also result from the inheritance of other less common genetic syndromes (e.g., Li-Fraumeni and Cowden syndromes). However, scientists believe that much of the occurrence of breast cancer in families results from the interaction between lifestyle factors and low risk variations in genetic factors that may be shared by women within a family.⁵²

Molecular tests are commercially available to identify some of the BRCA mutations and many of the family cancer syndromes responsible for inherited forms of breast cancer, yet the interpretation of these tests and treatment decisions remain complicated.⁵³ It is not yet possible to predict if or when women who carry a particular mutation will develop breast cancer. Furthermore, tests are not available for all of the genes that affect breast cancer risk.

The US Preventive Services Task Force recommends that only women with a strong family history (about 2% of adult US women) be evaluated for genetic testing for BRCA mutations.⁵⁴ The American Cancer Society, the American Society for Clinical Oncology, and other organizations strongly recommend that any person considering genetic testing talk with a genetic counselor, nurse, or doctor who is qualified to interpret and explain the test results before making a decision about testing. People should understand and carefully weigh the benefits and potential consequences of genetic testing before these tests are done. For more information, see the separate American Cancer Society document *Genetic Testing: What You Need to Know*.

Hormonal factors

Reproductive hormones are thought to influence breast cancer risk through effects on cell proliferation and DNA damage, as well as promotion of cancer growth. Early menarche (<12 years) and older age at menopause (>55 years) may increase a woman's risk of breast cancer by affecting the levels of reproductive hormones produced by her body.⁵⁵ Younger age at first-full term pregnancy (<30 years) and a greater number of pregnancies decreases the risk of breast cancer over the long term; however, there also appears to be a transient increase in breast cancer risk following a term pregnancy, particularly among women who have a first birth at older ages.^{56,57} Breastfeeding has consistently been shown to decrease a woman's risk of breast cancer, with greater benefit associated with longer duration.⁵⁸ Recent use of oral contraceptives may slightly increase the risk of breast cancer; however, women who have stopped using oral contraceptives for 10 years or more have the same risk as women who never used the pill.⁵⁹

Recent use of menopausal hormones (sometimes referred to as hormone replacement therapy [HRT] or menopausal hormone therapy) with combined estrogen and progestin has been shown to increase breast cancer risk, with higher risk associated with longer use.^{60, 61} However, the increased risk appears to diminish within 5 years of discontinuation of hormone use.^{10, 60, 62} Estrogen alone can be prescribed for women without a uterus and this treatment is not associated with an increased risk of developing breast cancer.⁶²⁻⁶⁵

Clinical factors

High breast tissue density (a mammographic indicator of the amount of glandular tissue relative to fatty tissue in the breast) has been shown to be a strong independent risk factor for the development of breast cancer. In several studies, women with the highest levels of breast density were found to have a 4- to 6-fold increased risk of breast cancer, compared with women with the least dense breasts.⁶⁶⁻⁶⁸ For more information on the relationship between breast tissue density and breast cancer, see current research on early detection, page 23.

High bone mineral density in postmenopausal women also has been recognized as a risk factor for breast cancer.^{69, 70} Bone density is routinely measured to identify women at increased risk for osteoporosis, as high bone density indicates absence of osteoporosis, and may help determine a woman's risk for developing breast cancer. The association between bone density and breast cancer is probably mediated by hormonal factors.

Some types of benign breast conditions are more closely linked to breast cancer risk than others.⁷¹⁻⁷⁴ Doctors often categorize benign breast conditions into 3 general groups, reflecting the degree of risk: non-proliferative lesions, proliferative lesions without atypia, and proliferative lesions with atypia. Non-proliferative lesions are those not associated with any overgrowth of breast tissue and have little to no effect on breast cancer risk. Proliferative lesions without atypia (those with excessive growth of cells in the ducts or lobules of the breast tissue) are associated with a small increase in the risk of breast cancer (1.5 to 2 times normal). Proliferative lesions with atypia (those with excessive growth of cells in the ducts or lobules of the breast tissue and the cells no longer appear normal) are associated with the greatest breast cancer risk – 4 to 5 times that of average-risk women. They include atypical ductal hyperplasia (ADH) and atypical lobular hyperplasia (ALH). Women with a family history of breast cancer and either hyperplasia or atypical hyperplasia may have an even higher risk of developing breast cancer. Women should keep detailed records of any benign breast biopsy results, as this will be useful information if treatment is needed for a future breast cancer diagnosis.

Women with breast cancer also are at risk for developing a second primary cancer. There is a strong relationship between younger age at diagnosis of the primary breast cancer and risk of subsequent cancer. Women diagnosed with early-onset breast cancer (age <40) have almost a 3-fold increased risk of any subsequent cancer, with a 4.5-fold increased risk of subsequent breast cancer.⁷⁵ Genetic predisposition, notably mutations in BRCA1 and BRCA2 genes, contribute to the excess risk of subsequent cancer among women with early-onset breast cancer.⁷⁶ In addition, breast cancer survivors may be at increased risk of developing subsequent cancers of the breast and ovary because of hormonal and reproductive risk factors.⁷⁷

Radiation

The link between radiation exposure and breast cancer has been demonstrated in studies of atomic bomb survivors⁷⁸ and women who received high-dose radiation therapy to the chest, particularly those who were first exposed at younger ages.⁷⁹ Among atomic bomb survivors, increased risk of breast cancer was greatest among women exposed during adolescence. The development period when the terminal ducts and lobules of the breast have not completed differentiation may be a time of increased susceptibility to exogenous carcinogens.⁸⁰

A Comment about Relative Risk

Relative risk compares the risk of disease among people with a particular exposure to the risk among people without that exposure. If the relative risk is above 1.0, then risk is higher among exposed than unexposed persons. Relative risks below 1.0 reflect an inverse or protective association between a risk factor and the disease, or a protective effect. However, while relative risks are useful for comparisons, they do not provide information about the absolute amount of additional risk experienced by the exposed group.

For example, one study found current users of combination estrogen and progestin menopausal hormones have a relative risk of developing breast cancer of 1.26, or a 26% increased risk.⁸¹ Among 10,000 women who use estrogen and progestin for 5.2 years, the estimated number of breast cancers expected to be diagnosed is 38. Among 10,000 women of the same ages who never used menopausal hormones, 30 cases would be expected over the same period. Therefore, the 26% increased risk results in a total of 8 additional cases per 10,000 women diagnosed over a period of 5.2 years.

Breast cancer is one of the most common types of second cancers occurring among childhood cancer survivors. Secondary breast cancer is most strongly associated with high-dose radiation therapy to the chest for women treated between ages 10 and 30 years, such as for Hodgkin lymphoma. Breast cancer incidence rates among women with such exposure start to rise about 8 years after radiation treatment and continue to be elevated for more than 25 years.⁷⁵

To estimate one's risk for developing breast cancer, risk assessment tools are available at the Harvard School of Public Health's Web site (diseaseriskindex.harvard.edu/update/) and the National Cancer Institute's Web site (cancer.gov/bcrisktool/).

Can breast cancer be prevented?

At this time, there is no sure way to prevent breast cancer, which is why regular mammograms are so important. A woman's best overall preventive health strategy is to reduce her known risk factors as much as possible by avoiding weight gain and obesity, engaging in regular physical activity, and minimizing alcohol intake.^{82, 83} Women who choose to breast-feed for an extended period of time (studies suggest a year or more) may also get an added benefit of reducing their breast cancer risk. Women should consider the increased risk of breast cancer associated with the use of estrogen and progestin when evaluating treatment options for menopausal symptoms.

Treatment with tamoxifen or raloxifene can also reduce the risk of breast cancer among women at high risk (see section below on chemoprevention).

Obesity

Obesity, as well as weight gain during adulthood, increases the risk of postmenopausal, but not premenopausal breast cancer.⁸⁴⁻⁸⁸ A recent study found that women who gained 55 pounds or more after age 18 had almost 50% greater risk of breast cancer compared with those who maintained their weight. A gain of 22 pounds or more after menopause was associated with an increased risk of 18%, whereas losing at least 22 pounds after menopause and maintaining the weight loss was associated with 57% lower breast cancer risk.⁸⁵ In postmenopausal women, circulating estrogen is primarily produced in fat tissue. Thus, having more fat tissue increases estrogen levels and the likelihood of developing breast cancer. Given the large percentage of women in the US who are overweight or obese, strategies to maintain a healthy body weight are important to reduce the risk of both developing and dying from breast cancer.

Physical activity

Growing evidence supports a modest protective effect of physical activity on breast cancer.^{84, 89-93} Although most studies find reduced risk in women who exercise vigorously for 45 to 60 minutes on 5 or more days per week, one study suggests that regular physical activity, regardless of intensity, may reduce the risk of breast cancer in postmenopausal women.⁸⁹ The protective effect of physical activity appears greatest among postmenopausal women and women with normal BMI.⁹¹ The underlying mechanism of this potential protection is not well understood, although it has been hypothesized that the benefit may be due to the effects of physical activity on body mass, hormones, and energy balance.⁹⁴

Alcohol consumption

In 2007, the International Agency for Research on Cancer concluded that there was sufficient evidence that alcohol consumption causes breast cancer in women.⁹⁵ A meta-analysis of more than 40 epidemiologic studies suggests that the equivalent of 2 drinks a day (or 24g of alcohol) may increase breast cancer risk by 21%.⁹⁶ Recent studies have also reported that even low to moderate alcohol consumption (3-14 drinks per week) is associated with a slight increase in the risk of breast cancer.^{97,98} The increased risk is dose-dependent and exists regardless

of the type of alcoholic beverage consumed. One of the most likely mechanisms by which alcohol increases risk of breast cancer is by increasing estrogen and androgen levels. Thus, reducing alcohol intake may be a useful strategy for reducing breast cancer risk among regular consumers of alcohol.

Tobacco

Most studies have found no link between active cigarette smoking and breast cancer.^{99, 100} Though both active smoking and secondhand smoke have been suggested to increase the risk of breast cancer in a number of studies that restrict the comparison group to women who report no exposure to secondhand smoke, this issue remains controversial.^{100, 101} The California Environmental Protection Agency has concluded that regular exposure to secondhand smoke is causally related to breast cancer diagnosed in younger, primarily premenopausal women.¹⁰² However, the US surgeon general has characterized the evidence linking secondhand smoke and breast cancer as “suggestive but not sufficient” to infer a causal relationship.¹⁰³ Regardless, not smoking cigarettes and avoiding exposure to secondhand smoke has multiple health benefits.

Menopausal hormones

Use of estrogen and progestin increases the risk of developing breast cancer.^{10, 62, 104} Estrogen and progestin use may also increase the risk of a late-stage diagnosis by increasing breast tissue density, thereby reducing the effectiveness of mammograms.

The US Preventive Services Task Force has recommended against the routine use of menopausal hormones for the prevention of chronic diseases such as osteoporosis and heart disease in postmenopausal women.¹⁰⁵ However, if a woman and her doctor decide that hormone therapy is appropriate to treat specific menopausal symptoms or health problems, it should be prescribed at the lowest effective dose and for as short a time as possible. A woman considering the use of estrogen and progestin should discuss the benefits and risks with her health care provider, as well as alternative treatment options.

Chemoprevention

The use of drugs to reduce the risk of disease is called chemoprevention. Several clinical studies have shown that, in women known to be at increased risk for breast cancer, the drugs tamoxifen and raloxifene reduce this risk.¹⁰⁶

Tamoxifen has been used for more than 30 years as a treatment for some breast cancers. In 1998, a large randomized trial of more than 13,000 women first demonstrated that tamoxifen can also be used to reduce the risk of invasive and in situ breast cancer in women at high risk for developing the disease; however, the reduction in risk was limited to estrogen-receptor positive disease.¹⁰⁷ After an average of 7 years of follow-up, breast cancer risk decreased by 42% in the group that received tamoxifen, with 25 cases of breast cancer diagnosed per 1,000 women in the group, compared to 43 cases per 1,000 in the group who did not receive tamoxifen. A protective effect was also observed in an international randomized prevention trial involving more than 7,000 women.¹⁰⁸ After a median follow-up time of 8 years, breast cancer risk was reduced by 26% in the women who received tamoxifen, with 124 cases diagnosed among 3,579 women in the tamoxifen group, compared to 168 cases among 3,575 women in the group not receiving tamoxifen. These long-term follow-up results indicate that the reduction in risk persists after completion of the 5-year treatment schedule. However, administration of tamoxifen resulted in some risks in both trials, particularly an increased risk of endometrial cancer.

In a study looking at raloxifene for the prevention of osteoporosis, researchers noticed that patients taking raloxifene had a lower risk of breast cancer than the control group.¹⁰⁹ The Study of Tamoxifen and Raloxifene (STAR) trial compared the effectiveness of tamoxifen and raloxifene and found that raloxifene reduced the risk of invasive breast cancer to the same degree as tamoxifen, although it didn't have the same protective effect against in situ cancer (DCIS or LCIS).¹¹⁰ Like tamoxifen, the benefit appears to be limited to reducing the risk of developing an estrogen receptor-positive breast cancer.¹¹¹ Raloxifene appears to have lower risks of certain side effects, such as endometrial cancer and blood clots in the legs or lungs, compared to tamoxifen.¹¹⁰

A woman at increased risk of breast cancer should discuss taking tamoxifen or raloxifene with her doctor. It is estimated that more than 2 million US women could benefit from chemoprevention with these drugs.¹¹²

Prophylactic surgery

Women at very high risk of breast cancer may elect prophylactic (preventive) mastectomy. This operation removes one or both breasts before breast cancer has been discovered. Some women may choose to have their breasts reconstructed after the surgery. One study

reported a greater than 90% reduction in the risk of breast cancer in high-risk women with family history who received prophylactic mastectomy.¹¹³ Subsequent studies confirmed the benefit of prophylactic mastectomy in genetically susceptible women (i.e., women with BRCA1 and BRCA2 mutations).^{114, 115} Some women who are diagnosed with breast cancer in one breast choose to have the second breast removed. This is known as contralateral prophylactic mastectomy (CPM). (For more information on CPM, see current research on prevention on page 23.) While the operation greatly reduces the risk of breast cancer, it does not guarantee that cancer will not develop in the small amount of breast tissue remaining after the operation. Prophylactic oophorectomy (surgical removal of the ovaries) reduces the risk of both breast and ovarian cancers in carriers of BRCA mutations.^{116, 117} A woman considering these operations should discuss this carefully with her doctor. A second opinion is strongly recommended.

What are the signs and symptoms of breast cancer?

Breast cancer typically produces no symptoms when the tumor is small and most treatable. It is therefore very important for women to follow recommended screening guidelines for detecting breast cancer at an early stage, before symptoms develop. When breast cancer has grown to a size that can be felt, the most common physical sign is a painless mass. Sometimes breast cancer can spread to underarm lymph nodes and cause a lump or swelling, even before the original breast tumor is large enough to be felt. Less common signs and symptoms include breast pain or heaviness; persistent changes to the breast, such as swelling, thickening, or redness of the breast's skin; and nipple abnormalities such as spontaneous discharge, erosion, inversion, or tenderness. A woman should have any persistent abnormality evaluated by her physician as soon as possible.

How can breast cancer be detected early?

American Cancer Society guidelines for the early detection of breast cancer vary depending on a woman's age, and include mammography and clinical breast examination (CBE) (Table 6, page 16), as well as magnetic resonance imaging (MRI) for women at high risk.

In 2007, an expert panel convened by the Society reported new recommendations for the use of MRI for women at increased risk for breast cancer.⁵¹ The panel

Table 6. Screening Guidelines for the Early Detection of Breast Cancer in Average-risk, Asymptomatic Women Aged 20 Years and Older

Breast self-examination

Beginning in their early 20s, women should be told about the benefits and limitations of breast self-examination (BSE). The importance of prompt reporting of any new breast symptoms to a health professional should be emphasized. Women who choose to do BSE should receive instruction and have their technique reviewed on the occasion of a periodic health examination. It is acceptable for women to choose not to do BSE or to do BSE irregularly.

Clinical breast examination

For women in their 20s and 30s, it is recommended that clinical breast examination (CBE) be part of a periodic health examination, preferably at least every three years. Asymptomatic women aged 40 and over should continue to receive a clinical breast examination as part of a periodic health examination, preferably annually and prior to mammography.

Mammography

Begin annual mammography at age 40.

recommended annual screening using MRI in addition to mammography for women at high lifetime risk (~20%-25% or greater) of the disease. Women at moderately increased risk (15%-20% lifetime risk) should talk with their doctors about the benefits and limitations of adding MRI screening to their yearly mammogram. Yearly MRI screening is not recommended for women whose lifetime risk of breast cancer is less than 15%.

Women at high risk include those who:

- Have a known BRCA1 or BRCA2 gene mutation
- Have a first-degree relative (mother, father, brother, sister, or child) with a BRCA1 or BRCA2 gene mutation, and have not had genetic testing themselves
- Have a lifetime risk of breast cancer of approximately 20%-25% or greater, according to risk assessment tools that are based mainly on family history
- Had radiation therapy to the chest when they were between the ages of 10 and 30 years
- Have Li-Fraumeni syndrome, Cowden syndrome, or Bannayan-Riley-Ruvalcaba syndrome, or have a first-degree relative with one of these syndromes

Women at moderately increased risk include those who:

- Have a lifetime risk of breast cancer of 15%-20%, according to risk assessment tools that are based mainly on family history

- Have a personal history of breast cancer, ductal carcinoma in situ (DCIS), lobular carcinoma in situ (LCIS), atypical ductal hyperplasia (ADH), or atypical lobular hyperplasia (ALH)
- Have extremely dense breasts or unevenly dense breasts when viewed by mammograms

Although the American Cancer Society no longer recommends that all women perform monthly breast self-exams (BSE), women should be informed about the potential benefits and limitations associated with BSE. Research has shown that self awareness is more effective for detecting breast cancer than structured BSE. Women who detect their own breast cancer usually find it outside of a structured breast self-exam while bathing or getting dressed. A woman who wishes to perform periodic BSE should receive instruction from her health care provider and/or have her technique reviewed periodically.

Mammography

Numerous randomized trials, as well as population-based screening evaluations, have clearly shown that mammography reduces the risk of dying from breast cancer. Early detection of breast cancer by mammography may lead to a greater range of treatment options, including less-aggressive surgery (e.g., lumpectomy vs. mastectomy) and adjuvant therapy.¹¹⁸⁻¹²¹

However, mammography does have limitations. Not all breast cancer will be detected by a mammogram and some breast cancers detected by mammography may still have poor prognosis. Furthermore, mammography sometimes leads to follow-up examinations for positive test results, including biopsies of findings that are eventually determined to not be cancer. Despite these limitations, mammography is the single most effective method of early detection since it can identify cancer several years before physical symptoms develop. Treatment is more successful when cancer is discovered early.

What is mammography?

Mammography is a low-dose x-ray procedure that allows visualization of the internal structure of the breast. Mammography is highly accurate, but like most medical tests, it is not perfect. On average, mammography will detect about 80%-90% of the breast cancers in women without symptoms. Testing is somewhat more accurate in postmenopausal than in premenopausal women.¹²² The small percentage of breast cancers that are not identified by mammography may be missed for

any one of the following reasons: high breast density, inadequate positioning of the breast, or simply failing to see the small early signs of an abnormality. Although the overwhelming majority of women who undergo screening each year do not have breast cancer, about 5%-10% of women have their mammogram interpreted as abnormal or inconclusive until further tests are done. In most instances, additional tests (imaging studies and/or biopsy) lead to a final interpretation of normal breast tissue or benign (non-cancerous) tissue.

The American Cancer Society recommends that women receive an annual mammogram beginning at age 40. It is especially important that women receive *regular* mammograms. Recommended screening intervals are based on the duration of time a breast cancer is detectable by mammography before symptoms develop. Studies have shown that many breast cancers are diagnosed as larger, more advanced cancers simply because too much time has elapsed from the date of the last normal mammogram.^{123, 124} For this reason, women should talk with their doctors about a plan for receiving regular mammograms according to recommended guidelines.

There is no specific age at which mammography screening should be discontinued. Rather, the decision to stop regular mammography screening should be individualized based on the potential benefits and risks of screening within the context of overall health status and estimated longevity. As long as a woman is in good health and would be a candidate for breast cancer treatment, she should continue to be screened with mammography.

Today's modern, dedicated screen-film units result in higher-quality images with considerably lower x-ray dose than the general-purpose x-ray equipment used in the past, and newer, digital mammography systems are even more accurate for women with dense breast tissues.¹²⁵ Many people are concerned about the exposure to x-rays, but the level of radiation used in modern mammography does not measurably increase the risk for breast cancer. The Mammography Quality Standards Act, passed by Congress in 1992 and administered by the Food and Drug Administration, requires facilities to meet specific standards of quality in order to offer mammography.

Medicare, Medicaid, and most private health insurance plans cover mammogram costs or a percentage of them. Low-cost mammograms are available in most communities. Contact the American Cancer Society at 1-800-227-2345 for information about facilities in your area.

Prevalence of mammography

According to the National Health Interview Survey, the percentage of women aged 40 years and older who report having had a mammogram within the past two years increased from 29% in 1987 to 70% in 2000. Since then, mammography utilization stabilized through 2003 and showed small declines through 2005 (66.5%).⁸ Women who have less than a high school education, who have no health insurance coverage, or who are recent immigrants to the US are least likely to have had a recent mammogram (Table 7, page 18). Furthermore, low-income women are less likely to have had a mammogram within the past 2 years than women at or above the poverty level and recent declines in mammography usage have been greater among poorer women (Table 8, page 19).

Table 9 (page 20) shows the percentage of US women aged 40 and older who have had a mammogram within the past year by state, based on data from the 2006 Behavioral Risk Factor Surveillance System.¹²⁶ Reported screening rates range from 48.7% in Oklahoma to 71.4% in Massachusetts.

Efforts to increase screening should specifically target socioeconomically disadvantaged women and recent immigrants, who are most likely to have the lowest rates of mammographic screening.^{127, 128} The Centers for Disease Control and Prevention's National Breast and Cervical Cancer Early Detection Program (NBCCEDP) was begun in 1990 to improve access to breast cancer screening and diagnostic services for low-income women; however, the CDC estimates that the program is currently only reaching about 16% of the women eligible to receive a screening mammogram, due in part to funding shortages.¹²⁹ The American Cancer Society is committed to helping increase funding for NBCCEDP in order to expand the number of women who can be served through the program.

Magnetic resonance imaging (MRI)

MRI uses magnetic fields instead of x-rays to produce very detailed, cross-sectional images of the body. MRI exams for breast imaging use a contrast material (usually gadolinium DTPA) that is injected into a small vein in the arm before or during the exam. This improves the ability of the MRI to capture detailed images of breast tissue. For certain women at high risk for breast cancer based on the previously outlined criteria (page 16), a screening MRI is recommended along with a yearly mammogram. MRIs are not meant to take the place of mammograms.

Table 7. Mammography Use, Women 40 and Older, US, 2005

Characteristic	% Mammogram within the past year*	% Mammogram within the past two years*
Age		
40-49	47.8	63.5
50-64	55.5	71.8
65+	50.2	63.8
Race/Ethnicity		
White (non-Hispanic)	52.9	68.1
African American (non-Hispanic)	49.9	64.9
Hispanic/Latina	41.7	59.6
American Indian and Alaska Native†	46.9	66.6
Asian American‡	37.9	54.2
Education		
Less than high school	40.4	53.0
High school graduate	49.0	64.4
Some college or AA degree	53.6	69.1
College graduate	60.2	76.8
Health insurance coverage		
Yes	54.1	69.8
No	24.1	33.2
Immigration§		
Born in US	52.2	67.2
In US less than 10 years	34.9	50.0
In US 10 or more years	46.0	63.3
Total	51.2	66.5

*Percentages are age-adjusted to 2000 US standard population. †Estimates should be interpreted with caution because of small sample sizes. ‡Does not include Native Hawaiians and other Pacific Islanders. §Definition has changed such that individuals born in the US or in a US territory are reported separately from individuals born outside of the US. Individuals born in a US territory have been in the US for any length of time.

Data source: National Health Interview Survey Public Use Data File 2005, National Center for Health Statistics, Centers for Disease Control and Prevention, 2006.

American Cancer Society, Surveillance Research, 2009

Just as mammography uses x-ray machines designed especially to image the breasts, breast MRI also requires special equipment. Higher-quality images are produced by dedicated breast MRI equipment than by machines designed for head, chest, or abdominal MRI scanning. However, many hospitals and imaging centers do not have dedicated breast MRI equipment available. It is important that screening MRIs are done at facilities that are capable of performing an MRI-guided breast biopsy at the time of the exam if abnormalities are found. Otherwise, the scan must be repeated at another facility at the time of the biopsy.

MRI is also more expensive than mammography. Most major insurance companies will likely pay for these screening tests if a woman can be shown to be at high risk. At this time there are concerns about costs of and access to high-quality MRI breast screening services for women at high risk of breast cancer.

Clinical breast examination (CBE)

For average-risk asymptomatic women in their 20s and 30s, it is recommended that a breast exam be a part of a regular health examination, preferably at least every 3 years. For women aged 40 and older, annual CBE can be an important complement to mammography, since a small percentage of cancers may be missed by mammography. Preferably, women should have their CBE shortly before their annual mammogram. For CBE, the woman undresses from the waist up. Using the pads of the fingers, the examiner gently feels the breasts, giving special attention to shape, texture, location of any lumps, and whether such lumps are attached to the skin or to deeper tissues. The breasts should also be inspected for skin changes (e.g., dimpling, redness) and asymmetry. The area under both arms will also be examined. CBE is also an opportunity for a woman and her health care provider to discuss changes in her breasts, early detection testing, and factors in the woman's history that might make her more likely to develop breast cancer. The duration of a properly conducted CBE is influenced by breast size and composition, but generally will take about 10 minutes.

Breast self-awareness

All women should become familiar with both the appearance and feel of their breasts to detect any changes and report them promptly to their physician. A woman who chooses to perform breast self-exams (BSE) should receive instructions and have her technique reviewed by a health care professional who performs clinical examinations. If symptoms develop after a recent, normal mammogram, a woman should not assume that it is nothing to worry about; she should contact her doctor immediately. Lumps are not necessarily abnormal, and for women who are still menstruating, they can appear and disappear with the menstrual cycle. Most lumps that are detected and tested are not cancerous.

The American Cancer Society believes the use of regular mammograms, MRI (in women at high risk), and clinical breast exams should be a part of every woman's preventive health care. Finding and reporting breast changes early offers women the best opportunity for reducing

Table 8. Mammography Use* by Age and Poverty Status†, US, Selected Years 1987-2005

Year	40-49 years			50-64 years			65 years and over		
	Poor	Near poor	Non-poor	Poor	Near poor	Non-poor	Poor	Near poor	Non-poor
1987	18.6	18.4	36.4	14.6	24.2	36.9	13.1	19.9	29.5
1990	32.2	39.0	60.1	29.9	39.8	63.3	30.8	38.6	51.5
1991	33.0	43.8	61.2	37.3	50.2	66.0	35.2	41.8	57.8
1994	44.3	50.9	67.4	44.7	50.3	75.1	43.2	47.9	64.9
1998	44.8	46.9	68.4	52.7	61.8	78.7	51.9	57.8	70.1
1999	51.3	52.8	71.6	63.3	64.9	80.2	57.6	60.2	72.5
2000	47.4	43.6	69.9	61.7	68.3	82.6	54.8	60.3	75.0
2003	50.6	54.0	68.3	58.3	64.0	80.9	57.0	62.8	72.6
2005	42.5	49.8	69.0	50.4	58.8	76.8	52.3	56.1	70.1

*Percent of women having a mammogram within the past two years. † Poor persons are defined as below the poverty threshold. Near poor persons have income of 100% to less than 200% of the poverty threshold. Non-poor persons have an income greater than or equal to 200% of the poverty level.

Data source: Data for 1987-2005 from *Health, United States, 2008*.

American Cancer Society, Surveillance Research, 2009

breast cancer deaths. The combined approach is clearly better than any single test. Breast physical exams without regular mammograms will miss many breast cancers that are too small for a woman or her doctor to feel but can be seen on mammograms. Although a mammogram is a sensitive screening method, a small percentage of breast cancers do not show up on mammograms but can be felt by a woman or her physician.

How is breast cancer treated?

Treatment decisions are made by the patient and her physician after consideration of the optimal treatment available for the stage and biological characteristics of the cancer, the patient’s age and preferences, and the risks and benefits associated with each treatment protocol. Most women with breast cancer will have some type of surgery. Surgery is often combined with other treatments such as radiation therapy, chemotherapy, hormone therapy, and/or biologic therapy. Treatment guidelines from the National Comprehensive Cancer Network are available via free registration on its Web site (nccn.org/professionals/physician_gls/PDF/breast.pdf).

Surgery

The primary goal of breast cancer surgery is to remove the cancer from the breast and to assess the stage of disease. In a lumpectomy, only cancerous tissue plus a rim of normal tissue is removed. Simple or total mastectomy includes removal of the entire breast. Modified radical mastectomy includes removal of the entire breast and lymph nodes under the arm, but does not include removal of the underlying chest wall muscle, as with a

radical mastectomy. Radical mastectomy is rarely used due to the proven effectiveness of less aggressive and disfiguring surgeries.¹³⁰

If a woman chooses to have a mastectomy, she may consider having the breast reconstructed. Breast reconstruction may be done with saline-filled or silicone-filled implants or tissue from other parts of her body. A woman considering this option should discuss this with her breast surgeon prior to her mastectomy surgery as it may influence the surgical site (inpatient vs. outpatient) and type of procedure.

Lumpectomy is almost always followed by about 5 to 7 weeks of radiation therapy. A woman who chooses lumpectomy and radiation will have the same expected long-term survival as if she had chosen mastectomy.¹³¹

Both lumpectomy and mastectomy are often accompanied by removal of regional lymph nodes from the axilla, or armpit, to determine if the disease has spread beyond the breast. The presence of any cancer cells in the lymph nodes will help determine the need for subsequent therapy and the course it should take. Sentinel lymph node biopsy, in which selected lymph nodes are removed and tested before any others are excised, may reduce the need for full axillary lymph node dissections among most women with no evidence of lymph node enlargement before surgery.¹³²⁻¹³⁴ Prior to surgery, patients should talk with their doctors to determine whether or not they intend to perform sentinel lymph node biopsy. If a woman is eligible for sentinel lymph node biopsy and wishes to have this procedure, her breast cancer surgery should be performed at a facility

Table 9. Mammography and Clinical Breast Exam, Women 40 and Older by State, US, 2006

	% Recent Mammogram*					% Recent Mammogram and Clinical Breast Exam†				
	40+ years	40-64 years	65+ years	No usual source of medical care‡	No health insurance§	40+ years	40-64 years	65+ years	No usual source of medical care‡	No health insurance§
Alabama	59.6	59.3	60.2	26.4	29.4	52.8	54.8	48.2	21.5	23.3
Alaska	55.7	53.9	63.5	37.5	45.8	50.8	49.7	56.2	34.7	38.7
Arizona	59.7	56.1	67.1	38.5	32.1	51.8	49.9	55.8	28.3	25.5
Arkansas	54.5	52.6	58.4	20.8	27.5	46.5	46.9	45.7	15.9	23.5
California	61.0	59.4	65.2	37.2	40.1	49.7	49.9	49.2	26.7	35.0
Colorado	56.4	55.3	59.7	27.2	27.1	49.0	49.1	48.6	22.1	25.6
Connecticut	69.9	69.1	71.7	35.8	43.8	62.0	63.3	59.1	25.0	38.0
Delaware	70.2	70.2	70.2	35.7	57.1	62.8	65.0	58.0	31.2	50.0
District of Columbia	64.2	63.0	66.8	39.5	36.6	57.5	58.7	55.0	33.5	32.3
Florida	64.8	61.0	71.2	32.8	33.4	54.9	54.1	56.2	24.5	27.8
Georgia	64.0	62.2	69.1	39.3	42.5	57.4	57.9	56.0	35.0	37.9
Hawaii	62.7	61.1	66.1	31.4	27.5	53.0	53.2	52.7	25.4	25.7
Idaho	51.2	47.6	59.9	24.7	21.8	45.3	43.1	50.5	22.7	19.1
Illinois	58.1	56.9	60.8	27.6	30.7	50.2	50.7	49.1	20.9	28.8
Indiana	54.2	53.0	56.8	27.3	28.8	46.2	47.0	44.4	20.5	24.1
Iowa	63.5	62.9	64.5	33.4	29.7	55.8	57.6	52.1	29.6	25.0
Kansas	60.3	58.1	64.9	22.5	31.0	53.2	53.1	53.5	19.8	26.9
Kentucky	57.6	56.4	60.5	27.1	29.3	49.1	49.2	48.8	21.2	26.2
Louisiana	61.3	60.5	63.2	36.5	36.9	54.1	55.1	51.9	31.1	32.5
Maine	68.0	66.7	70.8	26.9	38.5	60.7	61.4	59.2	20.9	33.0
Maryland	63.9	62.7	67.0	39.7	39.6	57.0	57.2	56.3	35.2	34.3
Massachusetts	71.4	70.2	74.1	37.4	61.0	62.8	63.8	60.6	29.8	56.8
Michigan	64.2	63.4	65.9	30.8	38.3	57.7	59.4	53.9	28.4	36.9
Minnesota	68.0	67.6	69.0	33.1	27.1	63.8	64.3	62.6	30.5	26.7
Mississippi	51.2	50.6	52.4	27.7	31.1	44.5	45.3	42.7	23.5	25.3
Missouri	56.6	57.1	55.5	25.2	23.1	47.2	50.5	40.0	22.6	21.4
Montana	57.4	55.1	62.7	33.4	28.9	51.0	50.5	52.1	26.3	24.2
Nebraska	59.6	59.3	60.2	30.8	39.8	53.0	55.3	48.2	26.2	35.2
Nevada	54.5	54.7	54.0	26.7	34.0	47.1	48.7	42.8	22.6	31.7
New Hampshire	66.1	65.5	67.8	20.2	31.6	60.5	61.8	57.0	20.0	30.6
New Jersey	63.8	64.8	61.5	43.0	44.1	56.1	58.5	50.9	37.8	34.1
New Mexico	52.1	51.1	54.3	26.2	28.4	45.2	45.6	44.2	20.4	23.7
New York	65.0	63.8	67.7	37.7	46.8	57.1	58.3	54.5	26.3	37.4
North Carolina	63.9	63.5	64.9	34.4	35.9	53.9	55.3	50.5	28.6	29.8
North Dakota	63.0	62.0	65.1	40.7	50.2	56.0	57.4	53.3	36.0	48.8
Ohio	61.0	58.9	65.7	27.1	49.5	53.0	54.5	49.5	24.1	44.1
Oklahoma	48.7	46.9	52.5	21.7	26.2	41.1	41.6	39.9	18.9	24.3
Oregon	61.1	57.6	69.1	25.9	26.3	52.3	51.0	55.5	19.4	23.8
Pennsylvania	62.2	60.8	64.8	31.6	26.2	54.9	55.4	53.9	30.2	23.0
Rhode Island	70.8	71.0	70.3	41.0	50.3	64.8	66.9	60.5	37.1	46.2
South Carolina	57.4	55.7	61.2	26.3	34.0	49.2	49.3	48.9	22.3	28.8
South Dakota	59.1	56.5	63.9	30.1	29.9	51.9	51.9	52.1	27.5	27.3
Tennessee	61.7	61.1	63.0	39.9	37.0	55.6	56.5	53.3	34.0	31.3
Texas	56.0	54.0	61.4	27.2	30.2	50.4	50.4	50.2	24.9	26.7
Utah	48.9	45.7	57.0	21.0	22.2	39.5	38.6	41.8	16.4	18.0
Vermont	64.2	62.7	67.8	28.1	38.0	56.5	57.5	54.1	25.7	33.4
Virginia	62.2	60.6	66.5	33.5	25.2	54.6	55.0	53.4	28.1	23.9
Washington	59.5	57.4	65.0	27.5	29.4	51.7	51.6	51.8	23.2	26.0
West Virginia	61.9	61.5	62.7	27.0	28.3	54.2	56.6	49.3	24.6	26.1
Wisconsin	62.2	60.9	65.2	20.6	38.0	57.8	57.3	58.9	19.1	36.5
Wyoming	52.7	50.0	59.6	29.2	22.2	45.3	44.7	47.1	24.5	19.1
United States¶	61.2	59.7	64.6	32.2	34.9	53.2	53.8	51.9	26.2	30.3
Range	48.7-71.4	45.7-71.0	52.4-74.1	20.2-43.0	21.8-61.0	39.5-64.8	38.6-66.9	39.9-62.6	15.9-37.8	18.0-56.8

*A mammogram within the past year. †Both a mammogram and clinical breast exam within the past year. ‡Women 40 and older who reported that they did not have a personal doctor or health care provider. §Women aged 40 to 64 who reported that they did not have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare. ¶See Statistical Notes for definition.

Data source: Behavioral Risk Factor Surveillance System Public Use Data Tape 2006, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2007.

American Cancer Society, Surveillance Research, 2009

with a medical care team experienced with the technique. Sentinel lymph node biopsy is now widely available in the US.

Surgery and radiation therapy involving the axillary nodes can lead to lymphedema, a serious swelling of the arm caused by retention of lymph fluid. Sentinel lymph node biopsy is associated with lower rates of lymphedema, which was one of the motivations for the development of this technique.^{133, 135} Most women will not develop this side effect, but many will and others may develop a mild form of lymphedema. Lymphedema can occur soon after surgery or months to years later. Early recognition and management of lymphedema are important to minimize complications related to this incurable condition. In order to prevent lymphedema, women should utilize arm exercises and skin care to take care of the arm and hand on the treated side of the body for the rest of their lives, and if any swelling is experienced, they should see their doctor immediately.

Radiation therapy

Radiation may be used to destroy cancer cells remaining in the breast, chest wall, or underarm area after surgery, or to reduce the size of a tumor before surgery.¹³⁶ There are two types of radiation therapy. External radiation is the usual type of radiation for women with breast cancer. Radiation is focused from a machine outside the body on the area affected by cancer. This usually includes the whole breast and, depending on the size and extent of the cancer, may include the chest wall and underarm area as well. External beam radiation therapy is typically administered over a period of 5 to 7 weeks. Internal radiation therapy, known as brachytherapy, uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer. Some patients are treated with both internal and external radiation therapies in combination. The way the radiation therapy is given depends on the type, stage, and location of the tumor being treated. The ability to target radiation therapy accurately has increased dramatically in recent decades, which has greatly diminished side effects and can also reduce treatment time. For example, one form of brachytherapy (MammoSite) is given for only 5 days. Researchers are studying a new technique called accelerated partial breast irradiation (APBI), which is designed to give radiation to a smaller segment of the breast also over a period of 5 days.¹³⁷

Radiation to the breast is almost always recommended after a lumpectomy, and in some circumstances,

following mastectomy. Radiation of the chest wall may be recommended for a woman with positive lymph nodes, a very large tumor, or close or positive pathologic margins, even though her breast has been removed.

Systemic therapy

Systemic therapy uses anti-cancer drugs that are injected into a vein or given by mouth. These drugs travel through the bloodstream to all parts of the body. Systemic therapy includes biologic therapy, chemotherapy, and hormone therapy. Systemic treatment given to patients before surgery is called neoadjuvant therapy. It is often used to shrink the tumor enough to make surgical removal possible or allow for less extensive surgery. This may allow women otherwise needing mastectomy to undergo breast-conserving surgery. Neoadjuvant therapy has been found to be as effective as therapy given after surgery in terms of survival, disease progression, and distant recurrence.¹³⁸

Systemic treatment given to patients after surgery is called adjuvant therapy. After all visible cancer has been surgically removed, it is used to kill any undetected tumor cells that may have migrated to other parts of the body. Tumor size, histology, and the presence of cancer in axillary nodes are considered in the decision whether to use adjuvant systemic therapy.

Systemic therapy is also used in treating women with metastatic breast cancer.¹³⁹ In such conditions, removal of most of the cancer by surgery is not possible, and therefore systemic therapies are the main treatment option.

Biologic therapy

Approximately 15%-30% of breast cancers overproduce the growth-promoting protein HER2/neu. These tumors tend to grow faster and are generally more likely to recur than tumors that do not overproduce HER2. Herceptin (trastuzumab) is a monoclonal antibody that directly targets the HER2 protein of breast tumors and offers a survival benefit for some women with metastatic breast cancer.¹⁴⁰⁻¹⁴² More recently, trastuzumab has been shown to be effective in early-stage breast cancer that overexpresses HER2. The combined results of two large trials indicate that adding trastuzumab to standard chemotherapy for early-stage HER2 positive breast cancer reduced the risk of recurrence and death by 52% and 33%, respectively, compared to chemotherapy alone.¹⁴³ In 2006, the FDA approved trastuzumab for all HER2-positive breast cancers. All invasive breast cancers should be tested for the HER2 gene amplification or protein overexpression in order to identify women who

Clinical Trials

A clinical trial is a controlled experiment that is used to assess the safety and efficacy of treatments or other interventions for human disease and health problems. Generally, participants receive either the state-of-the-art standard treatment or a new therapy that may offer improved survival and/or fewer side effects. Participation in clinical trials provides essential information on the effectiveness and risks of a new treatment. Patients can visit the American Cancer Society Clinical Trials Matching Service at cancer.org/clinicaltrials or call the American Cancer Society Clinical Trials Matching Service (1-800-303-5691) to identify clinical trial options. This free and confidential service can help patients, their families, and health care workers locate a cancer clinical trial most appropriate to a patient's medical and personal situation. The Physicians Data Query (PDQ) program of the National Cancer Institute (NCI) contains summaries of cancer clinical trials that are open for patient participation. Patients can obtain PDQ information from their physician, by contacting the NCI Cancer Information Service at 1-800-4-CANCER, or from the NCI Clinical Trials Web page at cancer.gov/clinicaltrials. Patients should consult their personal doctors and cancer specialists for detailed information about appropriate treatment options.

would benefit from this therapy. New guidelines were recently released aimed at improving the accuracy of HER2 testing.¹⁴⁴

Another drug, Lapatinib, has been found to be effective in delaying disease progression in women with HER2-positive, advanced breast cancer who have become resistant to trastuzumab. A new generation of anti-HER2 targeted therapies are currently in development.¹⁴⁵

In 2008, the FDA granted approval for the use of bevacizumab (Avastin) for advanced breast cancer. Bevacizumab, a monoclonal antibody against circulating vascular endothelial growth factor, slows tumor growth in women whose cancer has metastasized by blocking growth of new vessels that increase blood supply to the tumor. However, bevacizumab has not been shown to increase survival.

Chemotherapy

The benefit of chemotherapy is dependent on multiple factors including the size of the cancer, the number of lymph nodes involved, the presence of estrogen or progesterone receptors, and the amount of HER2/neu protein made by the cancer cells. Research has established that, in most cases, combinations of drugs are more effective than just one drug alone for breast cancer treatment.¹⁴⁶ Many combinations are being used, and it is not clear that any single combination is the best.¹³⁹ The most common drugs recommended to be used in combination in early breast cancer are cyclophosphamide, methotrexate, fluorouracil, doxorubicin (Adriamycin), epirubicin, paclitaxel (Taxol), and docetaxol (Taxotere). Depending on the combination of drugs that is used, adjuvant chemotherapy is usually given for 3 to 6 months. Chemotherapy is most effective when the full dose and cycle of drugs is completed in a timely manner. These and other chemotherapy drugs may also be

used to shrink cancer that has metastasized (spread to distant organs).

Hormone therapy

Estrogen, a hormone produced by the ovaries, promotes the growth of many breast cancers. Women whose breast cancers test positive for estrogen receptors can be given hormone therapy to block the effects of estrogen on the growth of breast cancer cells. Tamoxifen is effective in both postmenopausal and premenopausal patients whose cancers are positive for hormone receptors. The current recommendation is for 5 years of tamoxifen therapy, which has been shown to provide a 41% reduction in the annual recurrence rate and a 33% reduction in the death rate.¹⁴⁷

A class of drugs known as aromatase inhibitors (AIs) are also used in treating both early and advanced breast cancer. These drugs are letrozole, anastrozole, and exemestane. They work by blocking an enzyme responsible for producing small amounts of estrogen in postmenopausal women. AIs are not an effective treatment in premenopausal women because they cannot stop the ovaries from producing estrogen. Clinical trials have been conducted comparing one of the AIs with tamoxifen for a total of 5 years and adding treatment with an AI following 2 to 6 years of tamoxifen.¹⁴⁸⁻¹⁵³ In each of these studies, there has been a clear advantage to using either an AI instead of tamoxifen for a total of 5 years or switching to an AI after several years of tamoxifen, rather than keeping postmenopausal women on tamoxifen alone for 5 years. Clinical trials continue to assess which of these strategies is best. AIs have fewer side effects than tamoxifen because they do not cause endometrial cancer and very rarely cause blood clots. They can, however, cause osteoporosis, bone fractures, and other musculoskeletal symptoms because they

completely deplete postmenopausal woman of estrogen. Many doctors prefer AIs over tamoxifen as the first hormonal treatment for hormone receptor-positive breast cancer in postmenopausal women.

What research is currently being done on breast cancer?

Risk factors

Many studies are currently under way to help find the causes of breast cancer. One particular study, known as the Sister Study, will follow for at least 10 years 50,000 women who have a biological sister who was diagnosed with breast cancer and will collect information about genes, lifestyle, and environmental factors that may cause breast cancer.¹⁵⁴ Enrollment for the Sister Study was completed on March 31, 2009. An offshoot of this study called the Two Sister Study is also under way and is enrolling 2,000 sisters of Sister Study participants who were diagnosed with breast cancer before age 50. The goal of the Two Sister Study is to investigate the genetic and environmental causes of young-onset breast cancer.¹⁵⁵

The Breast and Prostate Cancer and Hormone-related Gene Variants Cohort Consortium (BPC3 Study), established in 2003, is a collaboration to pool data among six large-scale cohorts.¹⁵⁶ By combining data across studies, the investigators are examining the role of genes and gene-environment interactions in the development of cancer in the large and powerful combined dataset.

Prevention

Aromatase inhibitors have proven more effective than tamoxifen in preventing recurrence in postmenopausal women with early-stage breast cancer and are associated with fewer side effects than tamoxifen.¹⁵⁷ Like tamoxifen, AIs are also expected to be effective in preventing estrogen-dependent breast cancers. Two international trials are currently examining the effectiveness of AIs for chemoprevention in high-risk postmenopausal women.¹⁵⁸ The British IBIS-II study is comparing anastrozole to placebo for 5 years in 6,000 post-menopausal women who are at increased risk of breast cancer. Results of the study are expected in 2012. The MAP3 study is comparing exemestane to placebo in a similar group of about 4,500 women at increased risk for breast cancer. Results should be available in late 2010. Smaller studies are also being done with letrozole.

Early-phase cancer prevention trials are now under way to test other drugs (e.g., tyrosine kinase inhibitors,

retinoids, and COX2 inhibitors) that may be effective in preventing estrogen-receptor negative breast cancer and to determine if they are safe for use in high-risk women without breast cancer.¹⁵⁹ It is hoped that in the future, drugs will be available for high-risk women that effectively prevent all forms of breast cancer.

Some women who are diagnosed with breast cancer in one breast choose to have the second breast removed. This is known as contralateral prophylactic mastectomy (CPM). Recent studies have shown marked increases in the rate of CPM for women diagnosed with stages I-III breast cancer, as well as DCIS.^{160, 161} Although CPM nearly eliminates the risk of developing a breast cancer in the second breast, there is little evidence that it improves long-term breast cancer survival.¹⁶² Not all women have the same risk for developing a contralateral breast cancer. A recent study suggests that certain characteristics may better predict those women for whom CPM may offer the greatest benefit.¹⁶³

Early detection

Results from a large clinical trial of digital vs. film mammography reported that digital mammography performed significantly better than conventional film mammography for pre- and peri-menopausal women younger than age 50 with dense breasts.¹²⁶ About 20% of US screening clinics now offer digital mammography. Digital tomosynthesis, an extension of digital mammography, is another area of promising screening research. Tomosynthesis consists of multiple digital x-ray images that allow the breast to be viewed as many thin slices and also can be combined into a three-dimensional picture. It may improve detection in women with dense breast tissue and is also hoped to reduce the rate of false-positives.¹⁶⁴ This technology is still considered experimental and is not yet commercially available.

Women with dense breast tissue have an increased risk of breast cancer; however, recent research indicates that increasing breast density over time may be a more accurate predictor of future breast cancer.¹⁶⁵ Future studies will focus on identifying the best time to measure breast density and how to incorporate this information into risk prediction models.

Among women with newly diagnosed breast cancer, MRI has been shown to be useful in detecting cancer in the contralateral (opposite) breast.¹⁶⁶ Diagnosing the second breast cancer earlier could help women make treatment decisions and might spare them from extra rounds of surgery and chemotherapy later.

Goals for a National Breast Cancer Research Agenda

In 1998, the Breast Cancer Progress Review Group, a collaboration organized by the National Cancer Institute of prominent members of the scientific, medical, advocacy, and industry communities, released its recommendations for a national breast cancer research agenda.¹⁶¹ The report included research goals in biology, etiology, genetics, prevention, detection and diagnosis, treatment, control, and outcomes. Among the goals in these eight areas are:

- To expand knowledge of normal breast development and the earliest breast lesions
- To identify modifiable risk factors, and to investigate the interaction between genes and environment
- To identify genetic mutations that occur at each stage of breast cancer development and progression, and evaluate these changes as targets for intervention
- To identify surrogate endpoint biomarkers to serve as early indicators of intervention effectiveness
- To develop better breast imaging and other technologies for diagnosis of clinically significant disease and better prediction of clinical outcomes
- To encourage development of innovative treatments in academic settings, and to test their effectiveness through better supported, more representative clinical trials
- To gain fuller understanding of mechanisms underlying behavioral change, and identify how psychosocial factors influence disease response and survival
- To better understand the effects of multimodality treatments, and to improve methods to study patient-focused outcomes across the continuum of age and race/ethnicity

Treatment

Gene expression analysis has led to the identification of molecularly defined subtypes of breast cancer that have distinct biological features, clinical outcomes, and responses to chemotherapy. Treatment strategies are now being developed based on an individual's tumor characteristics. A patient's response to chemotherapy is influenced not only by the tumor's genetic characteristics but also by inherited variation in genes that affect a person's ability to absorb, metabolize, and eliminate drugs. This knowledge should aid in the design of more effective and less toxic chemotherapeutic agents.

Postmenopausal breast cancer patients with hormone receptor-positive disease were historically given tamoxifen and are now often treated with an aromatase inhibitor to prevent breast cancer recurrence. Aromatase inhibitors have shown improved survival compared to tamoxifen; however, a new study indicates that the benefit of tamoxifen may vary according to the genotype of the patient.¹⁶⁷

Zoledronic acid (Zometa), a bisphosphonate drug used to treat bone metastases and recently approved to treat osteoporosis, appears to significantly reduce the risk of recurrence in early-stage hormone-receptor positive breast cancer when used in combination with hormonal therapy.¹⁶⁸ Future research will focus on determining

which patients will benefit the most from this therapy and optimizing the administration schedule and dose.

As a result of decades of basic molecular biology research, many new drugs are being studied that target the genetic changes that cause cells to become cancerous. Tyrosine kinase inhibitors are one class of these targeted therapies that have demonstrated benefits in patients with advanced disease and may also delay or reverse hormone resistance. Metronomic therapy is a relatively new concept in antiangiogenic therapy (drugs such as bevacizumab that block blood supply to the tumor) that uses much lower and less toxic doses of chemotherapy agents than currently used, in combination with an antiangiogenesis drug.¹⁶⁹ Preclinical studies have shown promising results using metronomic therapy to slow the progression of disease in patients with metastatic breast cancer.^{170, 171}

Another new class of drugs, Poly(ADP-ribose)polymerase (PARP) inhibitors, appears to be particularly effective in cancers with mutations in the breast cancer-associated genes (BRCA1 and BRCA2).¹⁷² PARPs are involved in DNA repair and transcriptional regulation, which are recognized as key regulators of cell survival and cell death. By inhibiting PARP-1, these drugs have been shown to enhance the therapeutic effects of radiation and chemotherapy agents. There are currently at least 5 PARP inhibitors in clinical trial development.

Advances in chemotherapy have had less of an impact on survival for women with ER-positive tumors compared to those with lymph node-positive, ER-negative tumors (although ER-positive patients who receive adjuvant hormonal therapy still have better disease-free survival and overall survival than ER-negative patients). Research is under way to identify which women with ER-positive disease truly benefit from the addition of chemotherapy to hormonal therapy. This research includes a clinical trial initiated in May 2006 known as TAILORx that uses information on the expression of 21 genes in breast tumor tissue (using a tool called Oncotype DX) to assign women to treatment groups based on their predicted likelihood of recurrence.¹⁷³

Quality of life

Breast cancer treatment can result in a variety of short- and long-term side effects that affect quality of life, including psychological distress, hormonal symptoms, and fatigue. In fact, fatigue may persist for up to 10 years in one-third of women treated for breast cancer.¹⁷⁴ Physical activity has been shown to alleviate some of the side effects associated with breast cancer and its treatment, such as fatigue, depression, and anxiety.¹⁷⁵ Results of a recent study show that meeting recommended physical activity levels was associated with better quality of life in non-Hispanic white and African American breast cancer survivors.¹⁷⁶ In addition, it has recently been suggested that moderate-intensity physical activity may affect breast cancer prognosis by reducing the risk of mortality by 64%.¹⁷⁷

What resources are available in your community?

The American Cancer Society offers several resource programs for breast cancer patients and their families to guide them through every step of the cancer experience so they can focus on getting well. Help and information is also available around the clock by calling the American Cancer Society at 1-800-227-2345 or visiting cancer.org.

Reach to Recovery®

Breast cancer survivors provide one-on-one support and information to help individuals cope with breast cancer. Specially trained survivors serve as volunteers, responding by phone or in person to the concerns of people facing a breast cancer diagnosis, treatment, recurrence, or recovery.

I Can Cope®

Adult cancer patients and their loved ones learn ways to navigate the cancer experience while building their knowledge, coping skills, and positive attitude. In this series of educational classes, doctors and other health care professionals provide information, encouragement, and practical tips in a supportive environment.

Look Good...Feel Better®

Through this free service, women in active cancer treatment learn techniques to restore their self-image and cope with appearance-related side effects. Certified beauty professionals provide tips on makeup, skin care, nail care, and head coverings. This program is a collaboration of the American Cancer Society with the Cosmetic, Toiletry, and Fragrance Association and the National Cosmetology Association.

“tlc” – Tender Loving Care®

A magazine and catalog in one, “tlc” supports women dealing with hair loss and other physical side effects of cancer treatment. The “magalog” offers a wide variety of affordable products, such as wigs, hats, and prostheses, through the privacy and convenience of mail order.

Hope Lodge®

Hope Lodge is a home-like environment providing free, temporary accommodations for cancer patients undergoing treatment and their family members. It makes the cancer treatment process a little easier by providing a supportive environment and lifting the financial burden of an extended stay.

Cancer Survivors NetworkSM

Created by and for cancer survivors, the Cancer Survivors Network (CSN) is a unique, Web-based support service designed not only for survivors, but for anyone dealing personally with cancer. Read discussions and stories, find and connect with others like yourself, and much more.

American Cancer Society Web Site and National Cancer Information Center

For comprehensive cancer information and for more information about the programs listed above, call the American Cancer Society toll free at 1-800-227-2345 (available 24 hours a day) or visit the American Cancer Society Web site at cancer.org.

Other sources of patient information and support include:

Encore Plus Program of the YWCA Office of Women's Health Initiatives

A program that targets medically underserved women in need of early detection education, breast and cervical cancer screening, and support services. It provides women in treatment and recovering from breast cancer with a unique combined peer group support and exercise program. Call 1-888-953-9922 to find a program in your area.

National Breast and Cervical Cancer Early Detection Program

Telephone: 1-800-CDC-INFO or 1-800-232-4636
cdc.gov/cancer/nbccedp/

This Centers for Disease Control and Prevention (CDC) program helps low-income women gain access to timely, high-quality screening programs for the detection of breast and cervical cancer.

National Breast Cancer Coalition

Telephone: 1-800-622-2838
natlbcc.org

A grassroots advocacy movement dedicated to the eradication of breast cancer through research, access, and influence

National Cancer Institute (NCI) Cancer Information Service

Telephone: 1-800-4-CANCER or 1-800-422-6237
cancer.gov

A nationwide telephone service that provides general cancer information for cancer patients and their families and friends, the public, and health care professionals

Sisters Network

Telephone: 1-866-781-1808
sistersnetworkinc.org

A national African American breast cancer survivors support group committed to increasing local and national attention to the devastating impact that breast cancer has in the African American community

Susan G. Komen for the Cure

Telephone: 1-877-GO-KOMEN or 1-877-465-6636
komen.org

A national volunteer organization working to eradicate breast cancer by advancing research, education, screening, and treatment. The helpline is answered by trained volunteers who provide information to callers with breast health or breast cancer concerns.

YourShoes 24/7 Breast Cancer Support Center

Telephone: 1-800-221-2141 (English),
1-800-986-9505 (Spanish)
networkofstrength.org

A 24-hour hotline staffed by trained peer counselors who are breast cancer survivors. YourShoes provides information on breast cancer and breast health to anyone touched by or concerned about this disease.

What is the American Cancer Society doing about breast cancer?

The American Cancer Society is saving lives from breast cancer by helping people stay well by taking steps to reduce the risk of breast cancer or detect it early, when it is most treatable; helping people get well by guiding them through every step of the cancer experience; by funding and conducting groundbreaking research to discover breast cancer's causes and effective ways to treat and help cure it; and by fighting back by working with legislators to pass laws that defeat cancer and rallying communities to join the fight.

Since 1971, the American Cancer Society has awarded approximately \$388.4 million in breast cancer research grants. As of January 19, 2009, through its extramural research grants program, the American Cancer Society funds 218 extramural research projects relating to breast cancer, totaling \$117.1 million.

Specific examples of ongoing breast cancer research being conducted by Society grantees include:

- Examining reasons for breast cancer treatment differences between African American and white women, including differences in delays in starting treatment, less-frequent treatment, and choice of mastectomy over lumpectomy in African American women. Findings will help inform strategies to minimize racial differences in the treatment of breast cancer.
- Exploring new therapies for the treatment of breast cancer targeting cells of the immune system. Recent

clinical and experimental evidence suggests a causal link between inflammation and breast cancer development and progression. This study will evaluate whether the immune system plays a role in inflammatory responses that promote cancer progression. Results will provide insight necessary to develop and evaluate new therapeutic approaches and define which patients might most benefit.

- Identifying and cataloging ribonucleic acids (RNAs) that are characteristic of normal and breast cancer tissues, with the goal of generating an “RNA fingerprint” of breast cancer. Recent research has established that there are thousands of RNAs that do not encode proteins but which are fundamentally important for the survival and development of cells. Sets of these RNAs will be tested to determine their use in predicting breast cancer disease progression. Researchers believe these RNA fingerprints may prove useful in detecting breast cancer at an early stage and allow for more effective treatments.
- Evaluating factors that influence mammography interpretation by radiologists, developing a test set that identifies radiologists that could benefit from additional training, and creating a continuing medical education course that reduces recall rates while maintaining or improving cancer detection. This project, co-funded with the National Cancer Institute, was designed in direct response to the Institute of Medicine’s report “Improving Breast Imaging Quality Standards,” which highlighted the need to decrease variability in mammography interpretation in the US and identified issues stalling the reauthorization of the Mammography Quality Standards Act.

The Society also internally conducts epidemiologic studies of breast cancer and performs surveillance research to monitor long-term trends and statistics. Using information collected from more than 600,000 women in the Cancer Prevention Study II, American Cancer Society epidemiologists study the influence of many risk factors including alcohol consumption, diethylstilbestrol (DES), estrogen hormone use, family history of cancer, obesity, smoking, and spontaneous abortion on the risk of death from breast cancer. The American Cancer Society is currently enrolling cancer-free adults in the Cancer Prevention Study-3 (CPS-3). These men and women will be followed for 20 to 30 years to gain a better understanding of the lifestyle,

behavioral, environmental, and genetic factors that cause or prevent cancer.

American Cancer Society epidemiologists have also studied the influence of mammography on breast cancer prognostic factors, conducted long-term follow-up of major breast cancer screening studies, and recommended breast cancer surveillance strategies that can be applied at the local and national levels.

In addition, the Society’s Behavioral Research Center is currently conducting a study of cancer survivors to examine the determinants of a good quality of life following a breast cancer diagnosis. Specific areas of interest include identifying the unmet needs of cancer survivors and their caregivers, the use of complementary therapies, and the needs of minority women with breast cancer.

The surveillance group has recently reported the widening of breast cancer mortality between white and African American women, the lack of/lower reduction in breast cancer death rates in less-educated women and in women residing in southern states, disparities in the receipt of sentinel lymph node biopsy in women with early-stage breast cancer, and the greater likelihood for patients without health insurance or with Medicaid coverage to present with advanced stage breast cancer.

Collaborative relationships and partnerships are established to achieve goals greater than could be achieved individually. The American Cancer Society devotes significant resources to the education of the public and health care professionals. An educational partnership with the African Methodist Episcopal Church, the National Hispanic Medical Association, and Conrad & Associates resulted in the production of the short film and guidebook *Taking Charge of Breast Cancer: A Guide for African American Women*. Similarly, a collaboration with the National Hispanic Medical Association, the League of United Latin American Citizens, and Conrad & Associates yielded a short film and guidebook that included information on breast cancer early detection and treatment options specifically targeting Hispanic underserved women. In 2008, the Society was awarded a CDC grant to revise and expand the Circle of LifeSM initiative aimed at reaching out to and partnering with American Indian and Alaska Native (AIAN) communities. With an emphasis on reaching the medically underserved, Circle of Life enables the Society to work with and through AIAN community-based groups to address the needs of patients, caregivers, and families

across the cancer continuum. Since 1995, the American Cancer Society has joined with the Longaberger Company in the Horizon of Hope® campaign, which provides information to millions of women attending home shows about the importance of breast cancer early detection and the resources available through the American Cancer Society. Funds generated through this relationship support breast cancer research and education projects in areas that include improving access to high-quality mammography screening and meeting the psychosocial needs of women with breast cancer.

The American Cancer Society and its nonprofit, nonpartisan advocacy affiliate, the American Cancer Society Cancer Action NetworkSM (ACS CAN), are involved in advocacy efforts at both the federal and state levels that seek to increase access to quality breast cancer screenings, diagnostic services and treatment, and care for all women; increase government funding for breast cancer research; and be a voice for the concerns of breast cancer patients and survivors. Below are some of the efforts that the American Cancer Society and ACS CAN have been involved with in the past few years to fight back against breast cancer – and all cancers:

- **Improving Access to Prevention and Early Detection Services, Meaningful Health Insurance, and Quality of Life:** In 2006, the American Cancer Society launched a nationwide initiative to improve access to quality health care. The Society recognized that the current health care system is fragmented and faces many complex challenges, so signature areas in which the Society and ACS CAN could achieve the greatest impact were defined and geared to align with patients' needs: prevention and early detection, meaningful health insurance, and quality of life throughout life. ACS CAN's legislative efforts have focused on health care reform to improve our nation's health system. The American Cancer Society and ACS CAN have elevated the health care reform debate at the national level through the "cancer lens."
- **Expanding the National Breast and Cervical Cancer Early Detection Program (NBCCEDP):** The American Cancer Society and ACS CAN continue to successfully lobby for millions of dollars at the state and federal levels to support this program that provides low-income, uninsured, and underinsured women access to breast and cervical cancer screening tests and follow-up services.
- **Protecting the Breast and Cervical Cancer Prevention and Treatment Act:** This act ensures that low-income women diagnosed with cancer through the NBCCEDP are eligible for Medicaid coverage for their treatment. ACS CAN continues to advocate at the state level to protect Medicaid dollars so that there is sufficient funding for treatment of these women.
- **Funding the Patient Navigator Program:** ACS CAN continues the fight for more funding for the Patient Navigator Program, which Congress passed with bipartisan support to place trained "navigators" in health facilities to help medically underserved populations get the quality care they need. Navigators improve mammography compliance rates and follow-up and decrease the average length of time between initial breast exams and biopsies to a rate comparable to patients in private care.
- **Eliminating Medicare Co-pays for Breast Cancer Screening Services:** Legislation is proposed to eliminate Medicare co-pays for mammography, which will help remove the financial barrier to these critical services, allowing more beneficiaries to receive these lifesaving screenings.
- **Funding for Cancer Research:** The American Cancer Society and ACS CAN continue to work to increase government funding for cancer research at the National Institutes of Health, including the National Cancer Institute and the National Center on Minority Health and Health Disparities.

Sources of statistics

General information. The statistics and statements in this booklet, unless otherwise stated, refer to invasive (not in situ) breast cancer.

New cancer cases. The estimated numbers of new US cancer cases are projected using a spatiotemporal model based on incidence data from 41 states and the District of Columbia for the years 1995-2005 that met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard for incidence, which covers about 85% of the US population. This method considers geographic variations in socio-demographic and lifestyle factors, medical settings, and cancer screening behaviors as predictors of incidence, as well as accounting for expected delays in case reporting. For more information about the method, see Pickle L, Hao Y, Jemal A, et al. *CA Cancer J Clin.* 2007;57:30-42.

Incidence rates. Incidence rates are defined as the number of people per 100,000 who develop disease during a given time period. When referenced as such, US SEER incidence rates were previously made available on SEER's Web site (seer.cancer.gov) and within the *SEER Cancer Statistics Review 1975-2006*.³ When not referenced otherwise, US SEER incidence rates are based on American Cancer Society analysis of the SEER Public Use Dataset, 1973-2006, November 2008 submission, using *SEER*Stat 6.5.1*, a statistical software package from the National Cancer Institute.¹⁷⁸ Note that because of delays in reporting newly diagnosed cancer cases to the cancer registries, cancer incidence rates for the most recent diagnosis years may be underestimated. Incidence rates adjusted for delays in reporting are used when available and are referenced as such. State incidence rates were previously published in *Cancer in North America, 2002-2006*, a publication of the North American Association of Central Cancer Registries (NAACCR).⁴ These rates were calculated using data on cancer cases collected by the SEER program and National Program of Cancer Registries programs and population data collected by the US Bureau of the Census. Except for the age-specific incidence rates described in Figure 1 (page 2), all incidence rates in this publication are age-adjusted to the 2000 US standard population. When not referenced otherwise, annual percent changes in the incidence rate were estimated based on American Cancer Society analysis of the SEER

Public Use Dataset, 1975-2006, November 2008 submission, using *SEER*Stat 6.5.1*.¹⁷⁹

Cancer deaths. The estimated number of US breast cancer deaths in 2009 is calculated by fitting the numbers of cancer deaths from 1969 through 2006 to a statistical forecasting model. Data on the number of deaths are obtained from the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention. For more information about the method, see Tiwari, et al. *CA Cancer J Clin.* 2004;54:30-40.

Mortality rates. Similar to incidence rates, mortality rates are defined as the number of people per 100,000 who die from a disease during a given time period. Death rates used in this publication were previously made available by SEER on their Web site (seer.cancer.gov) and within the *SEER Cancer Statistics Review 1975-2006*.³ Death rates were calculated using data on cancer deaths compiled by NCHS and population data collected by the US Bureau of the Census. All death rates in this publication were age-adjusted to the 2000 US standard population.

Survival rates. Five-year survival statistics are based on cancer patients diagnosed between 1999-2005, 10-year survival rates are based on diagnoses between 1995-2005, and 15-year survival rates are based on diagnoses between 1989-2005. All patients were followed through 2006. Relative survival rates are used to adjust for normal life expectancy (and events such as death from heart disease, accidents, and diseases of old age). Relative survival is calculated by dividing the percentage of observed 5-year survival for cancer patients by the 5-year survival expected for people in the general population who are similar to the patient group with respect to age, sex, race, and calendar year of observation. Relative survival rates are not calculated for Hispanics/Latinos, Asian Americans/Pacific Islanders, and American Indians/Alaska Natives because reliable estimates of normal life expectancy are not available for these groups. Therefore, cause-specific survival rates are presented. Cause-specific survival rates are the probability of not dying of breast cancer within 5 years after diagnosis. Cause-specific survival does not account for stage and age at diagnosis. When referenced as such, 5-year survival statistics were originally published in *SEER Cancer Statistics Review, 1975-2006*.³



Probability of developing cancer. Probabilities of developing breast cancer were calculated using DevCan (Probability of Developing Cancer Software) developed by the National Cancer Institute.¹⁷⁸ These probabilities reflect the average experience of women in the US and do not take into account individual behaviors and risk factors (e.g., utilization of mammography screening and family history of breast cancer).

Prevalence of mammography. The prevalence of mammography by age and state was obtained through analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS).¹²⁷ The BRFSS is an ongoing system of surveys conducted by the state health departments in cooperation with the Centers for Disease Control and Prevention. The prevalence of mammography by race/ethnicity is from the National Health Interview Survey.¹⁸⁰

Factors that influence cancer rates

Age adjustment to the year 2000 standard. Epidemiologists use a statistical method called “age adjustment” to compare groups of people with different age compositions. This is especially important when examining cancer rates, since cancer is generally a disease of older people. For example, without adjusting for age, it would be inaccurate to compare the cancer rates of Florida, which has a large elderly population, to that of Alaska, which has a younger population. Without adjusting for age, it would appear that the cancer rates in Florida are much higher than Alaska. However, once the adjustment is made for age, it appears their rates are similar.

Change in population estimates. Cancer rates are also affected by changes in population estimates, which are the basis for calculating rates for new cancer cases and deaths. The Census Bureau updates and revises population estimates every year. The Bureau calculates “intercensal” estimates after a new census is completed – for example, using information from both the 1990 and 2000 censuses, the Bureau obtains better estimates for the 1990s. These revisions are based on the most recent census information and on the best available demographic data reflecting components of population change (e.g., births, deaths, net internal migration, and net international immigration). Thus, it is customary to recalculate cancer rates based on the revised population estimates. In less populated areas, such as rural counties, or in adjacent urban and suburban areas where there is substantial migration of residents from a more populous urban area to a less populous suburban one between censuses, a change in the population estimates can affect the county rate by as much as 20%. This is in contrast to large counties, where a small change in a large population estimate will not affect rates nearly as much.

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