U.S. SEER Analysis of Breast Cancer Incidence, 1975-2007

It has been 30 years since the widespread introduction of screening mammography (SM) in the U.S., which is a sufficiently long interval to evaluate the national impact of SM on the incidence of breast cancer by era and stage of disease.

The proportion of women 40 to 59 years of age who underwent SM increased dramatically in the 1980s, reaching 60% by 1990 and 70% by 1995, after which the proportion has been relatively stable at 70% (Fig. 1). This historical pattern enables analysis of incidence patterns for SM impact.

In females <40 years of age, in whom SM was not performed and hormone replacement therapy (HRT) was not applicable, the incidence of breast cancer has been steady for the last three decades (Fig. 2).

Fig. 1

Proportion of Women in the U.S. >40 Years of Age Undergoing Screening Mammography

Age Adjusted, 1975-2005

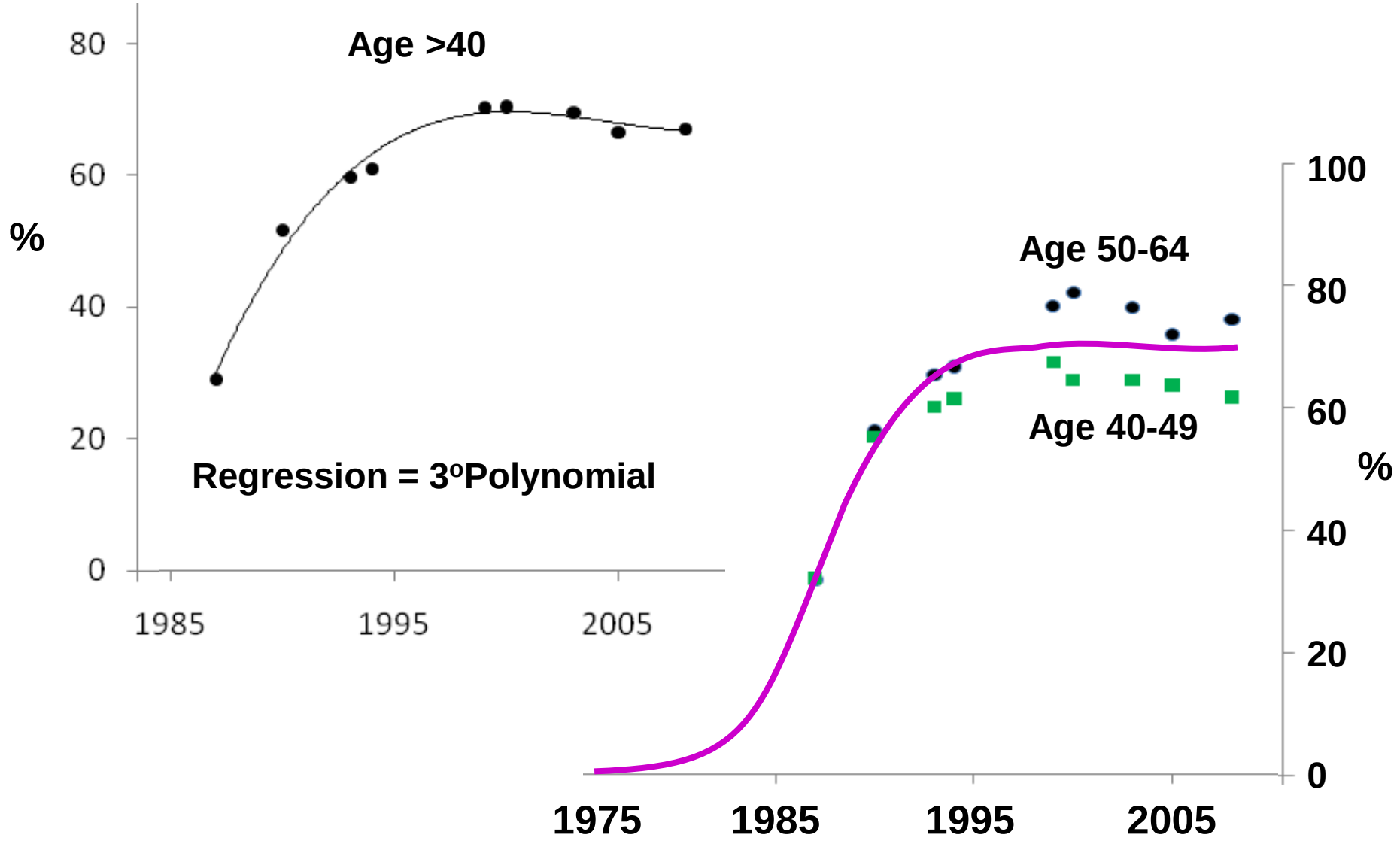
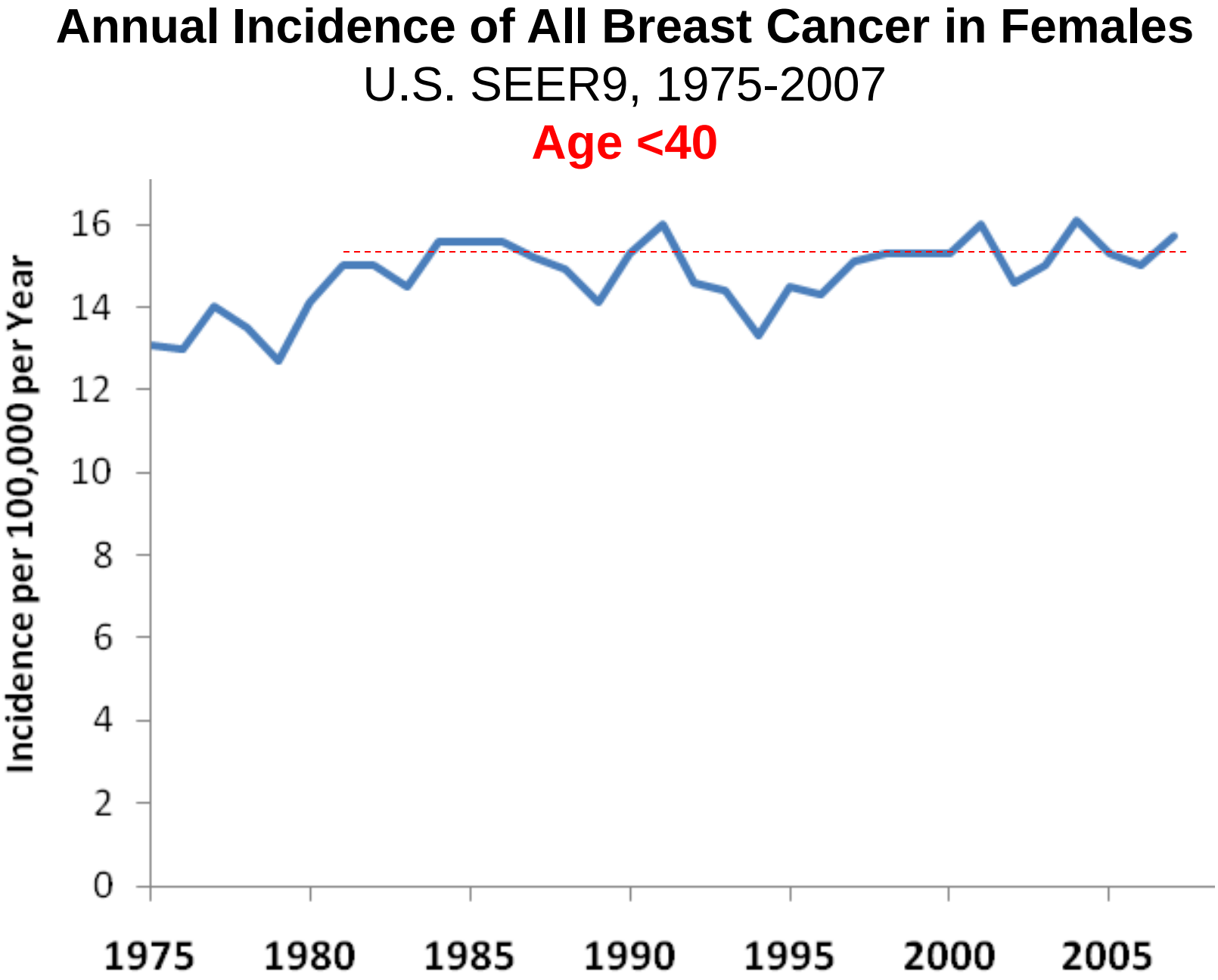


Fig. 2


Annual Incidence of All Breast Cancer in Females
U.S. SEER9, 1975-2007
Age <40
Incidence per 100,000 per Year
16
14
12
10
8
6
4
2
0
1975
1980
1985
1990
1995
2000
2005

U.S. SEER Analysis of Breast Cancer Incidence, 1975-2007

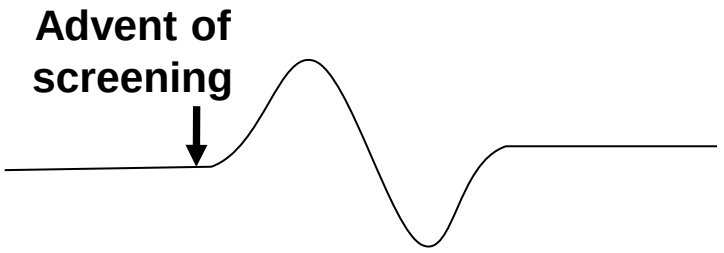
Conclusion

Older age groups can be assessed for incidence trends that occurred after SM was routinely recommended in the early 1980s for all women 40 or older and was nationally implemented to a more two-thirds of all women over this age by 1995 and has been above this proportion since (Fig. 1).

Epidemiologic Evidence for the Failure of Screening Mammography (SM)

The primary purpose of disease screening is to detect earlier disease that results in better outcomes. For cancer, this may be either improved survival or less therapy, or better yet both. Screening that is successful at detecting early disease increases the incidence transiently since the cases detected earlier are not detected later (Fig. 3).

Fig. 3

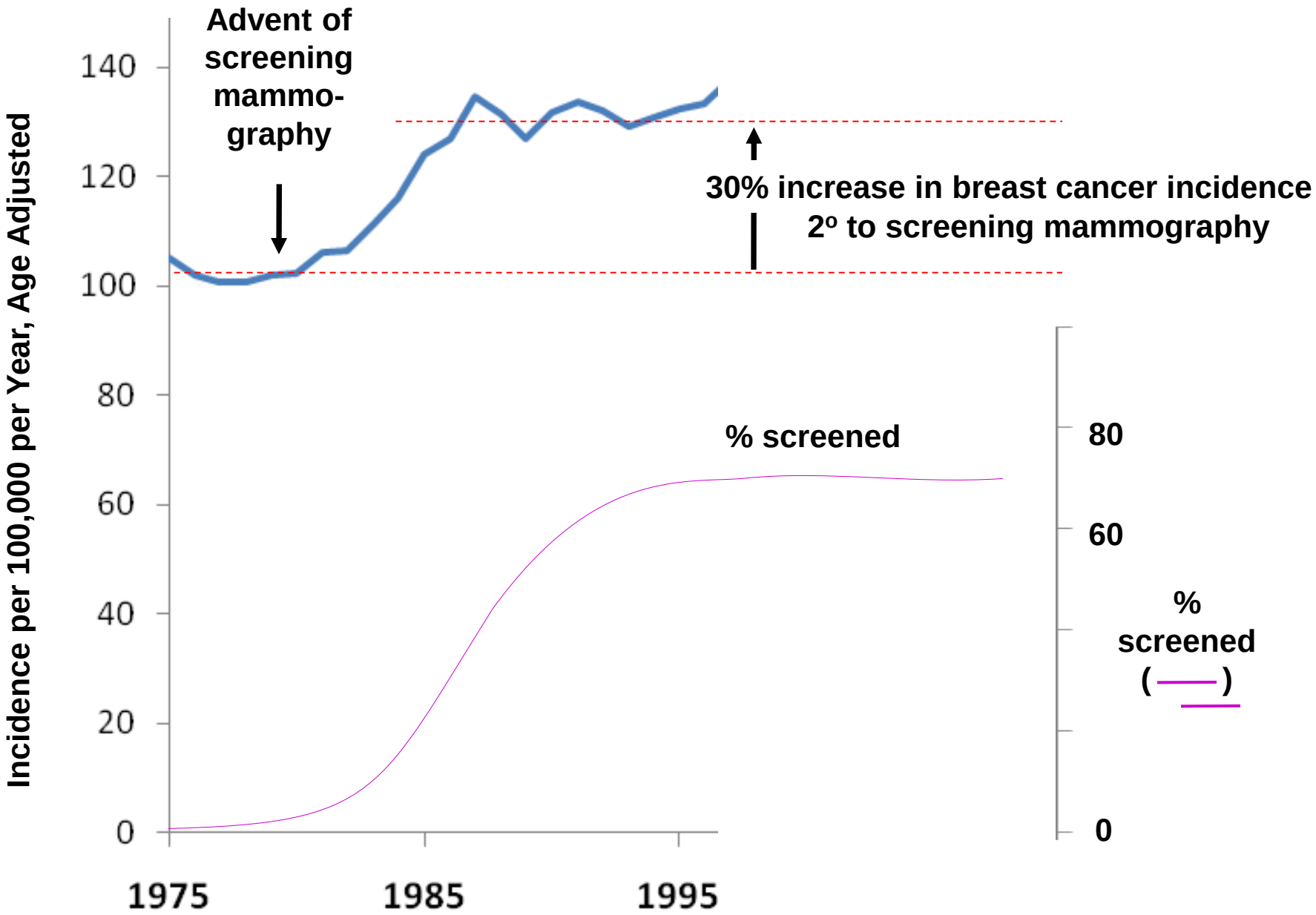


During the 1980s following the advent of SM, the incidence of breast cancer in females older than 40 increased 30% within less than a decade (Fig. 4). During the next decade, the incidence remained elevated.

Fig. 4

Annual Incidence of All Breast Cancer in Females

U.S. SEER9, 1975-2007



An alternative explanation for the lack of a decline in incidence is that the hormone replacement therapy (HRT) that also increased breast cancer incidence, may have prevented the decline. HRT was first practiced widely in the mid 1990s and within a few years was associated with an increased incidence (next frame). When HRT was widely discontinued in 2002-2003 the incidence rapidly decreased (Fig. 5).

Conclusion

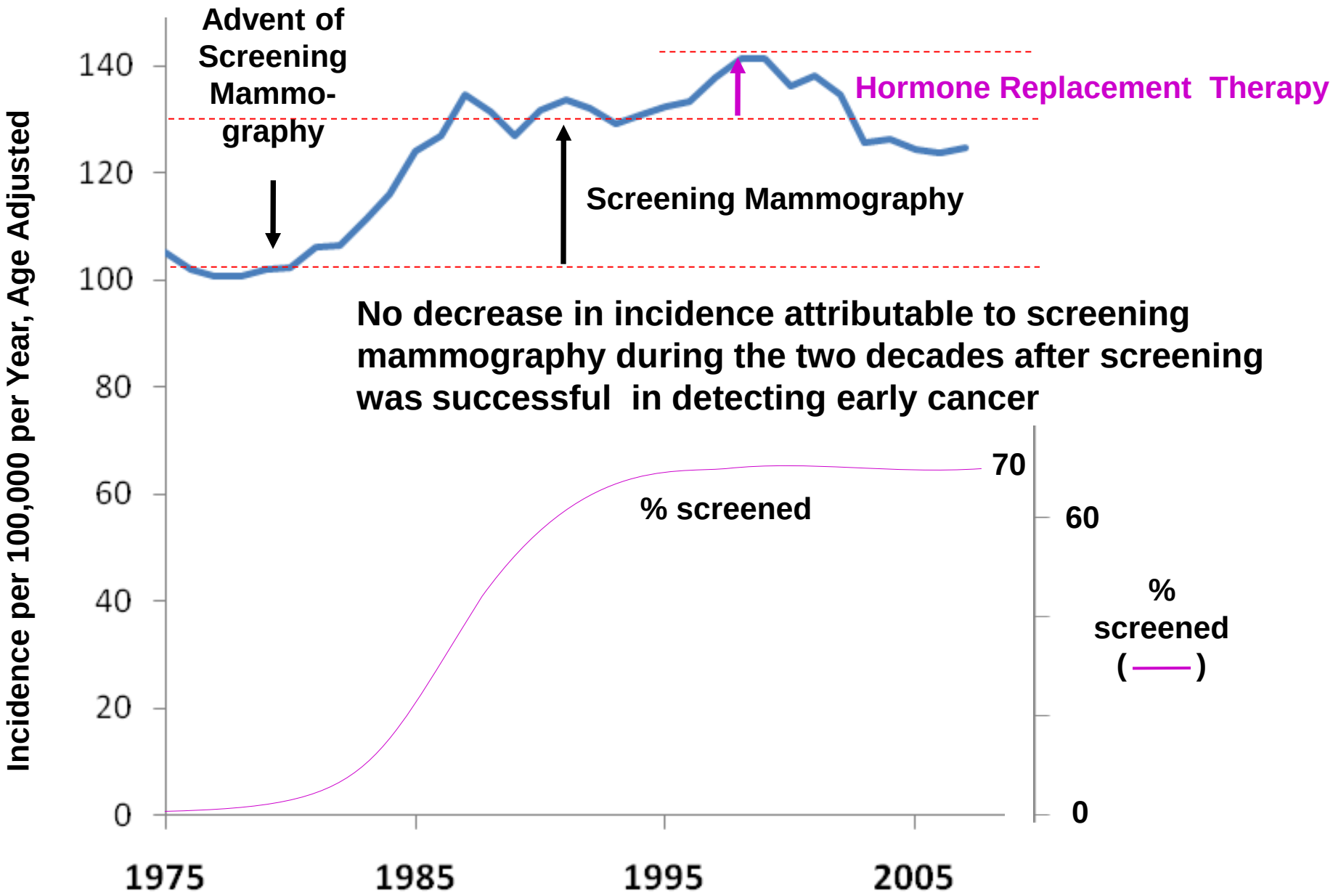
That the HRT effect is apparent in our nation's incidence trends but not apparent for SM reinforces the lack of evidence for detecting 'early breast cancer' that would have progressed to more advanced disease.

Corollary evidence for benefit should be apparent in the incidence of early cancer.

Fig. 5

Annual Incidence of All Breast Cancer in Females

U.S. SEER9, 1975-2007



In women 40-49 years of age (Fig. 6), the increase in breast cancer incidence attributable to SM was similar but there was less change during the HRT era. The corresponds to less usage of HRT in this age group.

For more than 2 decades after the increase attributable to SM, there has been evidence for a decline in incidence.

Conclusions

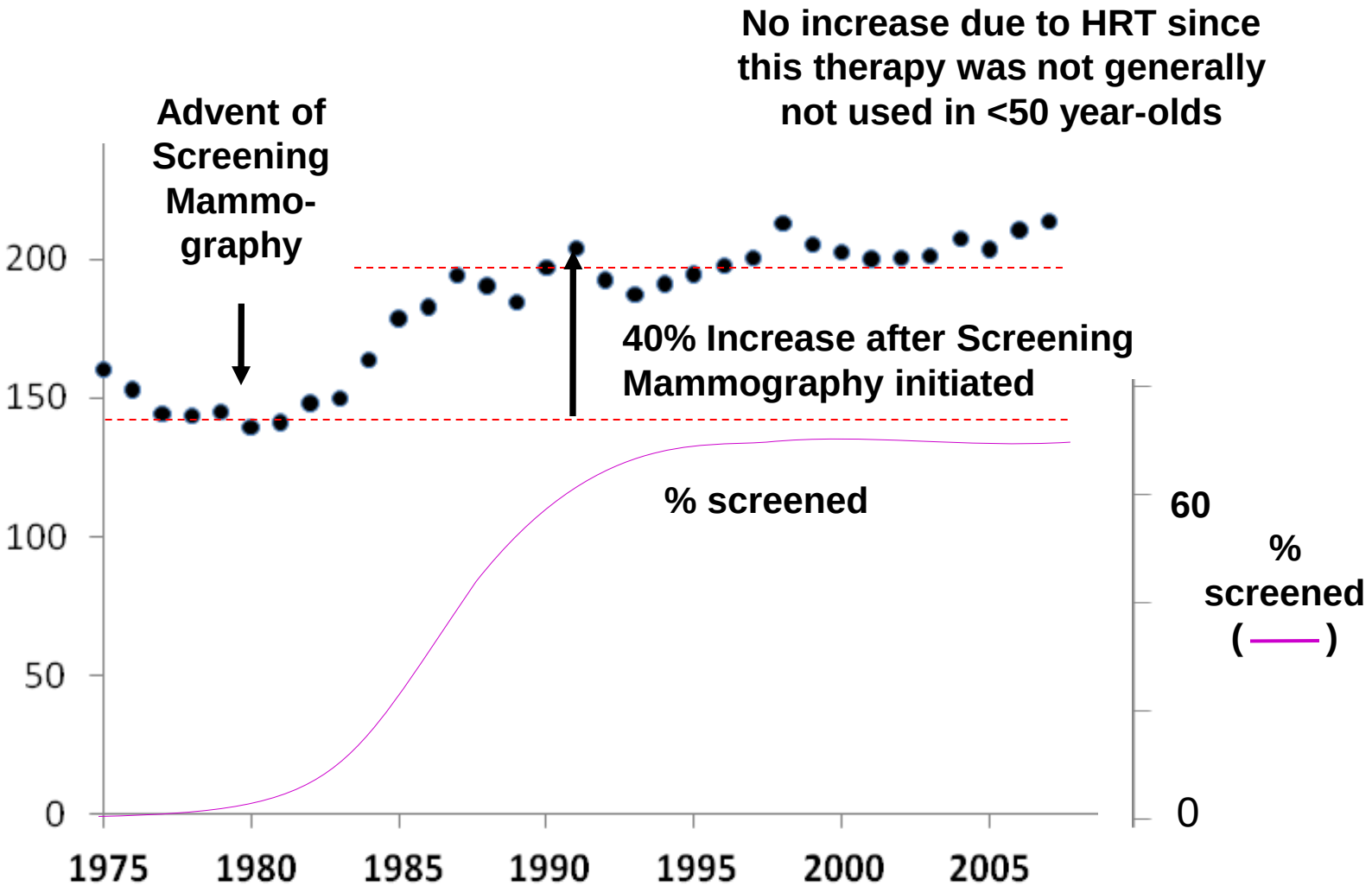
1: The proportion of all breast cancer that was DCIS tripled after SM was widely instituted
2. SM in 40-50 year-olds in the U.S. has not achieved it's primary purpose.

Fig. 6

Annual Incidence of All Breast Cancer in Females

U.S. SEER9, 1975-2007

Age <50



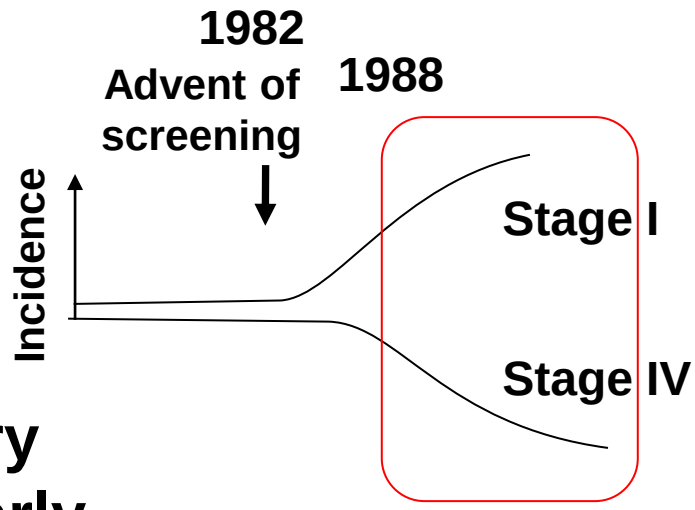
In women <40 years of age, in whom screening was not performed and hormone replacement therapy (HRT) was not applicable, the incidence of breast cancer has no evidence for the incidence peaks of the older age group in which SM or HRT was applied (Fig. 2).

Conclusions

1. **Nearly all of the 30% increase in incidence of breast cancer in the U.S. during the 1980s was due to SM.**
2. **Assuming that 90% of the increase was due to SM and that 70% of women over 40 have utilized SM, the number of women whose breast cancer was detected by SM between 1985 and 2006 may be estimated to be 467,000 nationally and 110,000 in the SEER13 registry.**
3. **By now, this large number of SM-detected cancers should have resulted in an obvious shift of incidence from advanced to early cases, as well as in a trend toward resumption of the pre-SM era overall incidence.**

Screening Mammography (SM) and Lack of Effect on Stage Shift, 1988-2006

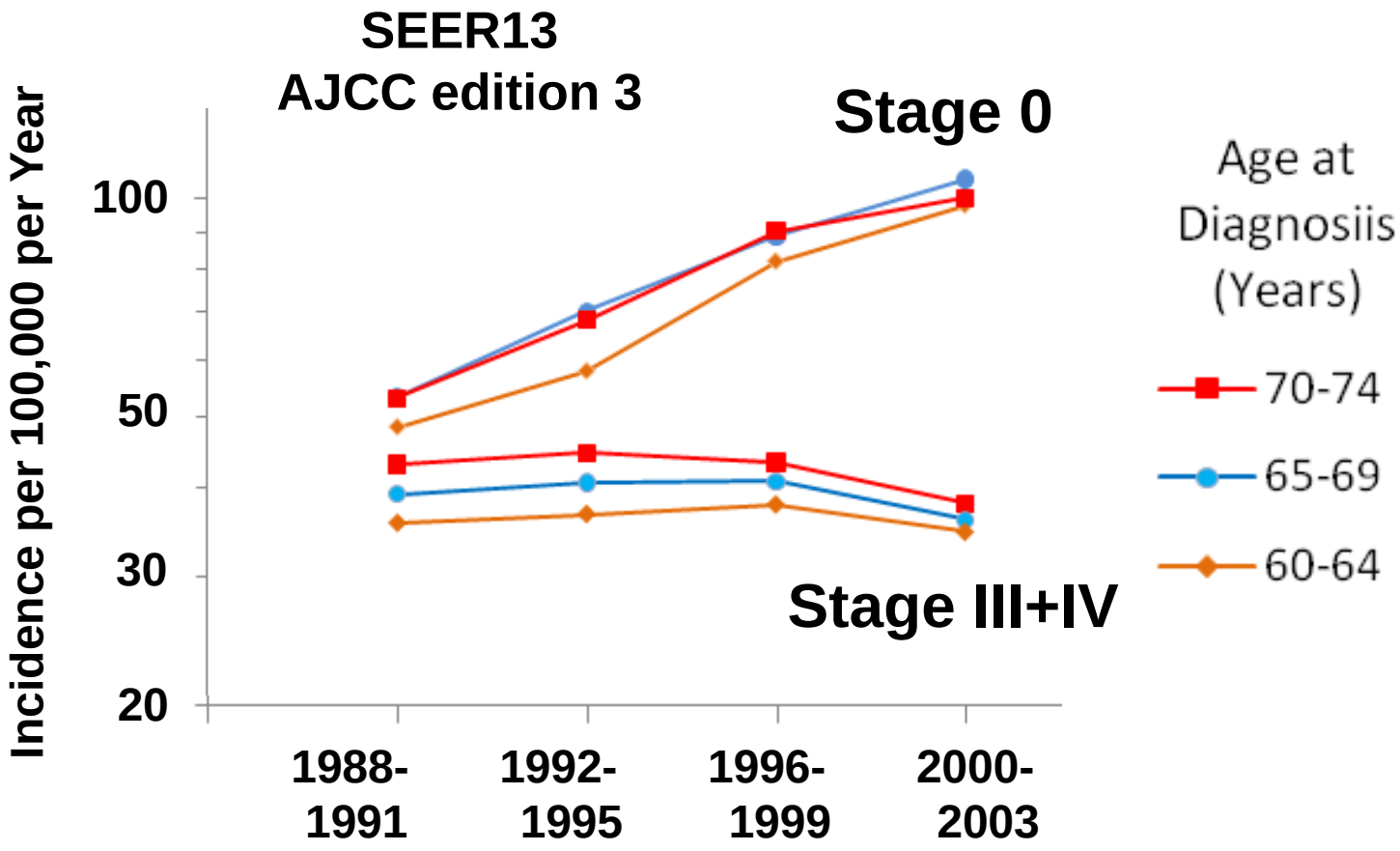
Fig. 7



Background

The primary purpose of screening is to diagnose disease earlier. By definition, effective every case of cancer that is diagnosed early means one less more advanced disease. Thus, for SM to be successful it not only results in increased incidence of early stage, but also and more importantly it results in a decrease in advanced disease, as shown in Fig. 7. In theory, the 110,00 women in the SEER registry who have been detected to have earlier breast cancer should have a reciprocal reduction in women with advanced cancer.

Some evidence for the reciprocal effect is apparent in SEER data after staging was standardized by the AJCC in 1988 in comparing incidence changes of early and advanced breast cancer by era during 1988-2003 among women 60- to 74 years of age



Screening Mammography (SM) and Effect on Stage 1988-2006

Methods

Classification of breast cancer by stage became available in the SEER data via the AJCC staging system in 1988, when the SEER registries were expanded from 9 to 13 and a few years after SM was implemented widely in the U.S. In 2000, the number of registries were increased to 18. In 2004, AJCC version used by SEER (v3) was replaced by version 6. The most recent breast cancer stage-specific incidence data available in SEER is 2006 (as of April 2010).

Breast cancer incidence according to AJCC edition 3 stage designation was evaluated from 1988 to 2004 using theSEER13 database. Years 2004 to 2006 were evaluated ins the SEER18 database with AJCC edition 6.

Screening Mammography (SM) and Effect on Stage 1988-2006

Methods (Continued)

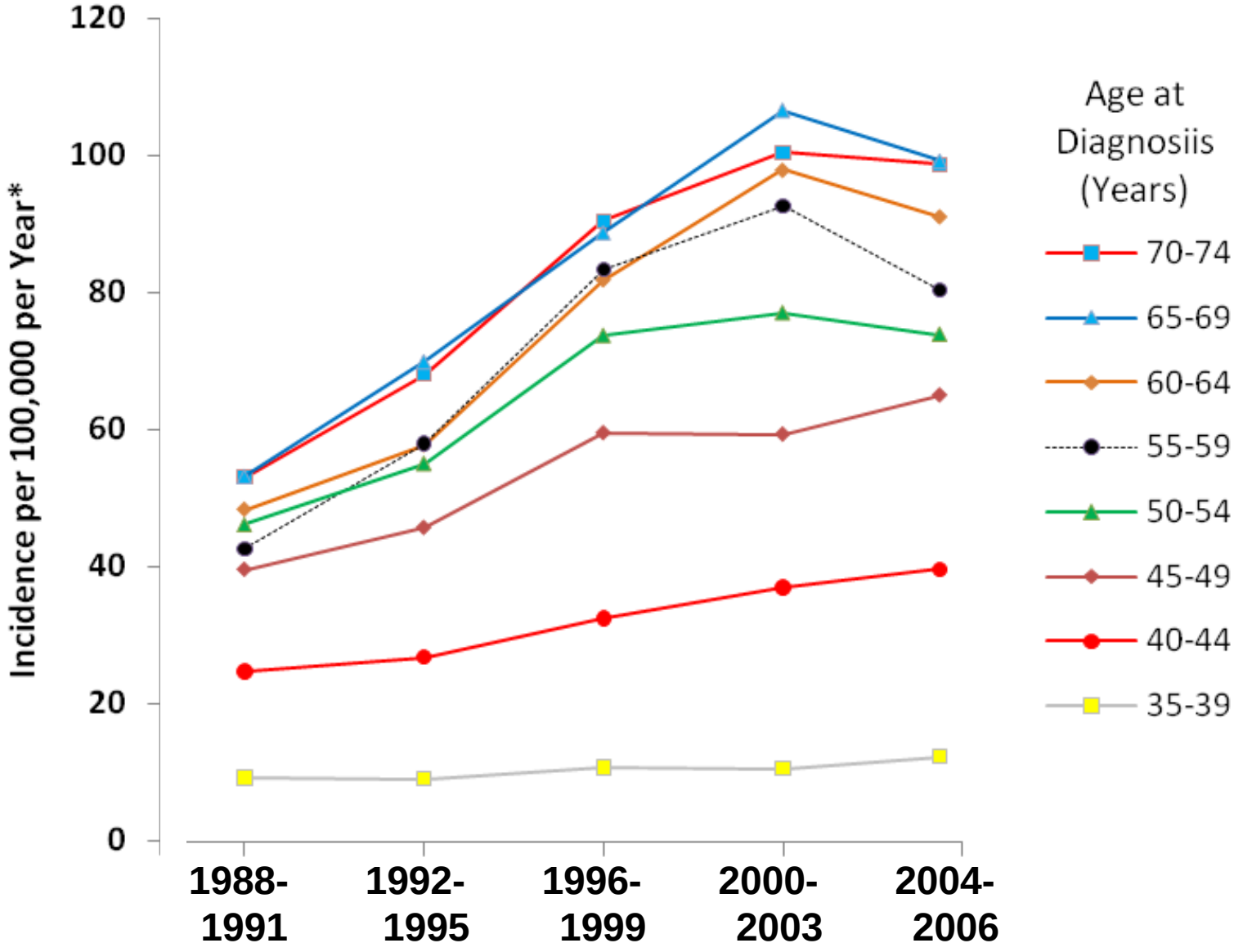
Stage 0 breast cancer, primarily *ductal carcinoma in situ* (DCIS), was included in this analysis since these cancers are treated with surgery, radiation and if the cell has certain type of receptor, either intravenous chemotherapy or a minimum of 5 years of hormonal therapy.

Results

Fig. 8-11 show the incidence from 1988 to 2006 of stage 0 (Fig. 8), I (Fig. 9), II+III (Fig. 10) and IV (Fig. 11) breast cancer for eight 5-year age groups from age 35 to 74.

Fig. 8

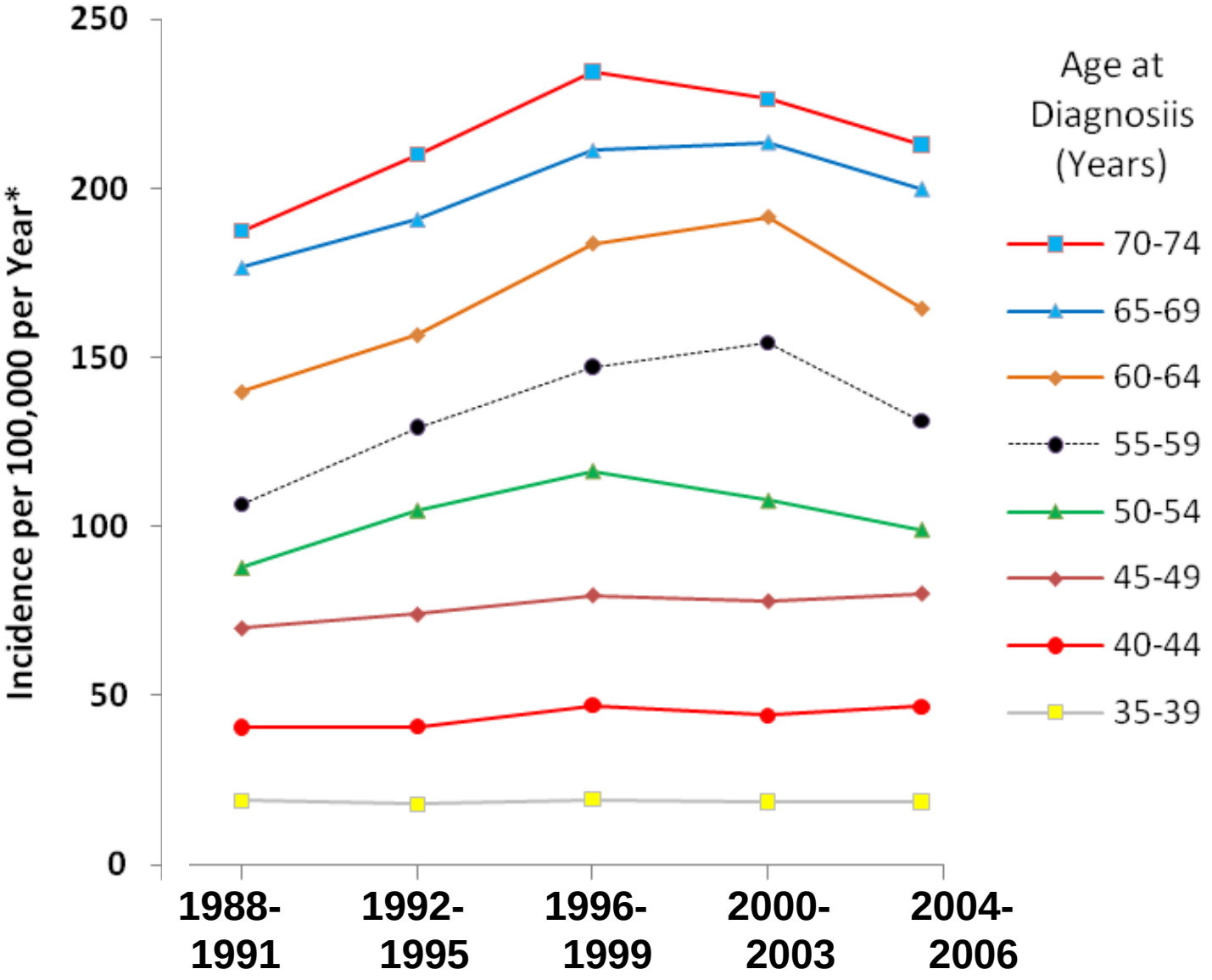
Incidence of Stage 0 Breast Cancer by Age at Diagnosis since the Advent of Screening Mammography, U.S. SEER



*age adjusted to the 2002 U.S. Standard Population (19 age groups – Census P25-1130) Standard

Fig. 9

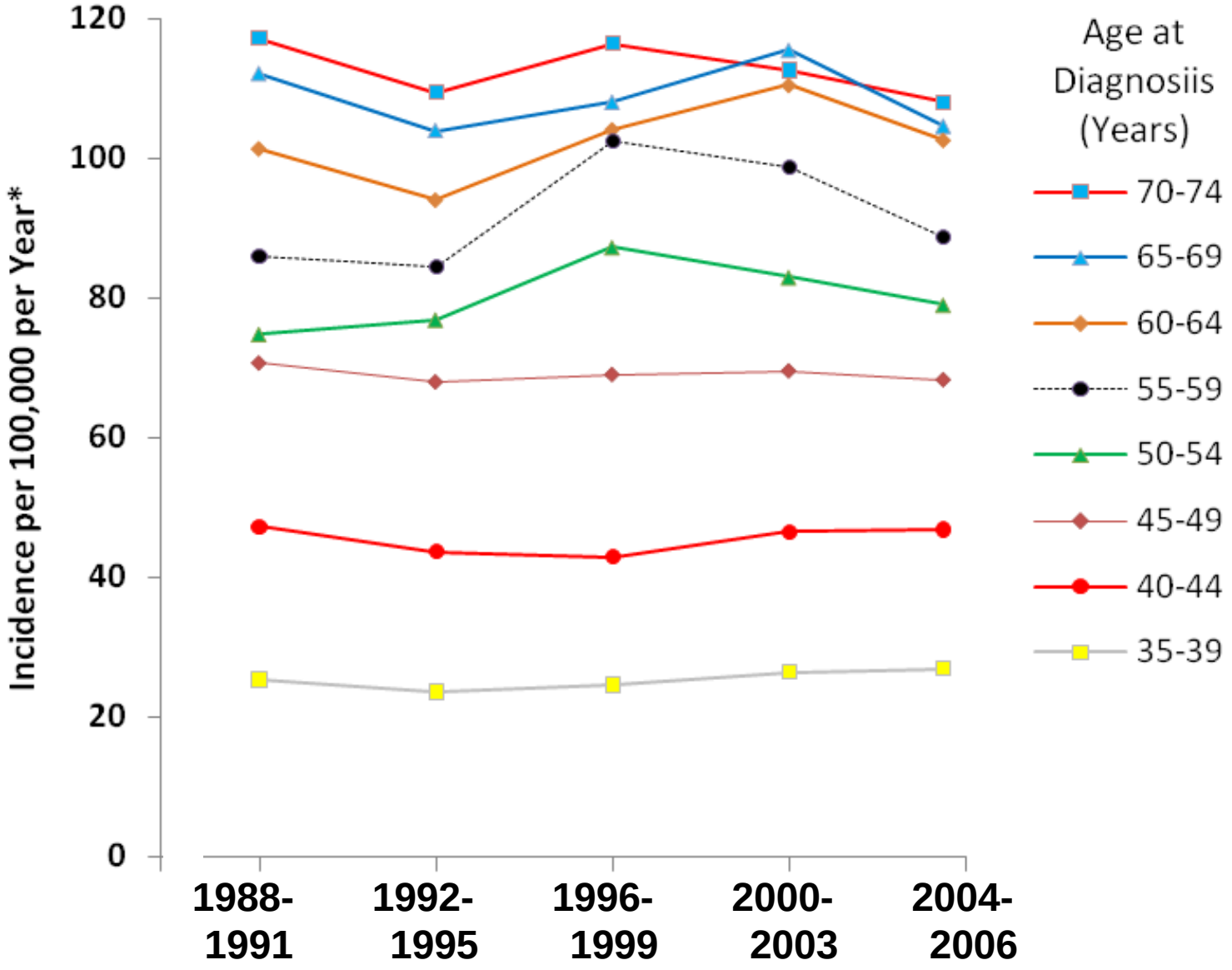
Incidence of Stage I Breast Cancer by Age at Diagnosis since the Advent of Screening Mammography, U.S. SEER



*age adjusted to the 2002 U.S. Standard Population (19 age groups – Census P25-1130) Standard

Fig. 10

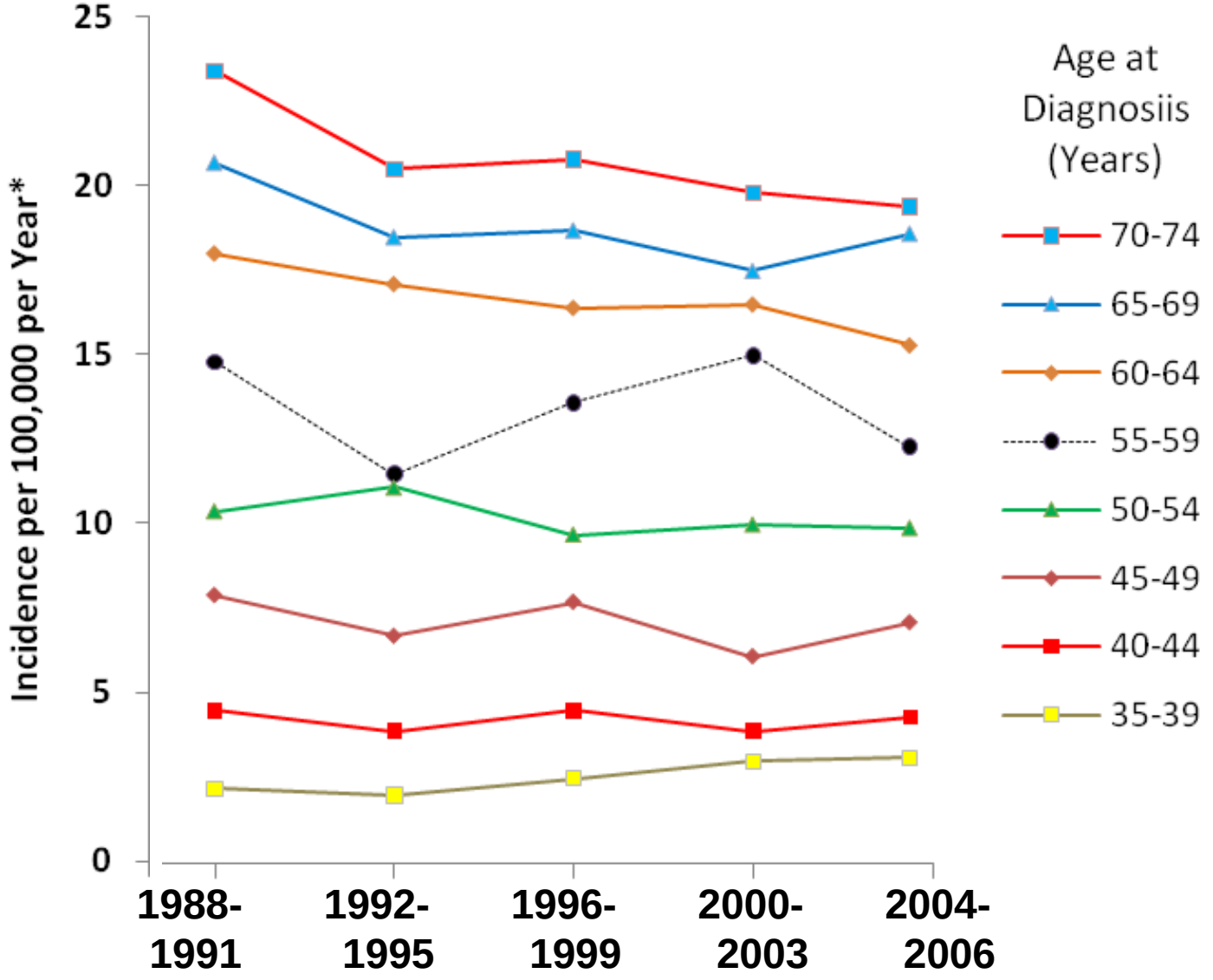
Incidence of Stage II and III Breast Cancer by Age at Diagnosis since the Advent of Screening Mammography, U.S. SEER



*age adjusted to the 2002 U.S. Standard Population (19 age groups – Census P25-1130) Standard

Fig. 11

Incidence of Stage IV Breast Cancer by Age at Diagnosis since the Advent of Screening Mammography, U.S. SEER



*age adjusted to the 2002 U.S. Standard Population (19 age groups – Census P25-1130) Standard

Results of Stage Analysis

The incidence of stage 0, I, II, and III breast cancer has been stable since 1988 among 35-39 year-olds, in whom neither screening mammography (SM) nor hormone replacement therapy (HRT) has been applied (Figs. 8-10). [Stage IV has increased in this age group (Fig. 11).]

The incidence of stage 0 and I breast cancer has steadily increased since 1988 as SM increased in the age group, but without any evidence for a commensurate decrease of Stage II, III or IV cancers (Figs. 8-10).

Similar to 40-40 year-olds, the incidence of stage 0 and I cancer in 50-59 year-olds has increased without any evidence for a commensurate decrease in stage II, III or IV disease (Figs. 8-10). That is until 2004 after which the incidence of all stages declined, presumably due to the reduction in HRT.

Results (continued)

In 60-74 year-olds , the incidence of early stage disease also increased as SM increased, but in this age group there was a corresponding reduction in advanced stage disease, especially stage IV (Fig. 11).

The decline preceded the era of HRT discontinuation by at least 15 years and was simultaneous and reciprocal with the increase in incidence of early stage disease.

Depending on how long it takes in individual patients for breast cancer to progress from early to late stage disease, women diagnosed in their late 50s with early stage disease may have contributed to the decline in the incidence of advanced stage disease observed in women of age 60 or more.

During the 1980s, the incidence of DCIS, the earliest stage of breast cancer, quadrupled (Fig. 13) after SM was implemented. In women 40-49 years of age, the incidence of DCIS tripled (Fig. 14). Whereas older women had a further increase and subsequent decline during the HRT era, women younger than 50 had much less change.

For more than 2 decades, there has been no evidence for a decline in proportion of patients with early cancer. There has been no evidence for any of the pattern expected with screening (red outline).

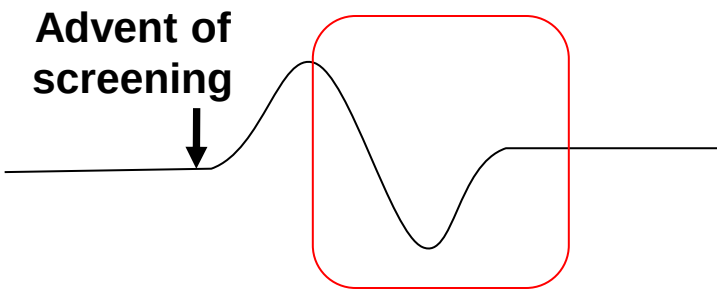


Fig. 12

Conclusions

1. **The dramatic surge in DCIS cases as a direct result of SM has not been associated with a post-surge decline**
2. **SM is detecting new cases of cancer that do not need to be detected.**

Fig. 13

Annual Rate of DCIS as % of All Breast Cancer

U.S. SEER9, 1975-2007

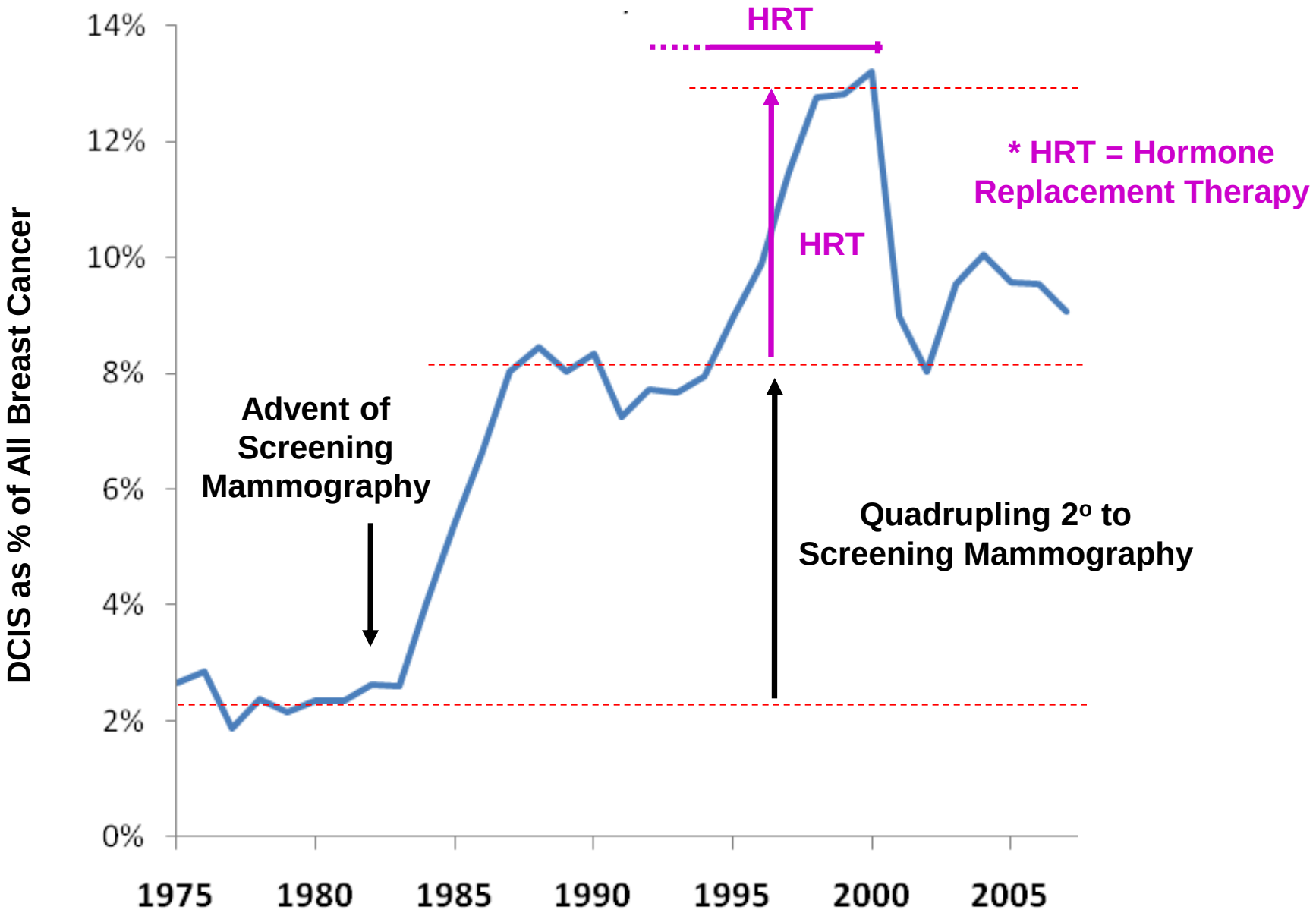
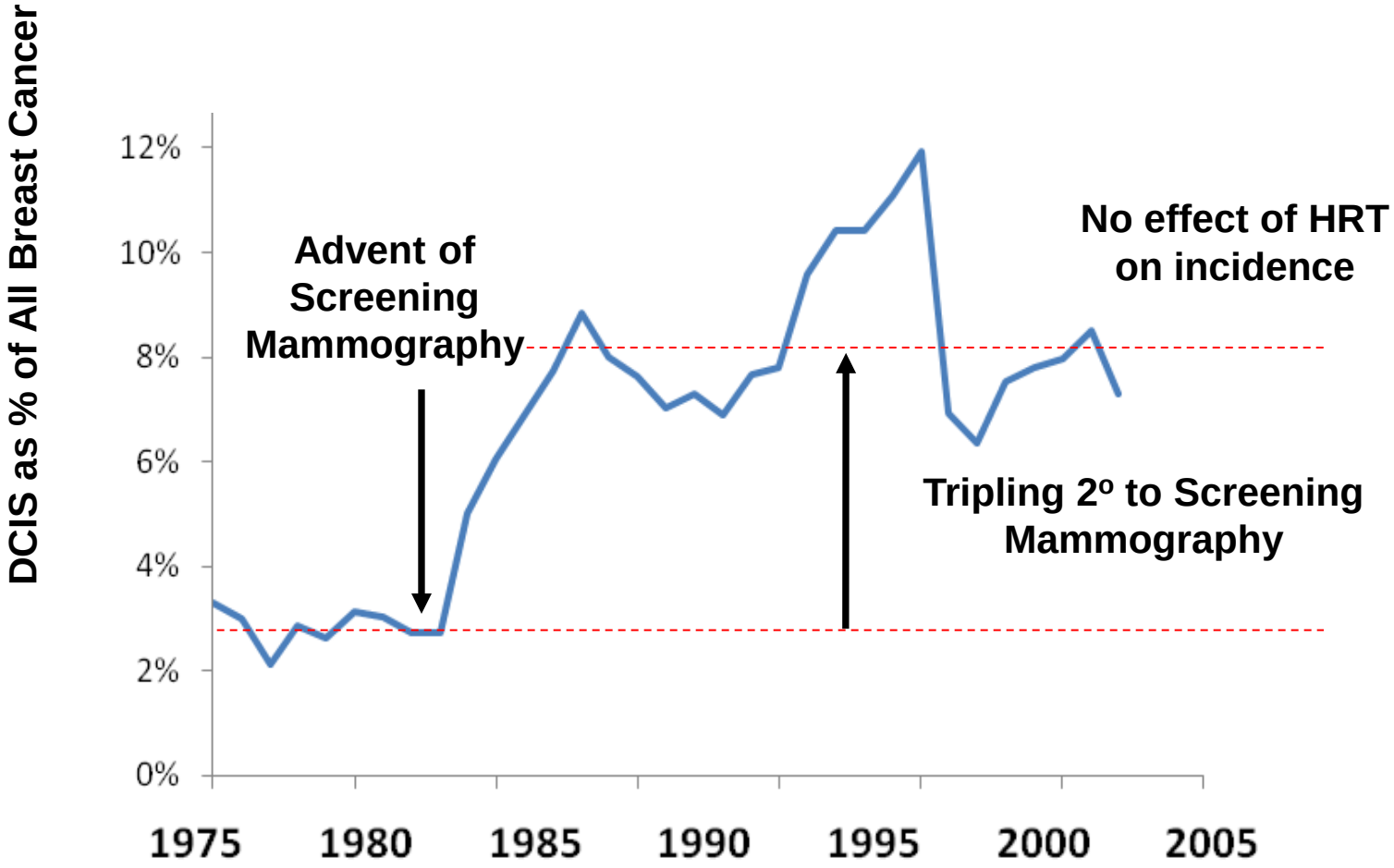


Fig. 14

Annual Rate of DCIS as % of All Breast Cancer

U.S. SEER9, 1975-2007, **Age <50**



Conclusions

1. SM has been of no national benefit in 40- to 49- year-olds, and of negligible benefit in 50-to 59-year-olds. SM has resulted in an earlier diagnosis in 60- to 74-year-olds.

2. On the contrary, most of the stage 0 and I tumors that SM has been detecting in 40- to 49-year-olds did not need to be diagnosed or treated (overdiagnosis, overtreatment) **since they did not progress to more advanced, clinically detectable disease. Some of the SM-detected tumors in 50- to 50-year-olds also fall into this category but the problem of overdiagnosis is less apparent in this age group.**

2. From an epidemiologic perspective, SM appears to have been most beneficial in 60- to 74-year-olds.

Conclusions (continued)

3. The reciprocity of the increase in stage 0-I incidence and the decrease in stage IV incidence suggests that the time to progression of breast cancer from early to advanced disease is in the range of a few years and not many years. This rate of disease progression for truly malignant epithelial neoplasms of the breast is consistent with Gompertzian growth kinetics and clinically-measured doubling times.

4. Incidence data and trends can be used to sort out cause and effect, as well as benefits and deficits of SM.

Conclusions (continued)

5. The USPSTF recommendation to discontinue *routine* SM of women <50 years of age is support by the national breast cancer incidence trends.

5. The analyses performed in this study suggests that the same recommendation may apply to 50-54 year-olds, and possible even to 55-59 year-olds.