Recent Trends and Racial/Ethnic Differences in the Incidence and Treatment of Ductal Carcinoma In Situ of the Breast in California Women

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BACKGROUND. The rapid increase in the incidence of ductal carcinoma in situ (DCIS) of the breast in the U.S. has been associated with the widespread adoption of screening mammography. Little is known regarding the incidence and treatment of DCIS in women of racial/ethnic groups other than white and black. The current investigation examined recent trends and racial/ethnic differences in the incidence and treatment of DCIS in California.

METHODS. All cases of DCIS diagnosed in women age ≥ 40 years in California between 1988–1999 were included. Age-adjusted incidence rates for white, black, Hispanic, and Asian-Pacific Islander women were calculated using the 2000 U.S. female population as the standard. The estimated annual percent change (EAPC) in the rates was calculated using least squares regression.

RESULTS. The average annual age-adjusted incidence of DCIS (1988–1999) was 45.3 per 100,000 in white women, 35.0 in black women, 30.9 in Asian-Pacific Islander women, and 21.8 in Hispanic women. Although a steady increase in the incidence of DCIS was noted in all racial/ethnic groups over the study period, Asian-Pacific Islander women were found to have experienced the steepest increase (EAPC = 9.1%), particularly in the age group 50–64 years (EAPC = 12.0%). The DCIS incidence was reported to increase with age in white, black, and Hispanic women, but remained fairly constant after the age of 50 years in Asian-Pacific Islanders. The proportion of women with DCIS treated with mastectomy decreased from 53% in 1988 to 32% in 1999. Younger women and Asian-Pacific Islander women reportedly were more likely to undergo mastectomy.

CONCLUSIONS. Considerable differences by race/ethnicity and age were observed in DCIS incidence and the change in the incidence in California between 1988 and 1999. Further information is needed to determine whether these differences are because of differential utilization of screening mammography or biologic characteristics of DCIS lesions. ***Cancer*** **2003;97:1099–106.**
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The increase in the incidence of breast carcinoma since the early 1980s has been associated with the widespread adoption of screening mammography.[1,2] Since that time, a very dramatic increase has been observed in the incidence of ductal carcinoma in situ (DCIS), which is detected mainly by screening mammography.[3]

Several studies have demonstrated a higher incidence of DCIS in white women compared with black women, although the time trends appear to be similar.[1,2,4,5] Information concerning the incidence of

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DCIS among women of other racial/ethnic origin to our knowledge is rather sparse. One study from New Mexico observed a lower incidence of DCIS in Hispanic and American Indian women compared with white women, although a steady increase since 1985 was observed for both Hispanic and white women.[6] The incidence of all in situ breast carcinoma also has been reported to be lower in Hispanic and Asian-Pacific Islander women than in white women.[7] However, an analysis of racial/ethnic patterns of cancer incidence in the Surveillance, Epidemiology, and End Results (SEER) areas between 1988–1992 reported a surprisingly high rate of in situ breast carcinoma in Japanese women, which was very close to the rate noted in white women in the 30–69 years age group and even higher than that in women age ≥ 70 years.[8]

One of the most controversial issues related to the diagnosis of DCIS is the selection of appropriate treatment because it is not clear which patient or tumor characteristics predict progression.[9,10] In SEER areas, the proportion of cases of DCIS treated by mastectomy decreased from 71% to 44% between 1983–1992.[1] Similarly, analysis of the National Cancer Data Base data revealed that the use of breast-conserving therapy increased from 31% to 54% between 1985–1993.[11] At the same time, very large differences were reported to have occurred across geographic areas.[1,11,12] Studies have shown that people of different racial/ethnic origins in the U.S. may not receive similar cancer treatment.[13]

This investigation was undertaken to examine the racial/ethnic differences and recent trends in the incidence of DCIS in white, black, Hispanic, and Asian-Pacific Islander women in California between 1988–1999. We also examined the patterns of mastectomy use in the treatment of DCIS in these racial/ethnic groups.

MATERIALS AND METHODS

This analysis used data collected by the California Cancer Registry (CCR).[14] This population-based registry conforms to the quality and completeness standards of the National Cancer Institute's SEER program and has had complete statewide coverage since 1988.[15] As of August 2001, case reporting for invasive tumors was estimated to be 99% complete for the last year available, 1999.[15]

All cases of carcinoma in situ of the breast, excluding lobular carcinoma in situ (ICD-O-2 code 8520), diagnosed in women age ≥ 40 years in California between 1988–1999 were included. Histologic type was recorded as noninfiltrating intraductal carcinoma (ICD-O-2 code 8500) (58%), comedocarcinoma (8501) (23%), intraductal papillary adenocarcinoma (8503) (8%), intraductal carcinoma with lobular carcinoma in situ (8522) (5%), and as other specific or nonspecific histologic types (6%).

Race/ethnicity was grouped into mutually exclusive categories of non-Hispanic white (hereafter referred to as white), non-Hispanic black (black), Hispanic, and non-Hispanic Asian-Pacific Islander (Asian-Pacific Islander). When feasible, we examined three specific subgroups of women of Asian-Pacific Island origin: Chinese, Japanese, and Filipino women. Information in the CCR regarding race/ethnicity is based on medical records and on lists of Spanish and Hmong surnames provided by the U.S. Census Bureau.[15] The use of surnames has been shown to allow for more accurate classification of race/ethnicity, which may be underreported in medical records.[16] Race was unknown for 2% of all DCIS cases reported to the CCR.

Treatment classification was based on breast surgery from the first course of cancer-directed therapy (i.e., treatment occurring or planned within the first 4 months after diagnosis). Mastectomies included total mastectomy, radical mastectomy, and subcutaneous mastectomy. Cases diagnosed at the time of autopsy and based on death certificate only were excluded from the analysis of treatment patterns. The extent of surgery was not specified for 16 cases (0.06%) and for 12 cases (0.04%) it was unknown whether cancer-directed surgery had been performed.

Age-specific and age-adjusted incidence rates were calculated for white, black, Hispanic, and Asian-Pacific Islander women for 1988–1999. Annual population estimates for these calculations were produced by the State of California Department of Finance Demographic Research Unit.[17–19] These estimates are based in part on ethnic self-identification at the time of the 1990 Census and are subject to periodic revisions based on monitoring a number of other information sources that reflect population changes, such as school enrollment and vital statistics.[15] For Chinese, Japanese, and Filipino women, the average annual age-adjusted rates were calculated for 1988–1992, using population estimates from the 1990 Census for these groups as denominators. The 2000 female U.S. population was used as the standard for the calculation of age-adjusted rates. The change in incidence rates of DCIS was evaluated by calculating the estimated annual percent change (EAPC) using least squares regression as defined in SEER*Stat.[20]

Data from the California Behavioral Risk Factor Survey (BRFS) were used to examine the use of screening mammography in California women.[21] Details regarding the methodology of the survey are available elsewhere.[22] The sample included 8794 white women,

TABLE 1
DCIS of the Breast Diagnosed in California Women Age ≥ 40 Years by Race/Ethnicity, 1988–1999

	White		Black		Hispanic		Asian-Pacific Islander							
							Total		Chinese		Japanese		Filipino	
	No.	%[a]	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	22,657	11.9	1530	11.9	2510	10.8	2126	14.9	599	17.5	382	14.5	617	13.8
Year of diagnosis														
1988–1989	2620	9.1	149	8.3	199	6.8	135	9.6	37	10.6	36	11.5	35	8.2
1990–1991	3144	10.5	193	10.1	307	9.5	230	13.2	68	16.1	46	12.8	67	11.5
1992–1993	3521	11.4	225	11.1	343	9.7	238	11.6	59	11.8	50	11.8	66	10.2
1994–1995	3796	12.1	281	12.8	390	10.1	387	15.9	108	19.0	62	14.5	118	15.1
1996–1997	4444	13.3	324	13.6	513	11.5	493	16.1	127	18.4	96	18.1	144	15.1
1998–1999	5132	14.5	358	14.3	758	14.3	643	18.0	200	22.3	92	15.8	187	17.2
Age at diagnosis (yrs)														
40–49	4477	14.5	343	11.1	711	11.0	715	15.9	217	19.5	69	13.3	209	14.3
50–64	7992	13.3	565	11.9	962	11.0	839	15.0	205	17.9	153	15.0	279	14.8
≥ 65	10,188	10.3	622	12.5	837	10.3	572	13.6	177	15.2	160	14.6	129	11.4

DCIS: ductal carcinoma in situ.
[a] Percent of all breast tumors that were ductal carcinoma in situ.

TABLE 2
Average Annual Age-Adjusted Incidence Rate (per 100,000) of DCIS of the Breast in California Women Age ≥ 40 Years, 1988–1999[a]

	White		Black		Hispanic		Asian-Pacific Islander	
	IR	95% CI	IR	95% CI	IR	95% CI	IR	95% CI
Total	45.3	44.7–45.9	35.0	33.2–36.8	21.8	21.0–22.7	30.9	29.6–32.3
Age (yrs)								
40–49	28.8	28.0–29.7	19.6	17.6–21.8	13.7	12.7–14.8	25.3	23.4–27.2
50–64	51.3	50.1–52.4	36.4	33.5–39.6	23.3	21.8–24.8	35.3	33.0–37.8
≥ 65	58.1	57.0–59.3	51.9	47.9–56.2	30.0	28.0–32.1	32.6	29.9–35.4

DCIS: ductal carcinoma in situ; IR: incidence rate; 95% CI: 95% confidence interval.
[a] Age-adjusted to 2000 U.S. female population.

656 black women, 1689 Hispanic women, and 659 women classified as Asian/Other. In the latter category, 80% were Asian-Pacific Islanders. Data were weighted to the 1990 California population.

RESULTS

The number of cases of DCIS diagnosed in women age ≥40 years in California increased from 1554 in 1988 to 3574 in 1999. Table 1 details the age, ethnic distribution, and period of diagnosis of these cases as well as the proportion of all breast carcinoma cases that were DCIS. In addition to the large increase in the number of cases of DCIS diagnosed each year, the proportion of all breast carcinoma cases that were DCIS was found to have increased in all racial/ethnic groups in California during the study period. The proportion of DCIS was highest among Asian-Pacific Islanders, and the difference was particularly noticeable after 1994. In the majority of racial/ethnic groups, younger women were found to have a higher proportion of DCIS cases. However, in black women the proportion of all breast carcinoma cases that were DCIS increased with age.

The average annual age-adjusted incidence rates of DCIS per 100,000 women are presented in Table 2. Overall, the highest incidence of DCIS was observed in white women. In the younger age group (ages 40–49 years), Asian-Pacific Islander women were found to have a higher incidence of DCIS than black women, whereas the rates for these 2 groups were similar for women ages 50–64 years. In addition, although the incidence of DCIS was found to increase with age in white, black, and Hispanic women, it was reported to remain fairly constant after age 50 years in Asian-Pacific Islander women. The sudden increase in the incidence of DCIS around age 65 years in black

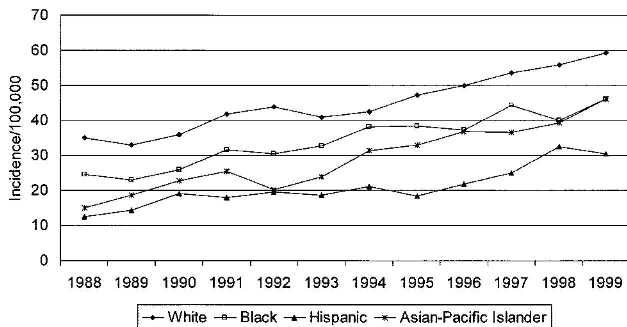

FIGURE 1. Age-adjusted incidence rates of ductal carcinoma in situ (DCIS) of the breast in California women age ≥ 40 years, 1988–1999.

women (and less markedly in Hispanic women) was confirmed when age-specific incidence rates (based on 5-year age groups) were examined (data not shown).

We also calculated the average annual age-adjusted incidence rates of DCIS in Chinese, Japanese, and Filipino women age ≥40 years in California for 1988–1992 (population estimates for these groups were not available for later years). Overall, Japanese women were found to have the highest incidence of DCIS (age-adjusted incidence rate of 25.2; 95% confidence interval [95% CI], 20.3–30.6%). The incidence in Chinese and Filipino women was lower (20.2 [95% CI, 16.7–23.9%] and 20.0 [95% CI, 16.6–23.7%], respectively). In the 40–49 years, 50–64 years, and ≥65 years age groups, the age-adjusted incidence rates of DCIS were 21.9, 14.0, and 25.5, respectively, in Chinese women; 15.4, 26.7, and 35.1, respectively, in Japanese women; and 19.2, 22.0, and 18.7, respectively, in Filipino women.

Time trends in the age-adjusted incidence rates of DCIS over the study period are presented in Figure 1. Although a steady increase was noted in all racial/ethnic groups, the increase in the age-adjusted incidence rate of DCIS (both in terms of absolute increase and percent change) was reported to be the steepest in Asian-Pacific Islander women (from 15.0 in 1988 to 46.2 in 1999; EAPC = 9.1, 95% CI, 7.3–11.1) compared with Hispanic women (from 12.4 in 1988 to 30.4 in 1999; EAPC = 7.4, 95% CI, 5.0–9.9), black women (from 24.5 in 1988 to 46.1 in 1999; EAPC = 6.0, 95% CI, 4.6–7.5), and white women (from 35.0 in 1988 to 59.3 in 1999; EAPC = 5.2, 95% CI, 4.3–6.1). When examined by age group (data not shown), the EAPC was significantly higher in Asian-Pacific Islander women ages 50–64 years (EAPC = 12.0; 95% CI, 9.3–14.6) compared with white women of this age (EAPC = 5.6; 95% CI 4.6–6.6). The only significant differences within racial/ethnic groups were observed for white women ages 40–49 years (EAPC = 3.1; 95% CI, 1.3–5.0) and those age ≥65 years (EAPC = 6.1; 95% CI, 5.3–6.8).

TABLE 3
Mastectomy Use in the Treatment of DCIS of the Breast in California Women Age ≥ 40 Years, 1988–1999

	Total		1988–1993		1994–1999	
	No.	%	No.	%	No.	%
Age group (yrs)						
40–49	2636	42.2	1192	47.7	1444	38.6
50–64	4114	39.7	1932	49.3	2182	33.9
≥ 65	4639	38.0	2293	47.0	2346	32.0
Race/ethnicity						
White	8964	39.6	4440	47.8	4524	33.8
Black	586	38.3	256	45.2	330	34.3
Hispanic	937	37.3	389	45.9	548	33.0
Asian-Pacific Islander	902	42.4	332	55.0	570	37.4

DCIS: ductal carcinoma in situ.

The proportion of women with DCIS who were treated with mastectomy decreased from 53% in 1988 to 32% in 1999 ($P < 0.001$). Over this period, younger women (age < 65 years) with DCIS underwent a mastectomy more often than older women ($P < 0.001$) (Table 3). Asian-Pacific Islander women also were more likely to undergo a mastectomy ($P \leq 0.01$). The difference between Asian-Pacific Islanders and other racial/ethnic groups was larger in 1988–1993 than in 1994–1999. The difference in mastectomy use between these 2 periods was more pronounced in older women; mastectomy use decreased 15% in the 50–64 years age group and the ≥65 years age group compared with 9% in the 40–49 years age group.

Table 4 presents data regarding the use of screening mammography among asymptomatic women in California based on the California BRFS data. Although the proportion of women screened within last 2 years was similar between white and black women in the majority of categories shown, the difference between white women and women of Hispanic or Asian/Other origin had decreased considerably from 1988–1993 to 1994–1999 (for all age groups except Asian/Other women age ≥ 65 years).

DISCUSSION

The incidence of DCIS began to rise in the U.S. around 1983, coinciding with the widespread adoption of screening mammography.[2,23] The increase was evident in both white and nonwhite women.[5,6,24] Several earlier studies have suggested that after a steep increase during the 1980s, the incidence of DCIS began to level off after 1987.[2,12,25] The results of the current analysis indicate that the increase has continued in all

TABLE 4
Use of Screening Mammography among Asymptomatic Women Age ≥ 40 Years in the California Behavioral Risk Factor Survey, 1988–1999[a,b]

	Never (%)				Screened within last 2 yrs (%)			
	White	Black	Hispanic	Asian/Other	White	Black	Hispanic	Asian/Other
1988–1993								
Age (yrs)								
40–49	27.1	27.1	38.3	41.2	65.1	63.7	51.9	50.1
50–64	19.4	11.4	36.9	30.3	71.0	76.1	55.8	61.3
≥ 65	25.1	21.9	34.5	30.5	63.3	66.9	53.7	58.4
1994–1999								
Age (yrs)								
40–49	17.5	11.1	29.2	26.1	64.5	75.0	58.5	57.9
50–64	8.7	8.5	16.5	11.3	81.0	79.9	74.5	75.0
≥ 65	10.0	7.7	13.6	17.5	77.7	77.3	78.3	68.5

[a] Data were weighted to the 1990 California population.
[b] The sample included 8794 white women, 656 black women, 1689 Hispanic women, and 659 women classified as Asian/Other. In the latter category, 80% were Asian-Pacific Islanders.

major racial/ethnic groups in California until the most recent year included in our analysis, 1999. The increase was larger among Asian-Pacific Islander, Hispanic, and black women than among white women. It is possible that the increase in mammography use in nonwhite women has been delayed compared with white women who may have experienced a steeper change during the early 1980s. An analysis of SEER data indicated less of an increase in DCIS rates for black women (153%) during 1983–1989 compared with white women (213%).[2] In addition, data from Connecticut and Atlanta demonstrated that the DCIS rates started to rise later among black women than in white women.[5,23] A considerable increase in the use of mammography was reported from 1987 to 1993 in Hispanic communities in the southwestern U.S.[26] Our analysis of the California BRFS data indicates that the gap between mammography utilization rates between white women and women of Hispanic or Asian-Pacific Islander origin (age < 65 years) narrowed considerably from 1988–1993 to 1994–1999.

The California BRFS data and earlier published data[27,28] suggest lower mammography utilization rates among Asian-Pacific Islander women in California. However, these women experience a higher proportion of all breast carcinomas as DCIS and a more rapidly increasing incidence of DCIS, particularly among women ages 50–64 years, compared with women of other racial/ethnic groups. The incidence of invasive breast carcinoma also has been increasing among Asian-Pacific Islander women in California, and the increase has been most evident for small localized tumors,[15] which also is consistent with an effect of screening mammography. The age-specific incidence curve of DCIS in Asian-Pacific Islander women resembles that of invasive breast carcinoma, and is reported to remain fairly constant after the age of 50 years. Recent early detection intervention and related programs performed in some parts of California have targeted minority and underserved women.[27,29,30] Women classified as Asian/Other were the only group who reported higher mammography utilization among low-income women than among women with higher income in California in 1997.[31] In addition, screening rates may differ across California because of differences in income, acculturation, or access to medical care. A study of breast carcinoma screening practices among Hispanic women of various descent in different areas of the U.S. demonstrated higher clinical breast examination and mammography rates among Central Americans in San Francisco (80% had undergone a mammography within past 2 years) than among Hispanic women in other areas, including Mexican Americans in San Diego (60% had undergone a mammography within past 2 years).[32] Because data for the BRFS are not sampled within racial groups, these regional differences that are likely to be more pronounced in minority women may not be reflected in the BRFS data, particularly because the number of minority women in the BRFS sample is quite small. Thus, it remains unclear whether available screening data are applicable to Asian-Pacific Islander women given observed DCIS rates, which are highly screening-dependent. Alternatively, breast tumors in Asian-Pacific Islander women may have different growth patterns compared with other racial/ethnic groups; in addition to different age-specific incidence curves, women of this racial/ethnic group also have been

shown to have better survival from breast carcinoma compared with other racial/ethnic groups.[33]

Japanese women had reported to have higher rates of DCIS than Chinese or Filipino women during the 5-year period that we were able to study. This is consistent with the higher invasive breast carcinoma rates reported in Japanese women in the U.S.[8] Japanese women in the U.S. are reported to have breast carcinoma rates that are approximately three times higher than the rates in their counterparts in Japan, whereas international differences are much less pronounced for Chinese and Filipino women.[34] Among Asian-Pacific Islander populations in the U.S., Japanese women have been here the longest and through acculturation may have acquired risk factor profiles and/or screening practices that are closer to white women.

There was a sudden increase in the age-specific incidence rate of DCIS among black women around the age of 65 years. A similar increase, although to a lesser extent, was noted for Hispanic women. We examined the hypothesis that this increase was associated with the start of Medicare coverage and thus better access to screening mammography services beginning at this age. Medicare pays 80% of the cost of a mammogram every other year for women age $\geq$ 65 years.[35] A lack of insurance has been shown to affect breast carcinoma screening utilization.[32] However, our analysis of the California BRFS data did not suggest higher screening among black women age $\geq$ 65 years compared with black women of other age groups. We also examined the age-specific incidence of small ($<$ 2 cm) invasive breast carcinoma that also is detected mainly by screening. However, the age-specific curve for this malignancy did not appear to demonstrate any increase around the age of 65 years (data not shown). Therefore, available screening patterns and the incidence of small tumors do not appear to support the hypothesis of delayed screening in black women relative to women in other racial/ethnic groups.

Previous studies have provided some indications that the pattern of in situ breast carcinoma occurrence differs by age in black and white women. The smallest differences between white and black women were observed in older women when examining the percent of in situ tumors[4] or the incidence rates of in situ tumor.[8] Several authors have suggested that invasive breast carcinoma may be biologically different in black and white women, and this may be the reason for the worse prognosis reported in black women. Poorer differentiation, a lower percentage of estrogen receptor-positive tumors, and different host response was found in black women compared with white women in the Black/White Cancer Survival Study.[36] These differences remained after adjusting for several social, lifestyle, and tumor factors. In a study in Connecticut, the authors demonstrated that screening mammography within the past 3 years reduced later-stage diagnosis only in white women and adjustment for age, obesity, and other factors did not appear to change this finding.[37] Screening mammography reportedly accounted for $< 10\%$ of the racial differences noted in disease stage at diagnosis.[37] Although large differences in stage distribution between blacks and whites were observed in younger women, practically no differences were noted in women ages 65–79 years.[38] To our knowledge, the significance of tumor biologic factors for the age-specific incidence patterns of DCIS remains to be determined.

Autopsy reports and follow-up studies have indicated that all DCIS cases will not necessarily progress into invasive tumor.[39,40] In an analysis of SEER data, only 1.9% of women diagnosed with DCIS between 1984–1989 were reported to have died of breast carcinoma after 10 years.[41] A recent review demonstrated that recurrence rates range from 10–17% in patients with DCIS treated with local excision with radiation therapy and from 15–27% in patients treated with local excision without radiation therapy.[10] Despite ongoing efforts, to our knowledge there still are no markers available that could be used to predict which DCIS lesions are going to progress into invasive breast carcinoma and to decide the most optimal treatment for each patient with DCIS.[10] Consistent with previous studies,[1,6,11] we observed a decreasing trend in the use of mastectomy in the treatment of DCIS during 1988–1999. Previous studies have shown that cancer treatment patterns may be influenced by the race/ethnicity of the patient.[13] Asian-Pacific Islander women in the current study were more likely to undergo mastectomy. Our finding is partly consistent with the results of a recent analysis of treatment patterns of early-stage invasive breast carcinoma in California that observed lower odds of undergoing breast-conserving surgery among Asian-Pacific Islander women compared with white and black women.[42] Although that same study found that younger women with early-stage invasive breast carcinoma were more likely than older women to undergo breast-conserving surgery, the current study data indicate that younger women with DCIS are more often treated with mastectomy; however, these age differences appear to be decreasing over time.

Summary

The incidence of DCIS continued to increase in women in California during 1988–1999. Asian-Pacific

Islanders reportedly experienced the largest increase in DCIS incidence and, despite lower mammography rates, had the highest proportion of all breast carcinomas that were DCIS. The differences observed in the incidence of DCIS between racial/ethnic groups appeared to vary by age. Although white women were found to have the highest DCIS rates in all age groups, the differences between white and Asian-Pacific Islander women were smallest at younger ages whereas the differences between white and black women were smallest at older ages. California is characterized by considerable regional diversity with regard to racial/ethnic distribution, socioeconomic status, culture, and access to medical care. The findings of the current study suggest that more detailed data regarding screening mammography is needed, particularly for minority populations, to disentangle whether the observed differences in the incidence of DCIS are a result of differential utilization of screening mammography or differences in the biologic characteristics of DCIS lesions.

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